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FRANK J. FERRANTE

Plaintiff

vs.

CITY OF ATLANTIC CITY, OMAR
MARTIN and JOHN DOES 1-5
(fictitious names)

Defendants

SUPERIOR COURT OF NEW JERSEY
MERCER COUNTY
LAW DIVISION

Docket No. ATL-L-1892-10
(Consolidated with Docket No.
ATL-L-1174-10)

CIVIL ACTION

**PLAINTIFF'S BRIEF IN OPPOSITION TO DEFENDANTS' MOTION TO
PRECLUDE EVIDENCE RELATING TO DIFFUSION TENSOR IMAGING (DTI),
SPECT AND NEUROQUANT**

BRUCE H. STERN, ESQUIRE
OF COUNSEL AND ON THE BRIEF

I. INTRODUCTION

Plaintiff Frank Ferrante requests this Court deny defendants' motion to preclude any reference to diffusion tensor imaging (DTI) testing, SPECT and MRI volumetry commercially known as NeuroQuant and deny defendants' request to strike the testimony of Drs. Gregory O'Shanick and Daniel Amen and bar the testimony of Dr. Randall Benson.

Diffusion tensor imaging (DTI) (Exhibit A)



SPECT (Exhibit B)



NeuroQuant (Exhibit C)

To support his opposition, plaintiff states:



- Diffusion tensor imaging, SPECT and NeuroQuant are widely accepted and reliable methodologies used across the country and the world to evaluate traumatic brain injury;
- Plaintiff's experts are all recognized experts in their fields;
- Plaintiff's experts relied on neuroimaging to assist them in making a diagnosis; and
- Elizabeth Post, MD is unqualified to comment and opine on the scientific reliability and validity of diffusion tensor imaging, SPECT and NeuroQuant.

II. STATEMENT OF THE CASE

On Sunday, June 1, 2008 at approximately 12:00 a.m., defendant Omar Martin, an Atlantic City police Officer, traveling westbound on Atlantic Avenue, was operating a marked vehicle, owned by the City of Atlantic. At the intersection with Missouri Avenue he attempted to make a left hand turn onto Missouri Avenue. Traffic was backed up on Missouri. Rather than waiting for traffic to clear before entering the intersection, he proceeded and stopped in the intersection.

While stopped in the intersection, the light changed from amber to red. Defendant testified that vehicles in two of the three oncoming lanes, who now had the green light, had inched

forward, but then stopped. Defendant was attempting to complete his turn, when he broadsided the vehicle driven by plaintiff Frank Ferrante who was travelling eastbound on Atlantic Avenue. When Mr. Ferrante entered the intersection, he was travelling approximately 25-30 miles per hour.



Defendant Martin struck the driver's side of plaintiff's vehicle, causing plaintiff's car to veer right, strike a light pole and flip over.

Mr. Ferrante was initially seen in the emergency room at Shore Medical Center, where he was noted to have pain in his neck and head. He was evaluated with a CT of the brain for an acute intracranial mass due to his diagnosed "head injury". To

the limits of CT resolution, this exam was non-revealing and he was released.

His initial medical care focused on significant pain issues and his comprehensive evaluation and treatment trials as well. He demonstrated inconsistent attendance at follow up and follow through in these interventions. This most probably reflected subtle dysfunction of frontal lobe systems responsible for initiation, planning and organization and is more a dyscompliance event rather than a noncompliant action. (A copy of the report, CV and video de bene esse deposition transcript of Gregory O'Shanick, MD are attached as Exhibits D1-3).

Coincident with his pain management, he also began to evidence increasingly severe reactive psychiatric dysfunction that represented elements of both Post Traumatic Stress Disorder (PTSD) and significant mood disturbance with reported psychotic elements. Interventions were limited to pharmacological trials with multiple psychotropic medications (Lexapro, Vistaril, Seroquel, Cymbalta, Wellbutrin, Trazodone, Klonophl), which were either ineffective or overused/misused by Mr. Ferrante. It is important to note a reference is made in his psychiatric records of his reporting "bedwetting" in the month following his collision. Onset of nocturnal incontinence in an adult is a significant indicator of nocturnal seizure activity.

His well-documented misuse of both opiate medications and benzodiazepines to alleviate his pain ultimately resulted in his admission to an inpatient drug rehab program in Arizona. During this admission, behavioral dysfunction was noted in excess of typical chronic pain patients and he was internally transferred to a program for dual diagnoses of substance abuse and PTSD. Mr. Ferrante's treating physician Robert Johnson, D.O. ordered a SPECT of Mr. Ferrante's brain. The SPECT demonstrated bitemporal, left parietal and bilateral inferior orbital frontal perfusion deficits. The scan was read and interpreted by Daniel Amen, MD. (A copy of Dr. Amen's report, CV, de bene esse deposition transcript, two of his articles and his bibliography of published articles supporting the use of SPECT are attached as Exhibits E1-5). This pattern of injury corresponds to the neurobehavioral syndrome Mr. Ferrante demonstrates and the executive and self-control impairments that characterize his behavior following the collision. It is not a pattern described in PTSD patients absent TBI.

In September 2011, Frank Ferrante entered an inpatient brain rehabilitation program at Neurological Rehabilitation Living Centers in Virginia Beach, Virginia. While there, he underwent MRI volumetry, commercially known as NeuroQuant at the request of his treating physician Brian Greenwald, MD. That objective diagnostic test revealed enlargement of both the left

lateral ventricle and left inferior lateral ventricle indicating the presence of hydrocephalus ex vacuo. Left globus pallidus was smaller than the right consistent with focal atrophy. (A copy of the NeuroQuant results is attached as Exhibit C. See also the report and video de bene esse deposition transcript of Gregory O'Shanick, MD, attached as Exhibit D1 and D3).

On April 18, 2012, plaintiff underwent a 3.0 Tesla MRI of the brain and a quantitative diffusion tensor imaging (DTI) using fractional anisotropy (FA). Both voxel-wise and tract based quantitative analyses revealed significantly low fractional anisotropy in multiple white matter fiber pathways, including the right middle cerebral peduncle, right corticospinal tract in the mid-brain, bilateral anterior limbs of the internal capsule, right posterior corona radiata, bilateral genu of the corpus callosum, bilateral body of the corpus callosum, and left superior longitudinal fasciculus. The summary findings of the DTI were (1) Global white matter fractional anisotropy was borderline low, voxel and tract based analysis both revealed several white matter tracts with abnormal reduced fractional anisotropy, oriented in the anterior-posterior direction, primarily in bilateral superior hemispheric white matter. According to Randall Benson, M.D., who interpreted the DTI, these findings in their totality strongly suggested blunt trauma to the head or body from the front or back. (A copy

of Dr. Benson's affidavit, clinical and neuroimaging reports, CV, published articles, congressional testimony and his bibliography of articles supporting the use of DTI for TBI patients are attached as Exhibits F1-6).

In September 2013 Mr. Ferrante entered the Center for Community Independence located in Revere, Massachusetts, which is a brain injury rehabilitation program. Mr. Ferrante remains an inpatient there at the present time.

Mr. Ferrante has been evaluated by Gregory O'Shanick MD, Randall Benson, MD and Brian Greenwald MD. (Their reports and CVs are attached as Exhibits D, F and G respectively).

Dr. Greenwald concluded after taking a history, doing an examination and reviewing voluminous medical records stated: "Mr. Ferrante is a 28-year-old man in a good state of health and function when he was in high-forced motor vehicle collision causing his car to flip over on 06/01/2008. The initial focus of Mr. Ferrante's care was on his musculoskeletal injuries and his neck and low back pain. He was initially dazed and confused at the time of injury and had a period of post-traumatic amnesia. Both are diagnostic of at least mild traumatic brain injury. Besides meeting these diagnostic criteria, he has supporting evidence of brain injury from multiple radiologic evaluations including SPECT examination and advanced MRI technology [DTI]. The diffuse brain injury he has, including

injuries to the frontal and temporal lobes have left him with cognitive impairment, neuropsychiatric impairment, visual impairment, poor impulse control, and poor motivation/apathy. Combining these neurologic impairments with his chronic pain has led to addiction to pain medication. Mr. Ferrante has had repeated neuropsychological testing that demonstrates objective evidence of pervasive cognitive impairments causally related to the traumatic brain injury he sustained on 06/01/2008."

Dr. Benson, a board certified behavioral neurologist and expert in neuroimaging, evaluated Frank Ferrante on April 14, 2012. He, like Dr. Greenwald, reviewed all of the medical records, and conducted a physical examination. Dr. Benson also administered and interpreted the diffusion tensor imaging (DTI) and the other diagnostic testing, including SPECT. Dr. Benson concluded:

There is little doubt that Frank Ferrante sustained a traumatic brain injury on June 1, 2008. Frank Ferrante continues to experience symptoms directly caused by this injury. There are four independent lines of evidence supporting a traumatic brain injury including biomechanical, clinical symptoms, neurobehavioral findings, neuropsychological findings, brain injury and convergence between and among these four lines. (See pp.16-19 of Dr. Benson's report).

Regarding the SPECT and DTI, Dr. Benson wrote:

Diffusion tensor imaging reveals a pattern of axonal injury primarily affecting the anterior brain white matter with

bilaterality and a few unilateral right-sided regions. Global white matter was borderline at less than first percentile. White matter tracts included the interior corpus callosum (genu) as well as the anterior limb of the internal capsules. These fibers connect the prefrontal cortex with homologous prefrontal regions and with diencephalic structures (basal ganglia, anterior thalamus). The body of the corpus callosum is comprised of fibers connecting more posterior frontal, temporal and parietal lobe homologous structures. The unilateral right-sided regions include MCP, CST in the midbrain and posterior corona radiata.

SPECT scanning mirrors the DTI to a great extent. Specifically, hypometabolism is present in frontal, temporal and parietal lobes. The left SLF reduced FA has a correlate in the left parietal hypometabolism in the SPECT scan. Relative hypermetabolism is seen the left basal ganglia on SPECT which may be related to right-sided corticospinal reduced FA on DTI.

Finally, Mr. Ferrante was evaluated by Gregory O'Shanick, M.D., the Medical Director Emeritus of the Brain Injury Association of America and a board certified neuropsychiatrist. Dr. O'Shanick was recently named to serve on a 10 member committee to devise the board certification test for a new subspecialty, Brain Injury Medicine. (See the video de bene esse deposition of Dr. O'Shanick attached as Exhibit D3). Dr. O'Shanick concluded (p. 40 of his report attached as D1)):

Frank's current examination by this physician demonstrates deficiencies in somatic fluency, attention, concentration, multitasking and working memory.

Neurological examination is notable for evidence of ambient visual dysfunction, vestibular dysfunction with marked asymmetry on Fukuda stepping test and visual tracking deficits. Neuroanatomic imaging with 3.0 Tesla MRI defines evidence of left hemispheric (fronto temporal region) asymmetry indicating hydrocephalus ex vacuo on quantitative volumetric measurement [NeuroQuant]. Fractional anisotropy measurement further defines significant anterior-posterior reductions of white matter tracts [DTI]. This constellation of findings as a result of the traumatic brain injury sustained in the collision of 1 June 2008 in combination with a PTSD he experiences consequent to that event.

Plaintiff has named three medical experts, a board certified physiatrist, a board certified neurologist and neuro-imaging expert and a board certified neuropsychiatrist. All three will testify that DTI, SPECT and NeuroQuant are scientifically valid diagnostic tests that are valid and reliable in assisting in making the diagnosis of traumatic brain injury. None of these three doctors relied exclusively on these diagnostic tests in making their diagnoses. Rather, all three used neuroimaging in conjunction with their review of medical records, history, and clinical examination in arriving at their diagnoses.

Defendants now move to bar the introduction of these objective diagnostic tests; diffusion tensor imaging (DTI), and SPECT. While defendants did not raise an objection to the use of

NeuroQuant by Dr. O'Shanick, for completeness the scientific validity of NeuroQuant will be discussed below as well. Defendants rely on the reports and possible testimony of Elizabeth Post MD, who is neither qualified nor competent to interpret or comment on the scientific validity of these tests. (See plaintiff's motion regarding Dr. Post's admitted lack of qualifications). Plaintiff opposes defendants' motion.

III. LEGAL ARGUMENT

A. THE STANDARD FOR ASSESSING THE ADMISSIBILITY OF EXPERT TESTIMONY IN NEW JERSEY IS WELL-ESTABLISHED.

The standard for assessing the admissibility of expert opinion testimony and diagnostic tests is well set in New Jersey. Seven years ago, our Supreme Court explained that N.J.R.E. 702:¹

sets forth three basic requirements for the admission of expert testimony: (1) the intended testimony must concern a subject matter that is beyond the ken of the average juror; (2) the field testified to must be at a state of the art that an expert's testimony could be sufficiently reliable; and (3) the witness must have sufficient expertise to offer the intended testimony.

¹ N.J.R.E. 702 provides: "[i]f scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education may testify thereto in the form of an opinion or otherwise."

Brenman v. Demello, 191 N.J. 18, 31-32 (2007) (quoting State v. Torres, 183 N.J. 554, 567-68 (2005) (internal citations and quotation marks omitted)).

While Rule 702 allows a qualified expert witness to testify "in the form of an opinion or otherwise," N.J.R.E. 703² "'addresses the '*bases of opinion testimony by experts.*'" Polzo v. County of Essex, 196 N.J. 569, 582 (2008) (emphasis in the original; quoting State v. Townsend, 186 N.J. 473, 494 (2006)). Rule 703 states:

"intended to permit expert opinion based on 'facts or data derived from (1) the expert's personal observations, or (2) evidence admitted at the trial, or (3) data relied upon by the expert which is not necessarily admissible in evidence but which is the type of data normally relied upon by experts in forming opinions on the same subject.'" Polzo, 196 N.J. at 583 (quoting Townsend, 186 N.J. at 494 (quoting Richard Biunno, N.J.R.E. 896 (2005))).

² N.J.R.E. 703 prescribes: "[t]he facts or data in the particular case upon which an expert bases an opinion or inference may be those perceived by or made known to the expert at or before the hearing. If of a type reasonably relied upon by experts in the particular field in forming opinions or inferences upon the subject, the facts or data need not be admissible in evidence."

B. NEW JERSEY COURTS APPLY THE ADMISSIBILITY STANDARD SET BY RULES 702 AND 703 "LIBERALLY," "BROAD[LY]," "PERMISSIVELY," AND "IN FAVOR OF ADMISSIBILITY."

The Supreme Court has admonished courts to construe Rule 702's "requirements . . . liberally in light of N.J.R.E. 702's tilt in favor of the admissibility of expert testimony." State v. Jenewicz, 193 N.J. 440, 454 (2008) (citing State v. Berry, 140 N.J. 280, 290-93 (1995)). See Phillips v. Gelpke, 190 N.J. 580, 590 (2007) (Rule 702's "permissive thrust . . . embodies the salutary policy that a lay finder of fact should be permitted to have the assistance of an expert's explanatory testimony when making determinations in areas of specialized knowledge.").

This "tilt" towards admissibility applies fully regarding "prong (3) -- the individual's expertise to speak on a topic as an expert witness" and New Jersey "courts take a liberal approach when assessing a person's qualifications." Jenewicz, 193 N.J. at 454. Thus,

[o]ur case law is replete with examples of the generous approach taken by our courts when qualifying experts based on training and experience. See, e.g., State v. Moore, 122 N.J. 420, 457-60 (1991) (holding that trial court did not err in qualifying individual, with more than two years of experience as crime scene investigator but only two days of experience analyzing blood-spatter, to testify as blood-spatter expert); State v. Krivacska, 341 N.J. Super. 1, 32-33 (App. Div.) (permitting psychologist to offer expert opinion about

mentally handicapped individual notwithstanding that he did not specialize in evaluating mentally handicapped patients and had no experience with victim's particular cognitive impairment), certif. denied, 170 N.J. 206 (2001), cert. denied, 535 U.S. 1012 (2002).

Jenewicz, 193 N.J. at 454-55 (emphasis added). As these examples show, New Jersey

courts allow the thinness and other vulnerabilities in an expert's background to be explored in cross-examination and avoid using such weaknesses as a reason to exclude a party's choice of expert witness to advance a claim or defense. That the strength of an individual's qualifications may be undermined through cross-examination is not a sound basis for precluding an expert from testifying as part of a [party's case], even if it likely will affect the weight that the jury will give the opinion. Rather, a court should simply be satisfied that the expert has a basis in knowledge, skill, education, training, or experience to be able to form an opinion that can aid the jury on a subject that is beyond its ken.

Jenewicz, 193 N.J. at 455 (emphasis added).

Federal courts, which construe identical "qualifications" requirements in F.R.E. 702,³ and whose decisions often provide "persuasive authority" to our courts,⁴ follow the same pro-admissibility approach to expert qualifications.⁵

³ "Rule 702 follows Fed.R.Evid.702 verbatim." N.J.R.E. 702, Official Comment.

⁴ Although "the standards for expert admissibility under N.J.R.E. 702 are not identical to F.R.E. 702," McCarrell v. Hoffman La Roche, Inc., 2009 N.J. Super. Unpub. LEXIS 558, *91 (App.Div. 2009), New Jersey's "Rules of Evidence were modeled on

To meet the second requirement, only expert opinions that are "constructed with a sound scientific methodology and provide the requisite nexus to the disputed issue" will qualify as helpful and be admissible. *Dennis v. Pertec Computer Corp.*, 927 F. Supp. 156, 159 (D.N.J. 1996).

the federal rules . . ." and federal cases may provide "persuasive authority" in their interpretation and application. *State v. Reshevsky*, 2010 N.J. Super. Unpub. LEXIS 1889, *30 (App.Div. 2010) (citing Richard Biunno, CURRENT N.J. RULES OF EVIDENCE, comment 2 on N.J.R.E. 102 (2010)).

⁵ As the authoritative *Notes of the Advisory Committee on Federal Rules of Evidence* explain,

[g]enerally speaking, the [federal] Courts have been reluctant to exclude an expert on the ground that he or she is unqualified. This is understandable given the generally permissive tone of Rule 702. Courts have not required a party to show that the witness is an outstanding expert, or to show that the witness is well-known or respected in the field; these are generally questions of weight. Also, the expert need not have encyclopedic knowledge about the field in question. Nor is it necessary, at least on the question of qualifications, for an expert to have published or researched on the matter to which she testifies.

F.R.E. 702 Advisory Committee's Note (2000 Amendments). F.R.E. 702's "liberal policy of admissibility extends to the . . . qualifications of experts." , *Brown v. Southeastern Penn. Transp. Auth.* (In re Paoli R.R. Yard PCB Litig.), 35 F.3d 717, 741(3d Cir. 1994) (per Becker, J.), cert. denied sub nom., *General Electric v. Ingram*, 513 U.S. 1190 (1995). See 4 Jack B. Weinstein & Margaret A. Berger, WEINSTEIN'S FEDERAL EVIDENCE § 702.06[4], at 702-39 (2d ed. 1997 & Annual Supp.).

The New Jersey Supreme Court ruled that the standard to be utilized in determining the reliability and admissibility of scientific theories focuses on the methodology and reasoning supporting the opinion. Kemp v. State, 174 N.J. 412, 430 (2002) citing to Landrigan v. Celotex Corp., 127 N.J. 404, 425-6 (1992). The proper inquiry is whether the expert's opinion is based on a "sound, adequately-founded scientific methodology involving data and information of the type relied on by experts in the scientific field." Id. at 430, citing to Rubanick v. Witco Chemical Corp., 125 N.J. 421, 449 (1991). The Court must make inquiry into and make a determination finding on whether experts in the relevant field actually do rely on such data. Ryan v. KDI System Pools, Inc., 121 N.J. 276, 289 (1990). The trial court should assess "whether the reasoning or methodology underlying the testimony is scientifically valid and whether that reasoning or methodology properly can be applied to the facts in issue." Kemp, supra., 174 N.J. at 426 citing to Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579, 592-93 (1993) [Emphasis provided].

Three ways prove general acceptance and reliability of a methodology: (1) by expert testimony as to the general acceptance, among those in the profession, of the premises on which the expert witness based his or her analysis; (2) by authoritative scientific and legal writings indicating the

scientific community accepts the premises underlying the testimony; and (3) by judicial opinions that indicate the expert's premises have gained general acceptance. State v. Harvey, 151 N.J. 117, 170 (1997). As will be demonstrated below, each of the three contested diagnostic tests, DTI, SPECT and NeuroQuant meet this test.

C. DIFFUSION TENSOR IMAGING MEETS THIS STANDARD.

1. WHAT IS DTI?

"A traditional MRI shows the structure of the brain. The majority of people who have sustained mild traumatic brain injury have normal MRI findings, even when they have a significant impairment. An overwhelming majority of people with MTBI have normal CT scans, even with significant impairments.

DTI examines the microstructure of the white matter of the brain, allowing for the detection of microscopic pathology or abnormality of the white matter. DTI is an FDA approved, peer reviewed and approved, commercially marketed, and widely available MRI method, which has been in clinical use for many years. DTI is a more sensitive technology that can reveal abnormalities that are not visible on standard MRI's. In fact, a major drive in the research and development of DTI is its ability to detect that which is largely invisible to conventional MRI and CT.

DTI measures the direction of movement or flow (known as diffusion) of water molecules through tissue. DTI is based upon the basic physics of the flow of water. With no barriers to flow, water will move in an isotropic distribution, which means it will move equally in all directions. If there are barriers to flow, it will move anisotropically, or unequally in all directions. (The Court is directed to the animation prepared by Dr. Benson).

DTI has the ability to measure the distribution of water throughout the brain by specifically measuring the flow of water in the many voxels of the brain. Voxels are like the pixels in a digital camera. Unlike an image from a digital camera, however, each of the MRI pixels has three dimensions - the left-right and up-down dimensions of the slice as well as the thickness of the slice. When multiple slices are stacked atop one another, the result is a full volumetric representation of the brain. DTI measures the distribution of water in each voxel with a degree of anisotropy (non-sphericity) expressed as a fraction of the total diffusion, i.e. fractional anisotropy (FA), which can range between zero (complete isotropic diffusion) and one (completely anisotropic diffusion).

White matter of the brain is comprised of axons, which are long processes extending from the nerve cells, which constitute the gray matter. Axons are organized into thick, tubular tracts,

which extend from one brain region to another, similar to electrical cables. Water diffusion is much greater along the long axon than across it and, therefore, has a relatively anisotropic distribution (higher FA). Closed head injury (or non-penetrating TBI), induced by sudden acceleration or deceleration of the head, results in widely scattered damage to white matter fibers known as "diffuse axonal injury." This damage includes segmental breakdown in the outer membrane of the axon, increasing diffusion in the short axis dimension leading to more isotropic distribution (decreased FA).

Since milder traumatic brain injuries, which are not visualized on standard clinical MRI scans, cause a relatively modest reduction in FA which cannot be seen by visual inspection, quantitative analysis of images is performed whereby a TBI patient's FA images are statistically analyzed using a set of non-TBI controls' brain images as the reference standard. This method is performed in an automated fashion on the white matter globally and voxel-by-voxel after co-registration of brain images or tracts into standard space. Comparing TBI images against a set of non-TBI brain images has been demonstrated by Dr. Benson's group and others to be a sensitive, reliable and objective means of distinguishing normal from TBI." (Affidavit of Dr. Benson attached as Exhibit E1).

2. DTI IS IN CLINICAL USE RIGHT NOW TO DIAGNOSE AND TREAT.

Contrary to the defense suggestion, DTI is in clinical use throughout the country. Right now, DTI is one of the core MRI techniques utilized to evaluate TBI and the Department of Defense Elite Brain Injury Institute at Walter Reed National Medical Center. The American College of Radiology, the American Society of Functional Neuroradiology (ASDFNR), and the Defense Centers of Excellence in Medical Multimedia (CEMM) all recognize and recommend DTI as a clinical tool to diagnose and treat mTBI. In short, not only is DTI reimbursable by insurance companies, it is used clinically throughout the country and the world.

The American College of Radiology, with more than 30,000 members, has issued revisions to its practice guideline for the performance and interpretation of MRI of the brain. (Resolution 6). According to the introduction, the guideline was revised collaboratively by the American College of Radiology, the American Society of Neuro Radiology, and the Society for Pediatric Radiology. The preamble to the Guidelines states,

These guidelines are an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. They are no inflexible rules or requirements or practice and are not intended, nor should they be used, to establish a legal standard of care.

Under Section 5, specifications of the examination, subsection (c) examination technique, the guideline states:

MRI examination of the brain can be performed on closed and open MRI systems of various field strengths,... The most commonly accepted basic imaging protocols for MRI of the brain currently include a T1-weighted sequence in the sagittal plane and T2-weighted fluid-attenuated inversion recovery (FLAIR) and fast spin-echo or turbo-spin-echo (or equivalent) sequences in the axial plane.

While a detailed discussion of all the evolving advanced imaging techniques is beyond the scope of this guideline, it should be noted that rapid pulse sequences and other advanced imaging techniques may provide added value for MRI of the brain. These can include, but are not limited to echo planar imaging, parallel imaging, diffusion weighted imaging, **diffusion tensor imaging**, rapid gradient-echo pulse sequences, susceptibility weighted imaging, functional imaging, perfusion imaging, volumetric, morphometric magnetic source imaging, and other quantitative applications. (Emphasis added). (See Exhibit H).

In March 2012, the American Society of Functional Neuroradiology issued guidelines for the clinical use of diffusion tensor imaging. The ASFNR found that DTI was an acceptable diagnostic test to be used in conjunction with other

factors in the diagnosis of TBI. (A copy of its guidelines is attached as Exhibit I).

The U.S. Department of Defense, Defense Centers of Excellence (DCoE) and the Defense and Veterans Brain Injury Center (DVBIC) have also endorsed the clinical use of DTI. (See Exhibit J).

Plaintiff has retained Randall Benson, MD as one of his experts. Dr. Randall Benson is co-director of the program in traumatic brain injury research at Wayne State University. Dr. Benson is a fellowship trained behavioral neurologist who has evaluated and treated hundreds of patients with head trauma and has been engaged in brain imaging research using advanced MRI methods for over twenty years. Dr. Benson published the seminal paper on DTI in TBI, delineating the alterations in DTI parameters in brain trauma and the ability of diffusion tensor imaging to predict injury severity, including mild TBI. He obtained his medical degree at Hahnemann University in Philadelphia and completed a residency at Boston University in Neurology.

He then completed a fellowship in behavioral neurology and cognitive imaging at Massachusetts General Hospital. This fellowship included clinical training in cognitive disorders as well as research and development of clinical neuroscience applications of functional MRI. Dr. Benson is board certified in

neurology. He is published extensively on brain injury and diffusion tensor imaging (DTI) in peer-reviewed journals. (See Dr. Benson's curriculum vitae attached as EXHIBIT F3).

As part of Dr. Benson's work, his imaging research group at Wayne State University has been using advanced MRI imaging to study brain injuries in the former National Football League football players. This work was funded by the NFL. Dr. Benson has also testified before the United States House Judiciary Committee (January 4, 2010) at a field hearing on the subject of brain injuries in football players. (See Exhibit F5). Additionally, Dr. Benson is an investigator on a seventeen-year, continuously funded National Institute on Disability and Rehabilitation Research (NIDRR) grant. The current grant award includes both DTI and SWI imaging components and was subjected to peer-review by NIDRR, which is a division of the United States Department of Education.

Dr. Benson, M.D., writes:

"23. It is generally accepted in the scientific community throughout the peer reviewed literature that DTI is a reliable and accurate tool to detect microscopic damage done to the white matter of the brain. There have been numerous validation studies in the peer reviewed literature, including studies that the defendant cites, that validate using DTI to detect axonal injury.

24. DTI is used clinically at the Detroit Medical Center as a diagnostic tool. The entire sequence given to Mr. Ferrante,

including DTI, was the standard trauma protocol at the Detroit Medical Center. DTI is used clinically by several sites across the country and internationally." (See affidavit of Randall Benson attached as part of Exhibit E1).

In written testimony before the United States Congress House Judiciary Committee on January 4, 2010, Dr. Benson testified:

"DTI is able to 'visualize' diffuse axonal injury from TBI. In some cases locations of lesions appear to correlate with specific symptoms but generally the severity of DAI as indicated by DTI is strongly predictive of general neurocognitive disability." (Dr. Benson's testimony to Congress is attached as part of Exhibit E5).

Dr. O'Shanick in his video de bene esse deposition testified that he uses DTI in his clinical practice and has referred patients to Dr. Benson for DTI. (Exhibit D3 at pages 89-90).

Michael Lipton, MD, one of the worlds's leading experts in DTI and its clinical use as well as the lead author of the ASFNR guidelines (see Exhibit I) is a neuroradiologist at the Albert Einstein College of Medicine and the Director of Research and Development and the Medical Director at the Montefiore Medical Center. He has over eleven years experience working with DTI and nine years using DTI to diagnose brain injury. Dr Lipton has written extensively on the clinical use of DTI. (His affidavit,

CV, some of his published papers and a transcript of his trial testimony are attached as Exhibit K1-4).

In Yang-Weissman v. South Carolina Prestress Dr. Michael Lipton testified:

- Q. Is DTI in clinical use?
A. Yes, it is.
Q. Is it experimental?
A. No.
Q. All right. Is it used-
A. People are certainly investigating it and trying to make improvements. But it's, you know, an FDA-approved technique that's in clinical use...
Q. Can diffusion-tensor imaging be used to diagnose a particular patient?
A. Yes, it can...
Q. Is DTI in use in other medical centers other than Einstein and Montefiore?
A. Yes, it is.
Q. And is it in use throughout the United States?
A. I believe it's in use throughout the world..
Q. Dr. Lipton, is there literature endorsing the assessment of individual subjects using DTI?
A. Yes there is.
Q. Can DTI be used to detect abnormalities due to traumatic brain injury?
A. Yes
Q. There are.
Q. Are there studies of individuals or groups?
A. Both
Q. Are there papers which support the use of DTI to diagnose traumatic brain injury in individual subjects?
A. Yes, there are"

Attached as K4 at pp. 28, 53-58.)

The United States District Court, District of South Carolina, in Yang-Weissman did not rule as the case settled for \$3,000,000 while the motions were pending.

Erin Bigler, Ph.D., is the Director of the Magnetic Resonance Imaging Research Facility at Brigham Young University, and an adjunct professor of psychiatry at the University of Utah. Dr. Bigler is the author of four books on the issue of neuroimaging and traumatic brain injury. A copy of his outstanding curriculum vitae, affidavit, certification and articles are attached as EXHIBIT L1-4). In the attached affidavit, Dr. Bigler writes:

Probably the best indicator of the importance of DTI in evaluating TBI is the fact that the NIH and the Department of Defense (DoD) sponsor the use of DTI. Specifically, DTI is an approved neuroimaging technique in the evaluation of TBI, including MTBI as sponsored by the Defense and Veteran's Brain Injury Center (DVBIC). In fact, the DVBIC webpage outlines the use of DTI in the evaluation of MTBI. Essentially all major neuroimaging studies that investigate TBI of all severity levels utilize DTI in their assessment of brain injury. (Paragraph 9)

13. In summary, DTI is in widespread use, including clinical use around the world. It provides unique information about white matter integrity across a broad spectrum of neurological and neuropsychiatric disorders that offers information that cannot be otherwise obtained.

Additionally, in Martin v. Nike, Inc., Erin Bigler, Ph.D. submitted a certification stating the following:

- "4. It is my opinion that diffusion tensor imaging is a scientifically valid assessment tool to assist in the diagnosis of mild traumatic brain injury.
5. DTI is being used clinically and as a diagnostic tool.
6. While DTI cannot diagnose the cause of the white matter damage, it is an acceptable assessment tool to use in conjunction with history, review of medical records, and/or clinical examination to make a diagnosis of traumatic brain injury."

Andrew Walker, M.D. is a board certified neuroradiologist and graduate of Yale University School of Medicine.

(A copy of Dr. Walker's affidavit and CV are attached as Exhibit M1-2). Dr. Walker completed his diagnostic radiology residency at Harvard Medical School, and completed a neuroradiology fellowship at Yale University School of Medicine. In his affidavit, Dr. Walker states:

2. The use of the MRI sequence diffusion tensor imaging (DTI) is widely and generally accepted in the clinical diagnosis of TBI. It is FDA approved, and is recognized and recommended as a useful MRI technique by the American College of Radiology (ACR), American Society of Functional Neuroradiology (ASFNR), the Defense Centers of Excellence (DCOE), and by the United States Air Force Surgeon General's Center for Excellence in Medical Multimedia (CEMM).

4. The use of DTI in the evaluation of TBI has been tested and validated, peer reviewed, is based upon well-recognized scientific principles, is generally accepted and has a determinable error rate, all of which are most comprehensively shown in the recent 2013 review article in the American Journal of Neuroradiology, "A Decade of DTI in Traumatic Brain Injury: Ten Years and 100 Articles Later."

F. Reed Murtaugh, M.D, is a board certified radiologist with an added qualification in neuroradiology. A copy of Dr. Murtaugh's affidavit and CV are attached as Exhibit N1-2). In his affidavit, Dr. Murtaugh states:

6. DTI improves the diagnosis and management of patients suffering from traumatic brain injury...
7. ...I have been actively involved in MR imaging since 1984 and in diffusion tensor imaging since 2004.
10. DTI technology is currently being used to diagnose brain injury in individual patients using the methodology employed by Dr. Lipton. This methodology is set forth as the subject of peer-reviewed literature of which I am aware...
12. DTI studies are not experimental and may be used to diagnose brain injury in individual subjects."

William W. Orrison, Jr., M.D., is a Professor of Radiology at the University of Utah. Dr. Orrison is a graduate of the University of Kansas School of Medicine, completed neurology and radiology residencies at the University of Wisconsin and neuroradiology fellowships at the University of Wisconsin as

well as Ulleval Hospital in Oslo, Norway. Dr. Orrison is the author of more than 150 medical publications and abstracts, six textbooks with translations in three languages, as well as numerous book chapters and reviews. He holds radiology-related patents in three countries and has several patents pending. He has served on the Editorial Board of the American Journal of Neuroradiology and the International Journal of Radiology and Radiology. (A copy of Dr. Orrison's affidavit, his July 23, 2009 report entitled "Selected Articles That Utilize Diffusion Tensor Imaging in the Evaluation and Diagnosis of Traumatic Brain Injury" and CV is attached as EXHIBIT 01-3).

Joseph C. Wu, M.D., Clinical Director of the University of California, Irvine, Brain Imaging Center, an Associate Professor of Psychiatry in the College of Medicine for the University of California, Irvine, also endorses the clinical use of diffusion tensor imaging. (The affidavit and curriculum vitae of Joseph C. Wu, M.D. are attached as EXHIBITS P1 and P2). Dr. Wu affirms:

DTI scans are not specifically diagnostic in and of themselves in isolation but are instead corroborative of brain injuries.

Further, Gary M. Weiss, M.D. and Nicholas D. A. Suite, M.D. have both offered affidavits, which state:

2. I am thoroughly familiar with the use of DTI and DTI is accepted as a diagnostic tool in clinical practice.
3. I review the literature routinely and am not aware of any state in which the

- use of this imaging test is not accepted in clinical practice.
4. As a result of my background, I consistently update information concerning valid, recognized diagnostic tools in brain injury and DTI has been a valid diagnostic tool for clinical purposes for many years.
 5. I am personally aware that DTI is used to aid in clinical diagnosis in several different locations in the State of Florida.
 6. DTI is a valid clinical diagnostic tool for mild, moderate and severe traumatic brain injury.

Similarly, Manley W. Kilgore, II, M.D. has submitted an affidavit stating:

3. I am thoroughly familiar with the use of PET and DTI and both tests are accepted as diagnostic tools in clinical practice.
4. I review the literature routinely and am not aware of any state in which the use of these imaging tests is not accepted in clinical practice.
5. As a result of my background, I consistently update information concerning valid, recognized diagnostic tools in brain injury and DTI has been a valid diagnostic tool for clinical purposes for many years.
6. I am personally aware that there are several private practices utilizing DTI on a clinical basis to diagnose brain injury and the same is true in Tampa, Orlando and Jacksonville has at least two private practices utilizing DTI.
7. DTI is a valid clinical diagnostic tool for brain injury including hypoxic brain injury.

(Dr. Weiss', Dr. Kilgore's and Dr. Suite's affidavits are attached as Exhibit Q).

Diffusion tensor imaging is also utilized at the Hospital of the University of Pennsylvania (Penn Medicine). (Attached as EXHIBIT R is the April 21, 2011 report of Rubin C. Gur, Ph.D.). Dr. Gur received his Ph.D. in Clinical Psychology from Michigan State University in 1973. He did his post-doctoral training at Stanford University and came to Penn as an Assistant Professor in 1974. Presently, Dr. Gur is a Professor in the Departments of Psychiatry, Neurology and Radiology, and is Director of the Penn Medicine Brain Behavior Laboratory.

Diffusion tensor imaging is also being used clinically at Children's Hospital of Philadelphia. (Attached as EXHIBIT S is a partial deposition transcript of Robert A. Zimmerman, M.D., Chief of Neuroradiology Division/MRI and Professor of Radiology at the Perelman School of Medicine at the University of Pennsylvania. Dr. Zimmerman also serves as Editor-In-Chief, USA, Neuroradiology, from 1989 to the present).

At his deposition, in the matter of *Steiner v. New Fairfield Board of Education*, Dr. Zimmerman testified as follows:

Q. Are you involved in the acquisition of DTI imaging?

A. Every day.

Q. And when you do it every day, please give me some context for what it is you use it for?

A. We use it in a - we do it routinely on all of our brain imaging at 3T, which is about 75% of the brains that are done here.

Q. You use it for clinical purposes?

A. We use it for clinical purposes and we use it for research purposes?

Q. So both clinical and research purposes?

A. Yes.

Q. And at least insofar as using it for clinical purposes, I take it that would extend in the context of traumatic brain injury as well, correct?

A. We do it in traumatic brain injury.

(Deposition at pp. 33-34).

Q. Well, DTI is also used in connection with mild traumatic brain injury?

A. Sure. We actually have a grant study.

Q. Do you? And where is the grant from?

A. The RSNA.

Q. What is RSNA?

A. It's the Radiologic Society of North America.

(Deposition at pp. 36-37).

Diffusion tensor imaging is also being used locally in New Jersey. Attached as Exhibit T is a radiologic report from JFK Medical Center, wherein DTI was requested by Dr. Greenwald for a patient with a suspected traumatic brain injury.

The overwhelming evidence is that DTI is accepted in the scientific community for assisting in the diagnosis of traumatic brain injury.

3. DTI IS DEMONSTRABLY RELIABLE.

DTI is demonstrably reliable because it (1) has been tested; (2) has been peer-reviewed; (3) has a low error rate; and (4) has been developed independent of litigation. Therefore, evidence of DTI is admissible even if this Court does not find acceptance in the relevant scientific community of DTI.

a. DTI HAS BEEN TESTED IN PEER-REVIEWED ARTICLES:

DTI has been tested through multiple peer-reviewed studies. As of September 12, 2012, 6,040 papers on DTI have been published in peer-review journals, of which 370 concern both DTI and TBI. Dr. Benson's methodology has been subject to the peer-review process through medical groups and the federal government. Finally, the following are quotes from the peer reviewed literature that show that DTI is scientifically valid and accepted within the community to assist in the diagnosis of mTBI:

1. Fakhran, Saeed, et al, *Symptomatic White Matter Changes in Mild Traumatic Brain Injury Resemble Pathologic Features of Early Alzheimer Dementia*, **Radiology** volume 269: Number 1 - October, 2013:

"Recent studies of white matter abnormalities at diffusion-tensor imaging in patients with mild TBI have correlated findings with clinical assessment tools of cognitive function, showing complex or widespread patterns of reduced white matter integrity associated with cognitive dysfunction."

"Quantitative comparison for tract-based spatial statistics analysis between patients with mild TBI and control subjects showed widespread significant differences in FA..."

"Total concussion symptom scores correlated positively with FA values at the gray matter-white matter junction, most prominently at regions of geometric inflection and in the primary and association auditory cortices. There were no regions where FA values negatively correlated with total concussion symptom scores." (internal citations omitted).

"Post hoc analysis showed that patients with mild TBI and sleep and wake disturbances had significantly lower FA in this region than did patients with mild TBI and no sleep and wake disturbances and control subjects." (internal citations omitted).

"Numerous prior studies have shown the important role of diffusion-tensor imaging in evaluating white matter integrity after mild TBI and white matter abnormalities in patients with mild TBI relative to control subjects." (internal citation omitted).

2. Treble, Amery, et al, *Working Memory and Corpus Callosum Microstructural Integrity after Pediatric Traumatic Brain Injury: A Diffusion Tensor Tractography*

Study, *Journal of Neurotrauma* 30:1609 – 1619 (October 1, 2013):

"Diffusion tensor imaging (DTI) and tractography are increasingly being utilized to quantify the effects of TAI *in vivo* through examination of the orientation and magnitude of water diffusion in the brain. Metrics provided by DTI include fractional anisotropy (FA) and mean diffusivity, which is separable into axial and radial diffusivities."

"Although the correlates of changes in different DTI metrics remain under investigation, recent studies suggest that FA and radial diffusivity, but not axial diffusivity, are significant predictors of post-traumatic changes in cognitive outcomes."

"DTI studies have shown lower FA and higher diffusivity metrics in all callosal subregions, relative to TC comparison groups, after TBI in both children and adults at subacute and chronic stages of recovery."

"DTI metrics indexing microstructural organization and integrity of particular callosal subregions were associated with WM performance in both groups of children. Lower FA and higher radial diffusivity in callosal subregions connecting anterior and/or posterior parietal cortical regions predicted poorer verbal WM, with both FA and radial diffusivity in these subregions accounting for significant variance over and above remaining callosal subregions."

"Our results are consistent with the building evidence suggesting that DTI of the [corpus callosum or "CC"] may serve as an effective biomarker for the degree of TAI and potential cognitive dysfunction after traumatic injury to the brain."

"Reductions in processing speed have been associated with lower FA in the body and splenium of the CC after pediatric TBI. Impaired fine motor speed and bimanual coordination were associated with lower FA insplential fibers, whereas impaired cognitive control of motor functions was associated with lower FA in callosal fibers connecting prefrontal, anterior parietal, and posterior parietal cortices in adults with TBI. Declarative memory impairment has been associated with posterior, but not anterior, callosal FA reductions in adult TBI. With regard to WM, in a case series of two pairs of twins discordant for sTBI sustained during childhood, poorer verbal WM was associated with lower mid-sagittal-area FA in the rostral mid-body, whereas visuospatial WM was unrelated to callosal FA in any subregion. Poorer verbal WM was also associated with lower mid-sagittal-area FA in the splenium in a group of children with TBI. In adults with sTBI, whole-brain FA analysis revealed positive correlations between anterior and posterior callosal subregions with visual WM performance and functional activation patterns."

"As hypothesized, both FA and radial diffusivity in particular callosal subregions predicted WM performance, whereas axial diffusivity was not significantly predictive. **This pattern of relative sensitivity of DTI metrics in prediction of neuropsychological outcome after TBI is a somewhat consistent trend in the TBI literature,** although it remains poorly understood."

"These results suggest that radial diffusivity may be the most sensitive DTI biomarker for predicting poor neuropsychological outcome after TBI."

"DTI of the CC may serve as a neuroanatomical biomarker for predicting WM deficits in children sustaining TBI."

3. Yeh, Ping-Hong, et al, *Postconcussional Disorder and PTSD Symptoms of Military-Related Traumatic Brain Injury Associated With Compromised Neurocircuitry*, **Human Brain Mapping** September 13, 2013:

DTI yields estimates of the main direction of axon fibers with reasonably good spatial resolution [Basser and Jones, 2002; Basser et al., 1994; Pierpaoli et al., 1996]. DTI provides a unique insight into the microstructure of numerous tissues. Within the brain, DTI can be used to quantify an index of white matter integrity and extract white matter features for visualization, for example, tractography [Basser et al., 2000]."

"Several recent studies have investigated the role of diffusion MR and shown promising results in detecting microstructural changes in mild TBI [Kasahara et al., 2012; Matsushita et al., 2011; Mayer et al., 2010]. The brain structures that are vulnerable to this type of injury are mainly the brainstem and the corpus callosum (CC), both regions with highly anisotropically oriented axons [Cloots et al., 2013]. The white matter tracts that tend to show abnormal DTI measures in TBI are long association fibers of fronto-parieto-temporal pathways such as superior and inferior longitudinal fasciculus, uncinate fasciculus, anterior corona radiata, projection fibers of the fronto-limbic network such as cingulum bundle and fornix, and the inter-hemispheric connection, i.e. genu and splenium of corpus callosum [Niogi and Mukherjee, 2010 for review]."

"Using high-dimensional tensor warping and tract specific analyses, **we have revealed evidence of white matter injury in those with military-related TBI.** Indicated primarily by reduced FA and increased trace, the injuries were most prominent in the pathways within the frontostriatal and fronto-limbic circuits, and the fiber tracts in the midbrain and the brainstem regions. Moreover, the compromised fiber tracts (reduced FA) in the nodes of frontostriatal and fronto-limbic circuits were associated with greater post-concussion and PTSD symptoms.

"Several DTI studies have shown decreased FA and increased apparent diffusion coefficient (ADC) in acute TBI patients [Arfanakis et al., 2002; Benson et al., 2007; Huisman et al., 2004; Lipton et al., 2009; Miles et al., 2008], possibly explained by the disruption of membrane skeleton and/or vasogenic edema due to the increased axolemmal permeability."

"The majority of our patients were in a subacute stage of injury, i.e. around 3 months or more post-injury. Our tract-specific analysis of the DTI diffusion metrics is consistent with the findings of recent reports [Bendlin et al., 2008; Singh et al., 2010], which found lower FA and higher trace in the pathways of frontostriatal and fronto-limbic circuitry and brain stem fiber tracts."

"our findings of significant associations between FA and post-concussion symptoms were in the affected regions of the neural networks in which the cognitive (frontal fibers), affective (limbic fibers), and somatic sequelae (sensory/motor pathways) following brain injury can be explained. The frequent comorbidity of PTSD and TBI is well described in military TBI patients [Belanger et al., 2009; Hoge et al., 2008; Ruff et al., 2010; Warden, 2006]. Compromised

integrity of white matter fiber connections, such as mainly decreased FA in the frontal region, has also been reported in PTSD patients [Schuff et al., 2011]. Therefore, the compromised integrity of white matter fiber connections of this study can be the combination of comorbid PTSD and TBI as these two separate and distinct diseases share common clinical symptoms."

Recent DTI studies suggest that cognitive impairment following trauma may correlate with the severity of white matter injury [see Levin et al., 2010 for review]."

4. Zwany Metting, et al, *Pathophysiological Concepts in Mild Traumatic Brain Injury: Diffusion Tensor Imaging Related to Acute Perfusion CT Imaging*, **PLOS ONE** May 2013, Volume 8, Issue 5:

"Diffuse axonal injury (DAI), a major pathological substrate of TBI, can be visualized with diffusion tensor imaging (DTI), also in the mild TBI category."

"In patients with mild TBI and normal convention imaging, a trend was observed towards DTI abnormalities in the chronic phase after injury. More importantly, these **DTI findings were found to be associated with hemodynamic abnormalities assessed with perfusion CT imaging in the acute phase of injury.**"

"Furthermore, several DTI studies identified subsequent white matter abnormalities in the chronic phase in patients with mild TBI. In general a decreased FA [fractional anisotropy] and an increased MD [mean diffusivity] is seen after injury in accordance with our study."

5. Hulklower, et al., *A Decade of DTI in Traumatic Brain Injury: 10 Years and 100 Articles Later*, **AJNR** - Published January 10, 2013 as 10.3174/ajnr.A3395.

"Because of the highly uniform collinear structure of normal white matter, **DTI is uniquely able to probe its microscopic structure and is, therefore, particularly well-suited for the assessment of TAI.** Although gross abnormalities can be identified in some cases of TAI by using CT and conventional MR imaging, **DTI can both qualitatively and quantitatively demonstrate pathology not detected by other modalities and is, therefore, an important tool not only in the research setting but in the clinical setting as well."**

"Numerous clinical studies have assessed TBI by using DTI."

"The corpus callosum, frontal lobe, internal capsule, and cingulum are among the most commonly identified regions of abnormality in DTI studies of TBI, perhaps because these structures are particularly vulnerable to injury due to their anatomic relationship to the skull and other structures such as the falx cerebri."

"DTI has been studied extensively as a tool for identification of brain abnormalities related to TBI and to understand the relationship of these brain abnormalities to other clinical features of the disorder. During the past decade, the number of such studies has risen exponentially and continues to increase with no sign of abatement. A unifying theme can be deduced from this large body of research: **DTI is an extremely useful and robust tool for the detection of TBI-related brain abnormalities. The overwhelming consensus of these studies is that low white matter FA is**

characteristic of TBI. This finding is consistent across almost all the articles we reviewed, despite significant variability in patient demographics, modest differences in data acquisition parameters, and a multiplicity of data analysis techniques. This consistency across studies attests to the robustness of DTI as a measure of brain injury in TBI."

"We also found an overwhelming consensus that imaging abnormalities detected with DTI are associated with important clinical outcomes. This further validates DTI as a meaningful measure of clinically important brain injury."

6. Editorial, Jonathan Silver, M.D., *Diffusion tensor imaging and mild traumatic brain injury in soldiers: abnormal findings, uncertain implications*, **Am J Psychiatry** 169:12, December 2012

Diffusion tensor imaging (DTI) is able to detect damage to axonal tracts by using a measure of directional water diffusion (fractional anisotropy)."

7. Aoki, et al, (**J Neurol Neurosurg Psychiatry**. 2012 Sep; 83(9):870-6:

A meta-analysis of 13 independent DTI studies on mTBI patients was performed and the authors concluded: "Our meta-analysis revealed the posterior part of the corpus callosum was more vulnerable to mTBI compared with the anterior part, and suggested the **potential utility of DTI to detect white matter damage...in mTBI patients.**

8. Dr. Toth, et al, (**J Neurotrauma**, 2012 Aug 20 E-published) report that "Advanced MRI methods were shown to be able to detect the subtle structural consequences of mild traumatic brain injury (mTBI). TBSS showed fractional anisotropy to be significantly lower... in the mTBI group in several white matter tracts compared to controls at 72 hours after injury and still one month later... **Our findings present dynamic micro- and macrostructural changes occurring in the acute to sub-acute phase in mTBI, in very mildly injured patients lacking micro hemorrhage detectable by SWI.**"

9. Wada, T., et al, *Decreased Fractional Anisotropy Evaluated Using Tract-Based Spatial Statistics and Correlated with Cognitive Dysfunction in Patients with Mild Traumatic Brain Injury in the Chronic Stage*, **Am J Neuroradiology**, published June 21, 2012 as 10.3174/ajnr.A3141:

"Diagnostic imaging of mTBI can increase our understanding of the clinical symptoms and help determine treatment strategies. In particular, **DTI** is sensitive to the diffusion characteristics of water (such as the principal diffusion direction and diffusion anisotropy) and **has been developed as a tool to investigate the integrity of brain tissues such as white matter tracts and to uncover discrete axonal injury.**"

"Evaluation of FA values obtained from DTI images is another promising neuroradiologic

technique for detecting minute brain lesions due to DAI. We have previously reported the significant relationship between white matter integrity and cognitive functions in certain areas of the brain following TBI."

"This is the first study to evaluate white matter abnormalities by comparing DTI from patients with mTBI without any focal morphologic abnormality on conventional MR imaging and healthy control subjects by using TBSS analysis. The results indicated that there were some regions, the right superior longitudinal fasciculus, left superior frontal gyrus, right insula, and left fornix, with significantly decreased FA values compared with those in healthy controls, which might be attributed to a minute morphologic abnormality in the damaged brains of patients with mTBI. Additionally, the results showed that the location of these regions was mostly concordant with those in the previous neuropathologic studies."

"Furthermore, our results showed a number of white matter regions that were significantly related to MMSE and FIQ in the brain, which suggests that cognitive function generally involves multiple white matter pathways—that is, these cognitive tests were not related to a single region in the brain."

"In patients with mTBI, significantly decreased FA value clusters in the white matter compared with the healthy controls were found in the superior longitudinal fasciculus, superior frontal gyrus, insula, and fornix. Cognitive examination scores positively correlated with FA values in a number of regions in deep brain structures, which were anatomically close or physiologically intimate to the regions with significant FA value reduction, in patients with mTBI. Their conclusion: "Patients with mTBI in the chronic stage have certain regions with abnormally reduced white matter

integrity in the brain (demonstrated by DTI). Although the clinical and pathologic-anatomic correlation of these findings remains to be elucidated, *these brain regions are strongly suggested to be related to chronic persistent cognitive impairments in these patients.*"

10. Lipton, et al., *Robust detection of traumatic axonal injury in individual mild traumatic brain injury patients: Intersubject variation, change over time and bidirectional changes in anisotropy*, **Brain Imaging and Behavior**, DOI 10.1007/s11682-012-9175-2. June, 2012

Diffusion tensor imaging (DTI) reveals evidence of TAI in animal models of TBI (e.g., (Mac Donald et al. 2007a, b; Wang et al. 2009)) and in patients, where brain abnormalities detected by DTI are associated with important clinical outcomes (e.g., (Kraus et al. 2007; Miles et al. 2008; Niogi et al. 2008a)). **Recent studies have used DTI to link specific functional impairment after mTBI to injury at specific brain regions (e.g., (Niogi et al. 2008b; Geary et al. 2010; Little et al. 2010; Levin et al. 2010; Hartikainen et al. 2010; Lipton et al. 2009)). (See Shenton, et al. 2012).**"

"In white matter, water diffuses more readily parallel to axons because its diffusion in other directions is restricted by subcellular structure including neurofilaments, microtubules, myelin and the axolemma. Intraaxonal microstructural disturbances and degradation of the myelin sheath have been demonstrated using DTI, in

the absence of frank axotomy (Song et al. 2003). The shear forces exerted on an axon during even mild head trauma have been reported to cause axonal pathology, with or without ultimate axotomy (Povlishock and Katz 2005) (see Bigler and Maxwell 2012)."

"Individual subject assessments reveal unique spatial patterns of white matter abnormalities in each patient, attributable to inter-individual differences in anatomy, vulnerability to injury and mechanism of injury. **This paper shows the ability to delineate abnormalities in single patients.**"

11. Huang, Ming-Xiong, et al, *An Automatic MEG Low-Frequency Source Imaging Approach for Detecting Injuries in Mild and Moderate TBI Patients With Blast and Non-Blast Causes*, **NeuroImage**, 61 (April 20, 2012) 1067 - 1082:

"Recently, DTI has also been used to examine potential axonal injury in mTBI patients with promising results. **DTI has been successfully applied in mild, moderate, and severe TBI and the method has shown great potential in providing a better understanding and improved diagnosis of - traumatic axonal injury]**. DTI studies in TBI patients have reported reduced fractional anisotropy (FA) in major white-matter tracts in central areas of the brain and the FA abnormality correlates with the GCS and post-traumatic amnesia."

"The present study also revealed the diffuse nature of the neuronal injuries in TBI patients. On average, approximately 4 - 8 cortical gray-matter areas showed abnormal slow-wave generation in each TBI patient using our automated MEG low-frequency source imaging. Such findings are consistent with the mechanism of diffuse axonal injury in TBI due to a combination of linear and

rotational acceleration and deceleration. The findings are also consistent with our previous MEG-DTI study in mTBI, in which we found that abnormal MEG slow-waves are generated from cortical gray-matter areas that connect to white-matter fibers with reduced DTI fractional anisotropy due to axonal injury in patients with mTBI. Specifically, the reduced DTI fractional anisotropy in local white-matter fiber tracts led to focal abnormal MEG slow-waves from neighboring gray matter in mTBI."

12. M.E. Shenton et al, *A Review Of Magnetic Resonance Imaging and Diffusion Tensor Imaging Findings in Mild Traumatic Brain Injury*, **Brain Imaging and Behavior J.** March 2012:

"DTI can depict multifocal and diffuse axonal injuries in individual cases of mTBI."

"Here we present evidence for brain abnormalities in mTBI based on studies using advanced MRI/DTI neuroimaging techniques. Importantly, these advances make it possible to use more sensitive tools to investigate the more subtle brain alterations in mTBI."

"Recent advances in neuroimaging techniques, such as DTI, make it possible to characterize better extant brain abnormalities in mTBI."

"Taken together, the findings presented below suggest that more sensitive neuroimaging tools improve the detection of brain injuries in mTBI (i.e., diagnosis)."

"We concur and believe that we now have neuroimaging tools that are sufficiently sensitive to discern both more gross indicators of pathology, as well as microstructural changes in white matter, and

microhemorrhages using newer imaging technologies."

"[T]here is no one single imaging modality that is capable of characterizing the multifaceted nature of TBI. **Advances in neuroimaging are, nonetheless, unprecedented and we are now able to visualize and to quantify information about brain alterations in the living brain in a manner that has previously not been possible. These advances ...[include]...DTI; useful for measuring white matter integrity.**"

"DTI...provides information about white matter anatomy that is not available using any other method..."

"DTI differs from conventional MRI in that it is sensitive to *microstructural* changes, particularly in white matter, whereas CT and conventional MRI (including also FLAIR) reveal only *macroscopic* changes in the brain. Thus subtle changes using **DTI can reveal microstructural axonal injuries**...which are potentially responsible for persistent postconcussive symptoms" (emphasis in original)

"The concept underlying DTI is that the local profile of the diffusion in different directions provides important indirect information about the microstructure of the underlying tissue. It has been invaluable in investigations of white matter pathology in multiple sclerosis, stroke, normal aging, Alzheimer's disease, schizophrenia and other psychiatric disorders, as well as in characterizing diffuse axonal injuries in mTBI."

"[DTI] figures reflect important, recent advances in methodology that are sufficiently robust and sensitive that they can be used for visualizing and quantifying white matter pathology *in vivo*, **for the**

assessment of mTBI clinically. These tools are available now for this purpose..."

"DTI is a sensitive measure of axonal injury that is particularly important for evaluating small and subtle brain alterations that are characteristic of most mTBI."

"DTI is by far the most sensitive in vivo method to detect subtle brain abnormalities in mTBI."

13. Drs. Sharp and Ham from the Hammersmith in London (**Curr Opin Neurol.** 2011 Dec;24(6):558-63) state:

"Diffusion tensor imaging (DTI) provides a more flexible way of investigating white matter injury. Recent studies largely confirm that DTI is sensitive to white matter damage after mTBI. Distinct DTI abnormalities are observed in the acute and subacute/chronic stages. DTI measurements change dynamically after an injury, reflecting the evolving pathological processes. DTI abnormalities correlate with cognitive and neuropsychiatric impairments. Importantly, DTI can contribute to the prediction of clinical outcome and has begun to be applied to the study of sports and blast injury."

14. Wang, J.Y., et al, *Longitudinal Changes of Structural Connectivity in Traumatic Axonal Injury*, **Neurology** 77, August 30, 2011:

"Diffusion tensor tractography is a valuable tool for identifying structural connectivity changes occurring between the acute and chronic stages of traumatic brain injury and for predicting patients' long term outcome."

15. Vos, Pieter; Bigler, Erin, *White Matter in Traumatic Brain Injury, Dis- or Dysconnection?*, **Neurology** 77, August 30, 2011:

"DTI detects decreases in the flow of water due to disturbed axonal transport and increased water diffusion due to myelin damage. Hence DTI measures the integrity of white matter."

"DTI methods permit the study of how networks are functionally affected by traumatic lesions; this is in contrast to past TBI research focusing only on location or lesion size in relation to cognitive functions."

16. Chu, Z, et al, *Voxel-based Analysis of Diffusion Tensor Imaging in Mild Traumatic Brain Injury in Adolescents*, **J Head Trauma Rehabil.**, 25(1): 31 - 42, January, 2010:

"Whole-brain WM DTI measures can detect abnormalities in acute mTBI associated with PCS symptoms in adolescents."

17. Niogi, SN, et al, *Diffusion Tensor Imaging of Mild Traumatic Brain Injury*, **Neuropsychologia**, 48(5): 1472 - 82, April, 2010:

"Researchers have shown that frontal and temporal association white matter pathways are most frequently damaged in mTBI and that the microstructural integrity of these tracts correlates with behavioral and cognitive measures."

18. Caeyenberghs, K, et al, *Brain-behavior Relationships in Young Traumatic Brain Injury Patients: Fractional Anisotropy Measures are Highly Correlated With Dynamic Visuomotor Tracking Performance*, **Neurology**, 74(*): 643 - 50, February 23, 2010:

"...the combined application of DTI and behavioral measures, was the most effective in distinguishing between TBI patients and controls."

19. Wu, Trevor, *Evaluating the Relationship between Memory Functioning and Cingulum Bundles in Acute Mild Traumatic Brain Injury using Diffusion Tensor Imaging* - **Journal of Neurotrauma** 27:303-307 (February 2010):

"...and decreased FA and increased ADC in chronic TBI have been attributed to white matter injury and degeneration."

20. Bigler, E.D. - *Voxel-Based Analysis of Diffusion Tensor Imaging in Mild Traumatic Brain Injury in Adolescents* - **AJNR Am J Neuroradiol** 31, Feb 2010:

"Whole brain WM **DTI measures can detect abnormalities in acute mTBI associated with PCS symptoms in adolescents.**"

"The present study revealed significant alteration in **DTI metrics in a group of patients with mTBI in several brain regions, and these changes were highly correlated with PCS severity and emotional distress.**"

"**Voxel based DTI analysis is capable of identifying potentially diffuse axonal injury vulnerable regions invisible to CT**

and conventional MR imaging, which may assist in classification, early diagnosis, and treatment."

21. Kumar, Raj - *Serial Changes in Diffusion Tensor Imaging Metrics of Corpus Callosum in Moderate Traumatic Brain Injury patients and Their Correlation with Neuropsychometric Tests: A 2-Year Follow Up Study - J Head Trauma Rehabil* Vol. 25, No 1, pp. 31-42 (February, 2010):

"...(DTI) has been shown to be a valuable technique for in vivo quantification of white matter microstructural alterations following TBI."

"However, changes in DTI indices were observed, confirming that DTI appears to be a more sensitive measure than volume of injury in these patients."

"In conclusion, our study suggests that FA and RD indices are surrogate markers of microstructural alterations in patients with TBI over time and correlate significantly with some NPT scores. The recovery in these indices in some regions of that CC⁶ is associated with recovery in neurocognitive deficits, suggesting that these indices may be used as an objective marker for the residual injury in these patients."

"FA and RD indices appear to be surrogate markers of microstructural alterations in patients over time and correlate significantly with some of the NPT scores. The recovery in these indices may be used as an objective marker for residual injury in these patients."

⁶CC stands for Corpus Collosum.

22. Bigler, Eric, Ph.D. - *Diffusion tensor imaging: A Biomarker for Mild Traumatic Brain Injury?* - **Neurology** February 23, 2010;74:626-627:

"DTI is particularly sensitive in assessing white matter (WM) microstructure, even in parenchyma deemed normal. **The sensitivity of DTI for WM injury makes it especially important in understanding mTBI...**"

23. Mayer, A.R, Ph.D. - *A prospective diffusion tensor imaging study in mild traumatic brain injury* - **Neurology** January 20, 2010;74: 643-650:

"Current results also suggest that DTI results are more accurate in objectively classifying mTBI patients from carefully matched HC⁷".

"Diffusion tensor imaging may have utility for objectively classifying mTBI, and may serve as a potential biomarker for recovery."

24. Sugiyama, K, et al, *Clinical Utility of Diffusion Tensor Imaging for Evaluating Patients with Diffuse Axonal Injury and Cognitive Disorders in the Chronic Stage*, **J Neurotrauma**, 26(11):1879-90, November, 2009:

"These results indicate that **DTI is a useful technique not only for detecting DAI lesions but also for examining cognitive disorders in DAI patients.**"

25. Lipton, Michael, M.D., Ph.D. - *Diffusion-Tensor Imaging Implicates Prefrontal Axonal Injury in Executive*

⁷ HC stands for Healthy Controls.

Radiology: Volume 252:Number 3-September 2009:

"Detection of ultrastructural damage by using DT imaging is a major advance in diagnostic imaging. **Several studies have supported the capability of FA to help identify white matter abnormalities in patients with traumatic brain injury including mTBI.** As confirmed by our findings, abnormal FA is detected even in the absence of other imaging abnormalities."

"Lower DLPFC FA was significantly correlated with worse executive function performance in patients)P. 05)."

26. Lo, Calvin - *Diffusion Tensor Imaging Abnormalities in Patients with Mild Traumatic Brain Injury and Neurocognitive Impairment - Comput Assist Tomogr*, Volume 33, Number 2, March/April 2009."

"Our results demonstrate a significant decrease in FA within the genu of the corpus callosum in patients with persistent cognitive impairment after mild TBI".

"Our study shows that DTI can be used to detect differences between patients with cognitive impairment after mild TBI and controls."

27. Wang, S, et al, *Longitudinal Diffusion Tensor Magnetic Resonance Imaging Study of Radiation-induced White Matter Damage in a Rat Model*, **Cancer Res**, 69(3): 1190-8, February 1, 2009:

"DTI indices reflected the histopathologic changes of WM damage and our results support the use of DTI as a biomarker."

28. Lipton, Michael - *Multifocal White Matter Ultrastructural Abnormalities in mild Traumatic Brain Injury with Cognitive Disability: A Voxel-Wise Analysis of Diffusion Tensor Imaging* - **Journal of Neurotrauma** 25:1335-1342 (November, 2008):

"Diffuse tensor MRI (DTI) shows lower fractional anisotropy (FA) in TBI patients that may correlate with disability."

"DTI was used to identify white matter abnormalities in patients with persistent cognitive impairment following mTBI"

"...showing a pattern of abnormalities in mTBI that is similar to DAI. Even more recently, Niogi et al reported voxel-wise analysis of DTI in mTBI and showed correlation of white matter abnormalities with a single reaction time measure."

"We have shown that DTI can identify abnormalities in patients cognitively impaired following mTBI."

29. D.R. Rutgers, et al, *Diffusion Tensor Imaging Characteristics of the Corpus Callosum in Mild, Moderate, and Severe Traumatic Brain Injury*, **American Journal of Neuroradiology** October 2008, 29: 1730-1735:

"Traumatic axonal injury is a frequent cause of impaired clinical outcome in patients with traumatic brain injury...[and] **DTI has evolved in recent years as a valuable complementary technique to investigate traumatic axonal injury.**"

30. Niogi, SN, et al, *Structural Dissociation of Attentional Control and Memory in Adults With and Without Mild Traumatic Brain Injury*, **Brain**, 131(Pt 12):3209-21, October 24, 2008:

"More generally, such findings suggest that diffusion anisotropy measurement can be used as a quantitative biomarker for neurocognitive function and dysfunction."

31. Chappell, Michael - *Multivariate analysis of diffusion tensor imaging data improves the detection of microstructural damage in young professional boxers* - **Magnetic Resonance Imaging** (May 27, 2008):

"DTI is a valuable tool to identify microscopic changes in brain tissue resulting from damage or disease..."

"This scatter plot shows the expected pattern that with mild head injury MD increases and FA decreases."

32. Wilde, E. A. - *Diffusion tensor imaging of acute mild traumatic brain injury in adolescents* - **Neurology** 70 March 18, 2008:

"Diffusion tensor imaging (DTI) is an imaging technique acquired on a standard MTI scanner that has been shown to be far more sensitive to white matter injury than conventional MRI."

"Validity of DTI in adult TBI has been supported by a positive correlation of FA in the internal capsule and splenium with the Glashow Coma Scale (GCS) score..."

"...the DTI indices were sensitive to pathologic processes of MTBI that contributed to the postconcussion symptom severity of our patients."

33. Rutgers, D.R. - *White Matter Abnormalities in Mild Traumatic Brain Injury: A Diffusion Tensor Imaging Study* - **AJNR Am J Neuroradiol** March, 2008:

"DTI quantifies white matter architecture through an extensive description of water diffusion and allows for the reconstruction of white matter fibers in 3D through fiber tracking Algorithms."

"...patients with mild TBI had multiple white matter regions with reduced FA, predominately involving cerebral lobar white matter, cingulum, and corpus callosum."

"...that subacute or early chronic DTI changes are an indicator of long-term DTI abnormalities in mild TBI."

"The present study shows that patients with mild TBI have multiple white matter regions with abnormality reduced FA, predominately in cerebral lobar white matter, cingulum, and corpus callosum."

34. Yuan, W - *Diffusion Tensor MR Imaging Reveals Persistent White Matter Alteration after Traumatic Brain Injury Experienced during Early Childhood* - **AJNR Am J Neuroradiol** 28:1919-25 Nov-Dec 2007:

"DTI is an advanced MR imaging technique that can detect in vivo anisotropic diffusion properties in WM."

"...that DTI is a feasible, sensitive, and noninvasive means of examining WM changes in young children with moderate, as well as severe, injuries."

35. Kraus, Marilyn F. - *White matter integrity and cognition in chronic traumatic brain injury: a diffusion tensor imaging study* - **Brain** (September 14, 2007) pp. 1-12:

"DTI provides an objective means for determining the relationship of cognitive deficits to TBI, even in cases where the injury was sustained years prior to the evaluation."

"DTI allows for the specific examination of the integrity of white matter tracts, tracts which are especially vulnerable to the mechanical trauma of TBI."

"Because DTI is more sensitive to changes in the microstructure of white matter, it shows considerable promise in the assessment of TBI."

"The data presented here demonstrate that DTI allows for a more sensitive delineation of severity and mechanism of white matter pathology, and may help to explain apparent discrepancies between clinically diagnoses injury severity and cognitive outcomes across the spectrum of TBI."

36. Benson, Randall - *Global White Matter Analysis of Diffusion Tensor Images is Predictive of Injury Severity in Traumatic Brain Injury* - **Journal of Neurotrauma** Volume 24, Number3, March, 2007:

"FA changes appear to be correlated with injury severity suggesting a role in early diagnosis and prognosis of TBI..."

"The present study demonstrates the ability of a white matter FA histogram-based method of analyzing MRI diffusion tensor images to discriminate between persons with traumatic brain injury and healthy volunteers and to predict short term clinical outcome from TBI".

i. **DTI HAD BEEN SHOWN TO HAVE CLINICAL PREDICTIVE POWER.**

As shown below, DTI has been shown to predict significant sequelae of TBI:

1. Fakhran, Saeed, et al, *Symptomatic White Matter Changes in Mild Traumatic Brain Injury Resemble Pathologic Features of Early Alzheimer Dementia*, **Radiology** volume 269: Number 1 - October, 2013:

"Recent studies of white matter abnormalities at diffusion-tensor imaging in patients **with mild TBI have correlated findings with clinical assessment tools of cognitive function, showing complex or widespread patterns of reduced white matter integrity associated with cognitive dysfunction.**"

"**Total concussion symptom scores correlated positively with FA values at the gray matter-white matter junction**, most prominently at regions of geometric inflection and in the primary and association auditory cortices. There were no regions where FA values negatively correlated with total concussion symptom scores." (internal citations omitted).

"Our study correlates white matter abnormalities who had mild TBI with patient-reported postconcussion symptoms."

"Other studies have correlated postconcussive cognitive dysfunction with focal white matter abnormalities."

2. Treble, Amery, et al, *Working Memory and Corpus Callosum Microstructural Integrity after Pediatric Traumatic Brain Injury: A Diffusion Tensor Tractography Study*, **Journal of Neurotrauma** 30:1609 - 1619 (October 1, 2013):

"Although the correlates of changes in different DTI metrics remain under investigation, recent studies suggest that FA and radial diffusivity, but not axial diffusivity, are significant predictors of post-traumatic changes in cognitive outcomes."

"In adults with sTBI, whole-brain FA analysis revealed positive correlations between anterior and posterior callosal subregions with visual WM performance and functional activation patterns."

3. Yeh, Ping-Hong, et al, *Postconcussional Disorder and PTSD Symptoms of Military-Related Traumatic Brain Injury Associated With Compromised Neurocircuitry*, **Human Brain Mapping** September 13, 2013:

Recent DTI studies suggest that cognitive impairment following trauma may correlate with the severity of white matter injury [see Levin et al., 2010 for review]."

4. Zwany Metting, et al, *Pathophysiological Concepts in Mild Traumatic Brain Injury: Diffusion Tensor Imaging Related to Acute Perfusion CT Imaging*, **PLOS ONE** May 2013, Volume 8, Issue 5:

More importantly, these **DTI findings were found to be associated with hemodynamic abnormalities assessed with perfusion CT imaging in the acute phase of injury.**"

5. Huang, Ming-Xiong, et al, *An Automatic MEG Low-Frequency Source Imaging Approach for Detecting Injuries in Mild and Moderate TBI Patients With Blast and Non-Blast Causes*, **NeuroImage**, 61 (April 20, 2012) 1067 - 1082:

"DTI studies in TBI patients have reported **reduced fractional anisotropy (FA) in major white-matter tracts in central areas of the brain and the FA abnormality correlates with the GCS and post-traumatic amnesia.**"

6. Sharp, *Curr Opin Neurol*, (December, 2011) "DTI abnormalities correlate with cognitive and neuropsychiatric impairments. Importantly, **DTI can contribute to the prediction of clinical outcome** and has begun to be applied to the study of sports and blast injury."

7. Kumar, Raj - *Serial Changes in Diffusion Tensor Imaging Metrics of Corpus Callosum in Moderate Traumatic Brain Injury patients and Their Correlation with Neuropsychometric Tests: A 2-Year Follow Up Study* - **J Head Trauma Rehabil** Vol. 25, No 1, pp. 31-42 (February, 2010):

"In conclusion, our study suggests that **FA and RD indices are surrogate markers of microstructural alterations in patients with TBI over time and correlate significantly with some NPT scores.**

8. Lipton, Michael, M.D., Ph.D. - *Diffusion-Tensor Imaging Implicates Prefrontal Axonal Injury in Executive Function Impairment Following Very Mild Traumatic Brain Injury* - **Radiology**: Volume 252:Number 3-September 2009:

"In conclusion, we found **that lower DLPFC⁸ white matter FA in acute mTBI helps predict impairment executive function in these patients.**"

9. Wilde, E. A. - *Diffusion tensor imaging of acute mild traumatic brain injury in adolescents* - **Neurology** 70 March 18, 2008:

"Validity of DTI in adult TBI has been supported by a **positive correlation of FA in the internal capsule and splenium with the Glashow Coma Scale (GCS) score...**"

10. Benson-Global White Matter Analysis of Diffusion Tensor Images is Predictive of Injury Severity in Traumatic Brain Injury, J. of Neurotrauma, Vol. 24, No. 3, pp. 446-459, 2007.

"FA changes appear to be correlated with injury severity..."

Copies of some of the literature are attached as Exhibit U).

⁸ DLPFC stands for dorsolateral prefrontal cortex.

ii. DTI HAS BEEN TESTED, APPROVED BY THE
FDA, AND IS SUPPORTED BY THE MEDICAL
LITERATURE.

DTI has been tested through multiple peer-reviewed studies as cited above. As of October, 2013, there were 7,900 papers on DTI that have been published in peer-review journals. 580 of the papers are on DTI and TBI and 150 of those papers employed a voxel based analysis such as the one used by Dr. Benson. Dr. Benson's methodology has been subject to the peer-review process through medical groups and the federal government.

DTI's reliability is further exemplified by its approval from the FDA. DTI software was submitted in 2001 to the FDA for Section 510(k) premarket notification and was granted permission to be marketed with the following language under Indications for Use: "Diffusion tensor imaging produces magnetic resonance (MR) images whose contrast is dependent on the local diffusion coefficient of water. Diffusion tensor imaging can be used to image the directional dependence of the diffusion coefficient in tissue such as white matter." The FDA tested the software for "safety and effectiveness" before granting permission for it to be marketed, specifically the:

"effectiveness of a device is . . .
[determined] on the basis of well-controlled
investigations, including 1 or more clinical
investigations where appropriate, by experts
qualified by training and experience to

evaluate the effectiveness of the device,
**from which investigations it can fairly and
responsibly be concluded by qualified
experts that the device will have the effect
it purports or is represented to have.**" 21
U.S.C. 360c.(3)(A) (emphasis added).

The DTI software was being manufactured by GE Medical Systems and the application states that the "Diffusion Tensor Imaging Option was evaluated to the IEC 601-2-33 International medical equipment safety standard for Magnetic Resonance Systems. Evaluation testing confirmed accuracy statements in the User manual." In 2003, the FDA granted permission for a device to be marketed that stated DTI "differentiates tissues with restricted diffusion from tissues with normal diffusion" and whose indications for use concluded that "[t]hese images when interpreted by a trained physician, yield information that may assist in diagnosis."

The medical literature makes clear that DTI is a widely accepted tool for assisting in the diagnosis of mTBI and post concussive syndrome. The defendant is asking this Court to disregard the overwhelming consensus of the medical community and preclude evidence of DTI because it is a tool used for diagnosis as opposed to a biomarker capable of exclusive diagnosis. The plaintiff's experts are using DTI as one of many tools to diagnose post concussive syndrome. This is how the overwhelming majority of medical diagnoses are made: by taking

all the information together and drawing a conclusion. DTI cannot, by itself, determine that the plaintiff has a brain injury caused by the subject car crash. The argument that DTI cannot by itself relate the brain damage found in the plaintiff to the car crash is irrelevant because it is not being used by itself to do so and therefore the defendant's motion should be denied.

The medical literature overwhelmingly demonstrates DTI is a widely accepted tool for assisting in the diagnosis of mTBI and post concussive syndrome. Defendants are asking this Court to disregard the overwhelming consensus of the medical community and preclude evidence of DTI. Defendants cite no literature to support their position.

Plaintiff's experts are using DTI as one of many tools to diagnose traumatic brain injury. Again, this is how the overwhelming majority of medical diagnoses are made: by taking all the information together and drawing a conclusion. DTI cannot, by itself, determine that the plaintiff has a brain injury caused by the car crash. It is when all the evidence is viewed together that Drs. Benson, O'Shanick and Greenwald reached their diagnosis of traumatic brain injury.

iii. DTI HAS A LOW ERROR RATE.

In assessing the reliability of a scientific technique, consideration should be given to the known or potential rate of

error and the existence and maintenance of standards controlling the technique's operation. Daubert, 509 U.S. at 594.

As described in Dr. Benson's affidavit, the odds of the plaintiff's findings because of chance are statistically impossible. There is little doubt that DTI demonstrates that the plaintiff has damage to her white matter typical for traumatic axonal injury. The findings are confirmed by the plaintiff's symptoms.

iv. DTI WAS NOT DEVELOPED FOR LITIGATION.

One such factor applicable here is whether experts are "proposing to testify about matters growing naturally and directly out of research they have conducted independent of the litigation, or whether they have developed their opinions expressly for purposes of testifying." Daubert v. Merrell Dow Pharmaceuticals, Inc., 43 F.3d 1311, 1317 (9th Cir. 1995). In the present matter, Dr. Benson did not develop his opinions regarding DTI for the purpose of testifying. Rather, Dr. Benson has submitted peer reviewed articles and testimony to the United States Congress that support the use of DTI for the diagnosis of mTBI. He employs DTI in his work for the NFL and recently spoke at a conference of experts on DTI to bring the benefits of DTI to our soldiers and veterans. Dr. Benson's anticipated trial testimony concerning DTI and its validity and reliability have

all grown naturally and directly out of research and other activities conducted completely independent of this lawsuit.

4. DTI HAS BEEN ADMITTED BY COURTS UNDER BOTH FRYE AND DAUBERT STANDARDS

There is no case in the country that has excluded DTI demonstrated by defendants' failure to cite one case where DTI has been barred. Rather, DTI has been admitted in every case where the issue has been raised and a court has ruled.

Defendants in other cases have attempted to preclude Dr. Benson from testifying regarding his interpretation of diffusion tensor imaging, recognizing the significance of the introduction of objective medical evidence of brain injury.

In Woods v. Ruth, Case No. 13-cv-99, (District Court, County of Arapahoe, CO, Division 402 (2014)). Defendant filed a motion to strike Dr. Benson's testimony arguing that using DTI-MRI evaluations to diagnose brain injury is not reasonably reliable because it is considered experimental and has never been independently tested and scientifically validated as a reliable method for diagnosing brain injury. (The court's order is attached as Exhibit V1) The Court denied the defendant's motion stating that in 2014:

"after fifteen years, tens of thousands of studies, and thousands of publications, the 'methods should no longer be considered experimental'" - quoting a 2009 article published in the Institute of Nerve Medicine

"The scientific method in question is the use of DTI-MRI evaluation in diagnosing brain injury...the method has been tested using control groups and over two thousand subjects have been studied across one hundred publications."

"the Court finds that using DTI-MRI evaluations to diagnose brain injury is reasonably reliable, and that any concerns regarding the method go to the weight of the evidence rather than its admissibility."

In Ebel v. Apache, et al., Case No. D-101-CV-2012-01210, (NM, December 11, 2013) (defendant filed a motion to exclude Dr. Benson using DTI as a tool to assist in diagnosing mTBI arguing that it has not been proved to be reliable for single subjects. The court's order and transcript is attached as Exhibit V2). The court ruled in December, 2013, "having read and considered the submissions of counsel..., having heard oral arguments, and otherwise being fully-advised in the premises" denied the defendant's motion. The court admitted the evidence "because diffusion tensor imaging and the expert opinions related thereto satisfy the standards for admissibility of expert testimony..."

The Ebel Court stated at hearing:

"First, with regard to the DTI, that motion is denied. It's my opinion that the cases that have looked at the issue have reached the conclusion that DTI is sufficiently reliable to be admitted under Daubert standards. It's also my opinion that there is sufficient evidence that would allow DTI to be used in the clinical setting as it relates to individuals, and that this is

just one part of the evidence that would be used to show that this plaintiff has mild traumatic brain injury.

If that were the only evidence, then I might have problems. But it's not. It's going to be used in combination with other things. And I believe that the threshold is met for admitting that. The other things go to weight and can be the subject of cross-examination."

In Ruppel v. Kucanin, No. 3:08 CV 591, (USDC Northern Division of Indiana, Southbend Division (2011) defendant sought to preclude evidence of a diffuse axonal brain injury under Federal Rule of Evidence 702. (A copy of the Court's decision is attached as Exhibit V3). Defendant specifically argued that Dr. Benson's opinion that the plaintiff suffered an mTBI was not reliable because he used DTI to reach his conclusion. The court issued a ruling denying defendant's motion to exclude DTI evidence complete with a lengthy discussion of DTI and specifically Dr. Benson's use of DTI under a Daubert analysis. The court stated that:

"DTI and FA quantification based on comparative scans appear to be reliable methods for Dr. Benson to arrive at his expert opinion of both Ruppel's diagnosis of diffuse axonal injury and the cause of that injury."

"there have been numerous validation studies, published in peer reviewed journals, on the use of DTI to detect diffuse axonal injuries."

"DTI is regularly used as a diagnostic tool at the Detroit Medical Center and at other locations throughout the country"

"the United States Army Telemedicine and Advanced Technology Research Command ("TATRC") sponsored a "Diffusion MRI TBI Roadmap Development Workshop" at which it was acknowledged: "DTI has detected abnormalities associated with brain trauma at several single centers.""

"approval for marketing by the FDA indicates that its effectiveness was determined pursuant to 21 U.S.C. § 360c(a)(3)(A)."

"DTI has been accepted within the medical community." "Importantly, as discussed below, there are many articles published in peer-reviewed publications that cover the effectiveness of DTI in detecting mild TBI."

"the evidence shows that DTI and analysis of white matter in DTI images are generally accepted methods for determining mild TBI."

The Court further found that DTI was demonstrably reliable through the remaining Daubert factors, independent of its general acceptance in the medical community. The Court denied the defendant's motion and allowed Dr. Benson to testify regarding DTI and mTBI.

The United States District Court (Massachusetts) in Chiulli v. Newbury Fine Dining, Inc., (Civ. Action. No. 10-10488-JLT (USDC MA 2012), rejected a similar motion to bar DTI and Dr. Benson. (See para. 6 of the attached order dated October 7, 2012 and attached as Exhibit V4).

In Hansen v. Crain, the Plaintiff suffered an mTBI and defendant filed a motion in limine to exclude evidence obtained through DTI. (A copy of the Court's order is attached as Exhibit V5). The court found that DTI "is not novel science, it has been around for maybe some twenty years, and is relied upon by medical professionals in a number of settings." The court rejected the defendant's argument that there can be other causes, other than a TBI, that could cause similar DTI results stating:

"The criticism is that it is not perfect, In fact, many other things besides trauma can lead to a similar finding on a scan of this nature. And that, in part, relies on clinical correlation and past history of a person's medical, psychological, or trauma conditions. That, like any other causation issue such as a herniated disc, if it's caused by the accident or not --- MRI doesn't tell you if a herniated disc is caused by an accident or not, it tells you it's a herniated disc. The doctors are allowed to opine whether they believe that injury or insult was caused by this, that, or the other thing. In this case, ...[the DTI results] form part of the basis for a qualified physician's opinion as to injury or causation from a motor vehicle accident passes that portion of our Frye Mack test, and I believe that it will be helpful to the jury."

In Hammar v. Sentinel Insurance Company, Ltd., State of Florida, Thirteenth Judicial Circuit of the State of Florida, Hillsborough County, Civil Action No. 08-019984 (Barton, J) (September 27, 2010), the defense raised a Frye challenge to

the admissibility of DTI. (A copy of the Court's order is attached as Exhibit V6). In denying the defense challenge, Judge Barton wrote in September, 2010:

"3. DTI of the brain is proven and well-established imaging modality in the evaluation and assessment of normal and abnormal conditions of the brain. DTI demonstrates evidence of traumatic brain injury pathology and can reveal abnormalities that are not visible on standard MRIs...

4. DTI is generally accepted by the medical community, FDA approved, peer reviewed and approved, and a commercially marketed imaging modality which has been in clinical use for the evaluation of suspected head traumas including mild traumatic brain injury."

In Whilden v. Cline, et al., Case No. 08-cv-4210 (CO, Jefferson County, May 10, 2010), plaintiff alleged he suffered an mTBI after being involved in a motor vehicle accident. (A copy of the Court's order is attached as Exhibit V7). The court denied the defendant's motion to exclude evidence of DTI finding that:

"the technology [is] sufficiently reliable and scientifically accepted so as to be of benefit to the jury."

"This court is convinced that it produces predictable, reproducible results and accurately images the portions of the brain to which it is applied. For these purposes, it is sufficiently accepted in the scientific and medical communities. It has been the subject of a substantial number of published studies and article, including

peer reviewed articles." (internal citations omitted)

In Booth v. Kit, Civ. No. 06-1219 JP/KBM, 2009 U.S. Dist. Lexis 125754, at *12, (D. N.M. March 23, 2009), the U.S. District Court for the District of New Mexico denied the defendant's motion to strike, limit, or exclude, expert testimony that, in part, relied on DTI testing. (A copy of the Court's order is attached as Exhibit V8). The court held that the expert's testimony was admissible under Rule 702 because the reasoning and methodology underlying the testimony was scientifically valid and therefore sufficiently reliable. The court indicated that Dr. Orrison's reasoning and methodology had been sufficiently tested, peer reviewed, lacked a high error rate, and was generally accepted in the scientific community. The court made clear that "any perceived weakness in Dr. Orrison's conclusions **may be attacked on cross examination or by contradictory opinions by one or more other qualified experts.**"

In LeBoeuf v. B & K Contractors, Inc., 2008 1351 (La.App. 4 Cir. May 27, 2009) at *15, 41-42; 10 So. 3d 897; 2009 La. App. Unpub. Lexis 324, a trial court judge properly allowed experts from both sides to testify regarding plaintiff's brain damage and the various tests performed on him (including DTI) in a bench trial restricted to damages. (A copy of the Court's decision is attached as Exhibit V9). The trial court judge found

that the plaintiff did have a brain injury and awarded him damages. In affirming the plaintiff's award, the appeals court noted that the "expert medical testimony regarding the nature and degree of injuries [the plaintiff] sustained was conflicting" and that the trial court judge found "that the evidence established [the plaintiff] sustained a mild brain injury." The appeals court decline[d] to disturb the trial court's award of general damages.

In Lamasa v. Bachman, 869 N.Y.S. 2d 17 (Sup. Ct. App. Div. 2008) the Supreme Court, Appellate Division, First Department, New York, considered whether a trial court properly admitted evidence of mild traumatic brain injury that had been obtained through DTI (A copy of the Court's order is attached as Exhibit V10). The court held that DTI evidence was properly admitted because it could not be characterized as novel science and that the defendant's concerns went to the weight of the evidence, not its admissibility. The court reasoned that "plaintiffs' experts, relying on objective medical tests, testified to brain damage and other injuries that they attributed to trauma, and the conflicting medical evidence and opinions of defendant's experts concerning the permanence and significance of plaintiff's injuries simply raised issues of fact for the jury." In denying defendant's motion for relief, the lower court explained that:

DTI is an imaging technique used to study the random motion of hydrogen atoms within water molecules in biological tissue (e.g., brain white matter) and spatially map this diffusion of water molecules, *in vivo*. DTI provides anatomical information about tissue structure and composition. Changes in these tissue properties can often be correlated with processes that occur, among other causes, as a result of disease and trauma.

The lower court further held that, as to the issues of causation and the precise physical injuries the plaintiff suffered as a result of the collision, "the parties had numerous expert witnesses testifying and in considering the conflicting testimony of the parties' respective expert witnesses, the jury was not required to accept one expert's testimony over that of another, but was entitled to accept or reject either expert's position in whole or in part." On appeal, the New York Supreme Court, Appellate Division, upheld the trial court's admission of the challenged expert testimony.

In Andrus v. Fulgham, Case No. 040904243 (District Ct., Salt Lake County, Utah July 17, 2006), defendants moved to exclude plaintiff's evidence based on diffusion tensor imaging (DTI), arguing that it is a novel method of imaging and one that is inherently unreliable. (A copy of the Court's Ruling is attached as Exhibit V11). In opposition, plaintiff referenced a wide array of medical literature and articles discussing DTI, its acceptance in the neuro-imaging field and its usefulness in

diagnosing and evaluating brain injuries and abnormalities, where more conventional imaging has been less reliable. The court held "under these circumstances, the Court is persuaded by the plaintiff's position and determined that while DTI imaging is a developing technology, there is nothing to suggest that it is inherently unreliable or inadmissible under the standards set forth in Rimmasch. Therefore, [the defendant]'s motion in limine is denied."

In Nordstrom v. Fleet Farm of Menomonie, Inc., Case no. 82-cv-11-5842, (MN, County of Washington, January 17, 2014) the court denied defendant's motion to exclude all evidence obtained with DTI. (The court's order is attached as Exhibit V12).

In January, 2014, the Court found that:

"DTI is FDA approved and peer reviewed. It has been in clinical use for many years and is generally accepted in the scientific community as a reliable and accurate tool which can detect damage to the white matter of the brain."

"DTI does not involve a novel scientific theory, therefore, a Frye-Mack analysis is not required."

Finally in both Rye v. Kia Motors, (Wayne County Ct., Michigan 2/16/2010) and Sworin v. Harris, (20th Jud. Cir. Ct., Fl 1/13/2014, motions to bar Dr. Benson were denied. (Copies of those orders are attached as Exhibits V13-14).

The science behind DTI is the main reason why every court in the country has admitted DTI over objection with the proper expert and the proper subject.

5. **THE DEFENSE ARGUMENTS AGAINST DTI ARE NOT SCIENTIFICALLY BASED AND SHOW A FUNDAMENTAL MISUNDERTANDING OF THE SCIENCE OF DTI**

The Plaintiff refers the Court to the sections where the peer reviewed quotes are provided as well as the affidavits. Plaintiff refers the Court specifically to the Hulkower article, "A Decade of DTI in Traumatic Brain Injury: 10 Years and 100 Articles Later" cited earlier. After reviewing 10 years and 100 articles of DTI and TBI, (articles which Dr. Post could not and did not locate in her PubMed search) the authors conclude:

"DTI is an extremely useful and robust tool for the detection of TBI-related brain abnormalities. The overwhelming consensus of these studies is that low white matter FA is characteristic of TBI. This finding is consistent across almost all the articles we reviewed, despite significant variability in patient demographics, modest differences in data acquisition parameters, and a multiplicity of data analysis techniques. This consistency across studies attests to the robustness of DTI as a measure of brain injury in TBI.... DTI can both qualitatively and quantitatively demonstrate pathology not detected by other modalities and is, therefore, an important tool not only in the research setting but in the clinical setting as well."

"We also found an overwhelming consensus that imaging abnormalities detected with DTI are associated with important clinical outcomes. This further validates DTI as a

meaningful measure of clinically important brain injury." (Emphasis added).

Defendants chose to ignore the above instead pointing to the paragraph cited on page 6 of defendants' brief where the authors state:

[L]arger longitudinal studies will be essential for the evaluation of DTI as a prognostic biomarker in TBI.

This sentence means that DTI, to date cannot evaluate what the long term outcome will be when an abnormality is found on DTI. Not one of plaintiff's experts has relied on DTI in arriving at an opinion regarding Mr. Ferrante's prognosis. The defendants' reliance on this one phrase is of no import. What is demonstrated by this article is that DTI is being used clinically to assist in the diagnosis of traumatic brain injury.

a. DTI IS NOT ABLE TO TELL THE ETIOLOGY OF ANY WHITE MATTER DAMAGE FOUND

The Court in Hansen v. Crain, correctly rejected this argument as cited supra. As stated above and repeatedly, DTI is simply a diagnostic tool to help the clinical diagnosis by objectively demonstrating white matter abnormalities. Few if any, radiologic tools can demonstrate etiology. X-Rays cannot, MRIs cannot, CT Scans cannot yet these tests are regularly allowed into evidence. It is an undisputed fact that mTBI can and will cause white matter damage that is shown on the DTI in

this case. Dr. Benson, Dr. O'Shanick and Dr. Greenwald have rendered the clinical opinion that these results are related to the mTBI and provide objective evidence of damage to the wiring of his brain. If the defense wants to cross examine these physicians regarding the etiology, that is their prerogative. However, to seek to exclude objective evidence of damage to important structures of her brain, in a case of where the defense is calling the Plaintiff a malingerer or someone with non-organic psychiatric issues, is patently unfair.

Here, like in Whilden, Dr. Benson, Dr. O'Shanick and Dr. Greenwald based their diagnosis that Frank Ferrante had sustained a traumatic brain injury, not only upon interpreting the diffusion tensor imaging, SPECT and NeuroQuant (in the case of Dr. O'Shanick), but also based on the history provided to them, the medical records they reviewed and their clinical examinations. Based on all of those factors, Drs. Benson, O'Shanick and Greenwald diagnosed that Frank Ferrante sustained a traumatic brain injury as a direct result and cause of the crash of June 1, 2008.

Defendants argue that somehow Dr. Benson's affidavit is contradictory and therefore he should not be permitted to testify. While plaintiff disagrees with this conclusion, this is not a basis to bar his testimony. If defendants think Dr. Benson

contradicts himself, they will have the opportunity to cross examine him at the appropriate time.

6. **CONCLUSION**

Plaintiff has established by expert testimonial, peer-reviewed articles, standards of the applicable professional societies and case law that diffusion tensor imaging (DTI) is scientifically valid and should be admitted in this case.

D. **SPECT IS A VALID AND REALIABLE DIAGNOSTIC TEST USED AND RELIED UPON BY EXPERTS IN THE FIELD OF BRAIN INJURY MEDICINE.**

While a patient at Sierra Tucson, Frank Ferrante's treating physician order that Frank undergo a SPECT, to assist in making a correct diagnosis. The SPECT was performed in Arizona and sent to Newport Beach, California to be reviewed by Daniel Amen, M.D., a pre-eminent expert in the field of neuropsychiatry and neuro-imaging (particularly in SPECT). (Dr. Amen's video de bene esse deposition transcript with Exhibits and CV are attached as Exhibit E). **Daniel G. Amen, M.D., is widely regarded as one of the world's foremost experts on applying brain imaging science to everyday clinical practice. Dr. Amen is the founder of Amen Clinics in Newport Beach and San Francisco, California; Bellevue, Washington; Reston, Virginia; Atlanta, Georgia; and New York City. Amen Clinics have the world's largest database of functional brain scans relating to behavior, totaling 80,000 scans on patients from 90 countries.** Dr. Amen is the author of

30 books, 50 articles, numerous television produced programs on SPECT and the brain. He has read more SPECTs than anyone else in the world (approximately 89,000).

Dr. Amen reviewed the SPECT done of Frank Ferrante. In his expert opinion the SPECT was properly administered and is a valid study. (Deposition of Dr. Amen at page 29). Dr. Amen interpreted the SPECT. Dr. Amen was not asked to render a diagnosis of Frank Ferrante, nor did he attempt to provide one. However, he included in his report typical medical explanations for each of the abnormalities found and commented the abnormalities were often associated with brain trauma. At his video de bene deposition he was asked whether the complaints expressed by Mr. Ferrante and his mother were consistent with the abnormalities seen on SPECT, dr. Amen answered in the affirmative.

At his deposition, Dr. Amen acknowledged that one cannot make a diagnosis solely on the basis of an abnormal SPECT. Dr. Amen explained that one had to correlate the findings with the clinical history, examination and review of medical documentation. (Deposition of Dr. Amen at page 45-46). While Dr. Amen acknowledged that he wrote his papers to educate psychiatrists about the efficacy of using SPECT, he also explained that most psychiatrists do not treat brain injury(deposition of Dr. Amen at pages 47-48), a comment echoed

by Dr. O'Shanick at his video de bene esse deposition as well. (See deposition of Dr. O'Shanick starting at page 11).

Subsequently, the SPECT and Dr. Amen's report and opinions were reviewed by Drs. Greenwald, O'Shanick, Benson and Carper, who with clinical history, examination and review of medical documentation relied and utilized Dr. Amen's findings and opinions in formulating their own opinions and diagnoses. (A copy of Dr. Carper's note is attached as Exhibit W). There Dr. Carper, Frank Ferrante's present treating neuropsychologist wrote:

"I continue to follow Mr. Ferrante for counseling and psychotherapy for brain injury sequelae and related psychological issues and their impact on Frank's life and activities....

These observations are consistent with depression, for which he is at particular risk secondary to fronto-temporal brain changes noted in his medical history, for example on SPECT scan performed earlier." (Emphasis added).

1. **WHAT IS SPECT?**

"SPECT is an acronym for Single Photon Emission Computerized Tomography. SPECT is a sophisticated nuclear medicine study that looks directly at cerebral blood flow and indirectly at brain activity (or metabolism). In this study, a radioactive isotope (akin to a myriad of beacons of energy or

light) is bound to a substance readily taken up by the cells in the brain.

A small amount of this compound is injected into the patient's vein where it runs throughout the blood stream and is taken up by certain receptor sites in the brain. The patient then lies on a table for 14-16 minutes while a SPECT "gamma" camera rotates slowly around his head. The camera has special crystals that detect where the compound (signaled by the radioisotope acting like a beacon of light) has gone. A supercomputer then reconstructs 3-D images of brain activity levels. The elegant brain snapshots that result offer a sophisticated blood flow/ metabolism brain map. With these maps, physicians have identified certain patterns of brain activity that correlate with psychiatric and neurological illnesses.

SPECT studies belong to a branch of medicine called nuclear medicine. Nuclear (refers to the nucleus of an unstable or radioactive atom) medicine uses radioactively tagged compounds (radiopharmaceuticals), because the unstable atoms emit gamma rays when they decay acting like a beacon of energy or light from each location where they go. An unstable atom is always looking for stability, and it will keep changing or degrading, until it reaches its most stable form. At each step of decay, it emits a gamma ray (portion of energy). Scientists can detect those gamma rays with film or special crystals and can record an

accumulation of the number of beacons that have decayed in each area of the brain. These unstable atoms are tracking devices - they track which cells were most active and had the most blood flow and those cells which are least active and have the least blood flow.

Nuclear medicine studies measure the physiological functioning of the body, and they can diagnose a multitude of medical conditions: heart disease, certain forms of infection, the spread of cancer, and bone and thyroid disease. My own area of expertise in nuclear medicine, the brain, uses SPECT studies to help in the diagnosis of head trauma, dementia, atypical or unresponsive mood disorders, strokes, seizures, the impact of drug abuse on brain function and atypical or unresponsive aggressive behavior.

During the late 1970s and 1980s SPECT studies were being replaced often by the sophisticated anatomical CAT and later MRI studies. Resolving those studies was far superior to SPECT as far as seeing tumors, cysts and blood clots. They nearly eliminated SPECT studies altogether. Yet despite their clarity, CAT scans and MRIs could offer only images of a static brain, and its anatomy; they gave little or no information on the activity in a working brain. It was analogous to looking at the parts of a car's engine without turning it on. In the last decade it has become increasingly recognized that many

neurological and psychiatric disorders are not disorders of the brain's anatomy, but problems in how it functions.

Two technological advancements have encouraged the use, once again, of SPECT studies. Initially, the SPECT cameras were single-headed, and they took a long time to scan a person's brain (up to an hour). People had trouble holding still that long, and the images were fuzzy, hard to read (earning nuclear medicine the nickname "unclear medicine") and they gave little information about the functioning deep within the brain. Then multi-headed cameras were developed which imaged the brain much faster and with enhanced resolution. The advancement of computer technology also allowed for improved data acquisition from the multi-headed systems. The brain SPECT studies of today, with their higher resolution, can see into the deeper areas of the brain with far greater clarity and show what CAT scans and MRIs cannot - how the brain functions." (See Amen, Daniel included as part of Exhibit E).

2. SPECT IS GENERALLY ACCEPTED IN THE RELEVANT SCIENTIFIC COMMUNITY.

Defendants seek to bar the use of SPECT and to strike Dr. Amen's testimony based on his answer that psychiatrists do generally rely on SPECT. Defendants seek to limit the relevant community to psychiatry. As evidenced, the relevant community is much larger and robust, and is relied upon by radiologists,

neuro-imaging experts, neuroradiologists, neuropsychiatrists, neurologists, neuropsychologists and physiatrists. Several medical societies have issued guidelines for SPECT in brain imaging. The American College of Radiology which describes itself as the principal organization of radiologists, radiation oncologists, and clinical medical physicists in the United States, published its ACR Practice Guideline to perform Single-Photon Emission Computed Tomography (SPECT) Brain Perfusion Imaging in 2002 which became effective on January 1, 2003. The guideline was revised and updated in 2012. (A copy is attached as Exhibit X).

In its introduction, the ACR stated:

Single-photon emission computed tomography (SPECT) brain perfusion imaging using lipophilic radiopharmaceuticals that cross the normal blood brain barrier and localize in normal brain tissue **is a proven and useful procedure** to define the regional distribution of brain perfusion and evaluate a variety of brain abnormalities. (emphasis added)

Under indications for SPECT imaging, the ACR Practice Guidelines enumerate 11 **clinical** indications, including:

"7. Evaluating symptomatic traumatic brain injury, especially in the absence of CT and/or MRI imaging findings." (emphasis added)

The Society of Nuclear Medicine has likewise issued its Procedure Guideline for Brain Perfusion Single Photon Emission Computed Tomography (SPECT) Using Tc- 99m Radiopharmaceuticals, which guidelines were approved on February 7, 1999. (See Exhibit Y). The guidelines define SPECT as a technique for obtaining tomographic images of the 3-dimensional distribution of a radiopharmaceutical, which reflects regional cerebral perfusion. The declared purpose of the guideline assists nuclear medicine practitioners in recommending, performing, interpreting, and reporting the results of brain perfusion SPECT studies using Tc-99m radiopharmaceuticals.

Under the designation, "Common Indications", the guidelines list:

"A.4. Evaluation of traumatic brain injury. SPECT has shown perfusion abnormalities in traumatic brain injury despite normal morphology, and results are considered to have a prognostic value for persistence of neuropsychological sequelae." (Emphasis added).

The two preeminent medical societies in the United States directly and immediately concerned with nuclear medical imaging endorse SPECT as a technique to evaluate traumatic brain injury. The American College of Radiology and the Society of Nuclear Medicine represent the relevant

scientific community regarding SPECT and both have endorsed SPECT as a valid scientific technique to evaluate traumatic brain injury.

Further, the authors and editors of the guidelines of these two medical organizations comprise highly skilled radiologists and nuclear medicine specialists possessed of extensive clinical experience and research knowledge in the fields of nuclear medicine and imaging. In formulating these guidelines, these organizations were tasked with the responsibility of reviewing, evaluating, and considering all research literature available on the subject so that the guidelines formulated represented state of the art procedural standards. The guidelines of the American College of Radiology were supported by 24 citations to medical journal articles and the guidelines of the Society of Nuclear Medicine were supported by 10 such references which it described as a "concise bibliography." In response to the judicial inquiry of whether SPECT has been subjected to peer review and publication, the referenced guidelines are compelling evidence of both.

An additional factor to be considered in determining the reliability of any technique is whether there exist standards to control its operation. Both the ACR and SNM guidelines in meticulous detail the standards to be observed, the procedures to be followed in performing the scan, the manner

in which the results are to be interpreted, and how the results are to be reported. These guidelines evidence the highest degree of standards to be observed in performing SPECT scans, and the report of Dr. Hipskind clearly states that, "These procedure and practice guidelines are adhered to in all of our acquisition and processing protocols."

Not only do the United States' nuclear imaging societies endorse using SPECT to evaluate traumatic brain injuries, their European counterpart, the European Association of Nuclear Medicine's Procedure Guidelines for Brain Perfusion SPECT using 99m Tc-labeled Radiopharmaceuticals likewise endorses such use. (Attached as Exhibit Z). As stated in its Guidelines, issued on October 4, 2001,

Applied to the brain, SPET [single photon emission tomography] imaging can be used to assess various functions, among those cerebral perfusion plays a predominant role. This information is often complementary to the anatomic detail provided by structural neuroimaging techniques such as CT or MRI.

Under "Common Indications", the European Association lists:

"A.4. Evaluation of traumatic brain injury. SPECT has shown perfusion abnormalities in traumatic brain injury, despite normal morphology and results are considered to have a prognostic value.

The U.S. Department of Defense, Defense Centers of Excellence (DCoE) and the Defense and Veterans Brain Injury Center (DVBIC) have also endorsed the clinical use of SPECT. (See Exhibit J).

SPECT is also used at the Mayo Clinic to help diagnose or monitor brain disorders including head injuries. (A copy of the Mayo Clinic's web page is attached as Exhibit AA).

Dr. O'Shanick, medical director emeritus of BIAA, testified that he has used SPECT in his clinical practice for well over twenty-five (25) years. (See deposition of Gregory O'Shanick at pages 12-15; 68).

Dr. Greenwald, a board certified physiatrist relied on the SPECT on arriving at his diagnosis.

3. **SPECT WAS NOT USED ALONE TO DIAGNOSE FRANK FERRANTE. IT WAS USED IN CONJUNCTION WITH THE CLINICAL HISTORY, EXAMINATION AND REVIEW OF MEDICAL RECORDS.**

Defendants argue that SPECT by itself cannot be used to make a diagnosis. Not only did Dr. Amen agree but so do plaintiff's other experts. Like any test, it must be used with other clinical information.

Understanding the role of the SPECT evidence, like that of the DTI and NeuroQuant evidence, is the single most important point Plaintiff can make in this response. The SPECT evidence is not offered as being **diagnostic** of mild traumatic brain injury.

Where, as here, the blood perfusion pattern of a traumatic injury to the brain does not have a signature so unique that it is diagnostic of such exposure, i.e., no pathognomonic profile emerges, SPECT cannot be the definitive diagnostic test. Not that SPECT has nothing useful to contribute to the analysis. SPECT unquestionably can furnish information as to abnormalities in brain function which, when integrated into the history and clinical evaluation of the patient, can be of considerable value in assisting the physician in arriving at a final diagnosis.

But there is a vast difference between utilizing a SPECT scan to determine whether there is or is not an abnormality in brain function based upon blood perfusion versus utilizing a SPECT scan to make a diagnosis of traumatic brain injury. In the former, the SPECT scan provides evidence of brain abnormality from which - based upon other clinical evidence - a diagnosis can be made whether the cause of the abnormality is epilepsy, stroke, Alzheimer's, hypoxic event, or mild traumatic brain injury. In the latter, the SPECT scan, standing on its own, is utilized to assign a cause to the perfusion abnormality.

Here, no contention is made that SPECT is diagnostic of brain injury from a traumatic event. This position follows the

Procedure Guideline of the Society of Nuclear Medicine which points out that "patients will present with non-specific perfusion patterns which cannot be directly attributed to a specific disorder or causative agent." It also follows the position of the Society of Nuclear Medicine Brain Imaging Council which states that where the abnormal imaging pattern is nonspecific and cannot be readily ascribed to a single disease entity, there is not adequate evidence to support using SPECT to establish cause-and-effect relationships. SPECT is not being utilized to establish a cause-and-effect relationship.

But the inability of SPECT, standing alone, to make the diagnosis of mild traumatic brain injury does not render the technique scientifically invalid or its results irrelevant.

The evidence produced by the SPECT scan is only one bit of data to be utilized by the physician in making the ultimate determination of whether there was or was not a brain injury because of the motor vehicle crash.

4. THE RELEVANCE OF SPECT EVIDENCE.

Having in mind that the results of the SPECT scan are not being offered in and of themselves as the sole basis for diagnosing mild traumatic brain injury, the question turns to whether the results would be useful to the jury; i.e., would the evidence have any tendency to make the existence of any fact of consequence to determining the action more

probable or less probable than it would be without the evidence." The unequivocal answer is "yes."

Once a jury understands that decreased regional cerebral blood flow corresponds with reduced metabolic requirements of the brain indicative of damaged tissue and brain dysfunction, it is of considerable relevance to know whether there is objective, scientific evidence of decreased blood perfusion. It is of considerable relevance to know the pattern of decreased blood perfusion is "consistent" with the pattern seen in a mild traumatic brain injury. Evidence of decreased blood perfusion is not analytically different from the results of neuropsychological testing that discloses deficits in memory or learning. Neuropsychological test results that show impaired scores in memory or learning support an ultimate diagnosis of mild traumatic brain injury as decreased blood perfusion in certain areas of the brain support the inference of a mild traumatic brain injury consistent with a high speed crash. Both techniques provide bits of objective data which can be of assistance in making an ultimate diagnosis of brain injury due to the motor vehicle crash. Such information would be useful to the jury in determining a fact in issue, i.e., did Plaintiff sustain a brain injury because of the motor vehicle crash?

5. THE USE OF SPECT IS SUPPORTED BY THE MEDICAL LITERATURE.

Other factors to be considered by the court in determining the reliability of the technique under consideration are whether there exists specialized literature dealing with the technique and whether the technique has been subjected to peer review and publication.

Since its introduction into the medical community in the 1980s, brain SPECT imaging has been the subject of numerous articles dealing with research projects and its effectiveness in the assessment of brain function. The ACR and SNM guidelines reference 24 and 10 medical journal articles supporting using SPECT in evaluating traumatic brain injury. The guidelines themselves constitute specialized literature dealing with the technique.

In 2006, Dr. Amen performed a literature of SPECT and traumatic brain injury. Dr. Amen found 86 studies which he summarized and posted on his website. (A copy of that summary of the medical literature is attached as part of Exhibit E5).

Dr. Amen testified at his deposition he performed a more detailed search of the medical literature in 2013 and found over 400 articles supporting using SPECT in evaluating traumatic

brain injury (Dr. Amen has submitted his work for publication).

In 2012 Dr. Amen with Andrew Newberg, Director of Research at Thomas Jefferson Medical College, Philadelphia, Pa. and Manuel Trujillo, MD, from the Department of Psychiatry, NYU published an article entitled, "Specific Ways Brain SPECT Imaging Enhances Psychiatric Practice", Journal of Psychoactive Drugs, Vol.44, Issue 2 (2012). (A copy is attached as Exhibit E4). The article's abstract reads:

Our objective was to ascertain in a prospective case series how often brain single photon emission computed tomography (SPECT) neuroimaging adds relevant information for diagnosis and/or treatment beyond current standard assessment tools in complex psychiatric cases. Charts of 109 consecutively evaluated outpatients from four psychiatrics clinics that routinely utilize SPECT imaging for complex cases were analyzed in two stages. In stage one, psychiatrists reviewed detailed clinical histories, mental status exams, and the Structured Clinical Interview for DSM-IV, but not the results of SPECT studies, assigned a diagnosis based on DSM-IV criteria, and then developed a comprehensive treatment plan. In stage two, evaluators were given access to the SPECT studies for each patient. The addition of SPECT modified the diagnosis or treatment plan in 78.9% (n = 86; rated level 2 or 3 change) of cases. The most clinically significant changes were undetected brain trauma (22.9%), toxicity patterns (22.9%) and the need for a

structural imaging study (9.2%). Specific functional abnormalities were seen as follows that potentially could impact treatment: temporal lobe dysfunction (66.1%) and prefrontal hypoperfusion (47.7%).

Utilization of SPECT in brain imaging has been the subject of considerable research and peer-reviewed medical journal articles. SPECT is not a new technique. It has been utilized in evaluating traumatic brain injury since the 1980s, but more intensively since the 1990s when specially-designed radiopharmaceuticals that have an affinity for brain tissue were approved by the FDA. Both nuclear medicine societies in the United States endorse SPECT to evaluate traumatic brain injury, as does DCoE and DVBIC. It is an established technique. The data supporting the usefulness of SPECT brain imaging in the assessment of brain injury is extensive and includes numerous medical articles published in peer-reviewed journals.

**6. SPECT HAS BEEN ADMITTED IN NUMEROUS CASES
THROUGHOUT THE UNITED STATES.**

The admissibility of SPECT has been the subject of numerous court decisions throughout the United States. Below is but a sample of decisions admitting SPECT into evidence.

In Fini v. General Motors Corporation, 2003 WL 1861025 (Mich. App. 2003) (a copy is attached as Exhibit BB1), plaintiff sustained a traumatic brain injury in a motor vehicle crash.

Plaintiff submitted proof of injuries based on SPECT scan evidence. Plaintiffs introduced several affidavits and transcripts of deposition testimony from physicians, psychologists and psychiatrists in the surrounding medical community to support the proposition that SPECT has been recognized within the medical and psychological communities as a reliable tool for assisting in the diagnosis of mild traumatic brain injury. The trial Court found SPECT evidence was admissible and reliable under "the general acceptance standard." The Michigan Appellate Court held that the trial judge did not abuse his discretion in allowing the evidence.

In Donnellan v. First Student, 891 N.E. 2d 463 (Ill. App. 2008), (a copy is attached as Exhibit BB2), plaintiff sought to introduce SPECT to support his expert's testimony that plaintiff sustained a traumatic brain injury because of an automobile/bus collision. SPECT was introduced by the plaintiff to show the SPECT was consistent with brain damage and plaintiff's treating physicians testified as to such scan in treatment.

Plaintiff presented the testimony of Dr. Dan G. Pavel, who testified that he was board certified in nuclear medicine. Pavel testified that he was currently affiliated with the University of Illinois at Chicago Hospital as a professor and had served an 11-month sabbatical with the National Institute of Health from 1995 to 1996. Dr. Pavel testified about the relationship of

blood flow to the function of the brain and the SPECT that was administered in September 2004. Pavel testified at length about symptoms that result from decreased function in different areas of the brain.

Dr. Gary M. Yarkony, board certified in physical medicine and rehabilitation since 1982, first saw plaintiff on July 12, 2002. Yarkony suspected that plaintiff was suffering from a brain injury, including a cranial nerve injury that was causing a problem with plaintiff's eye muscle. Yarkony stated that this type of injury is typically associated with traumatic brain damage and he ordered an MRI of plaintiff's brain. Yarkony testified that the MRI did not demonstrate any issues and he utilized the later SPECT scan, which identified a brain injury, in his diagnosis.

Plaintiff presented the evidence deposition of Dr. J. Jerry Rodos, a board certified osteopathic physician practicing psychiatry, who first saw plaintiff on August 24, 2006. Rodos prescribed a brain SPECT scan to help determine what was happening in plaintiff's brain. Rodos testified Dr. Pavel found that plaintiff's SPECT scan revealed a pattern of blood flow consistent with a traumatic brain injury.

Dr. Robert Kohn, a neuropsychiatrist and board-certified neurologist, testified that he saw plaintiff in January and April of 2005 as a consulting physician at Rodos' request. Kohn

testified he had experience in using SPECT scans and that he had authored several articles with Pavel on the subject.

In upholding the admission of the SPECT scan, the Court held:

We believe that, even if the trial court followed *Daubert*, as defendant contends would have been proper, its motion *in limine* would still have been properly denied. Id. at 481.

Plaintiff's expert testified that SPECT scans were in wide use throughout the profession, and baseline images are presented in medical schools teaching this technology. Three (3) additional doctors testified to using SPECT scans in this type of case.

In Matuszak v. Cermniak, 805 NE 681 (2004) (a copy is attached as Exhibit BB3), Plaintiff brought a medical malpractice action against his treating physician and hospital for damages allegedly sustained during a colonoscopy procedure. The trial court entered judgment on a jury verdict for defendants, and plaintiff timely appealed. In this appeal, plaintiff presents only one issue for review: Whether the trial court committed reversible error in allowing defendant's expert witness to render speculative opinions regarding the possible causes of his injury.

As part of his treatment, plaintiff underwent a SPECT exam at Loyola Medical Center in Chicago, Illinois. The scan showed

diminished blood flow in the temporal lobe and parietal area of plaintiff's brain. Defendant's causation expert reviewed plaintiff's clinical test results, including the SPECT scan results and the Mayo Clinic differential diagnosis. The Court found his testimony did not abuse its discretion in admitting the testimony.

In Baxter v. Ohio Dept. of Transp., No. 02AP-537, 2002 WL31838505 (Ohio App. 10 Dist. 2002) (a copy is attached as Exhibit W4), plaintiff was involved in a motor vehicle collision. Plaintiff sought to introduce SPECT to show diminished brain activity causing memory and attentional problems, and the lack of improvement. The Ohio Appellate Court found that the trial Court's exclusion of expert testimony regarding the causal link between the accident and injury based on SPECT was reversible error. The Court found that SPECT evidence should not have been disregarded.

In Berry v. CSX Transp., Inc., 709 So. 2d 552 (Fl. App. 1998), (a copy is attached as Exhibit BB5), a Federal Employer's Liability Act claim, a railroad worker was exposed to numerous toxic solvents and asbestos. Plaintiff claimed toxic encephalopathy because of this exposure. The Court excluded evidence offered by plaintiff's treating physician, who relied on SPECT to show brain damage consistent with toxic encephalopathy. On appeal, the Florida Appellate Court reversed

and remanded, finding under *Frye* and its Florida progeny, if an opinion is well-founded and based on accepted scientific principles and methods, it is unnecessary that opinions be generally accepted as well.

In Kennedy v. Eden Advanced Pest Technologies, 193 P. 3d 1030 (Or. App. 2008), (a copy is attached as Exhibit BB7), plaintiff, with extreme chemical sensitivity, retained defendant to exterminate ants after being advised of the availability of a non-toxic agent. The trial Court excluded the testimony of plaintiff's expert, who asserted that the chemical applied aggravated a pre-existing condition. Plaintiff's expert relied on SPECT to rule out other causes like schizophrenia and depression. On appeal, the Oregon Appellate Court held that excluding plaintiff's expert and SPECT scan evidence, and dismissal of plaintiff's claim was in error.

Similarly, in Rhilinger v. Jancies, 1998 WL 118 2058 (Mass. Super. 1998), (a copy is attached as Exhibit BBW6), plaintiff alleged she developed toxic solvent encephalopathy from chemicals stored illegally in the basement of her apartment building. Plaintiff sought to introduce SPECT to show brain damage consistent with toxic exposure and to disprove other potential causations. The Court found there was no dispute that SPECT scans show abnormalities in brain function. The plaintiff did not offer to show the existence or absence of toxic

exposure, but was reasonably used as one of a "constellation of diagnostic tools" used and considered by the experts consistent with their conclusion of toxic exposure damage.

Of note, during the cross-examination of defendant's expert, the expert conceded a SPECT scan is an appropriate technique by which to diagnose brain injuries. Id. at 1038.

In reaching its decision the Court noted:

"Our approach to that issue is informed by the Oregon Supreme Court's admonishment that a difference of opinion in a scientific community alone is insufficient to exclude evidence from the jury's consideration:

"[C]ontroversy within the scientific community is not necessarily a ground for exclusion of scientific evidence. In deciding whether to admit scientific evidence, a court need not resolve disputes between reputable experts; the evidence may be admissible even though a dispute exists. * * * [T]he witness who testifies to an expert opinion is subject to cross-examination concerning how he or she arrived at that opinion, and the cross-examiner is to be given 'great latitude' in eliciting testimony to vitiate the opinion." State v. Lyons, 324 Or. 256, 278-79, 924 P.2d 802 (1996) (quoting Bales v. SAIF, 294 Or. 224, 235 n. 4, 656 P.2d 300 (1982)).

The case of Lanter v. Kentucky State Police, 171 S.W. 3d 45 (Ky 2005) illustrates the general acceptance of SPECT. (A copy is attached as Exhibit W8), both plaintiff's and defendant's experts relied on SPECT.

There, one of plaintiff's physicians, Dr. Pagani, who is board-certified in neurology and emergency medicine, treated the claimant several times between April 18 and October 17, 2002. His December, 2002, report noted the history of injury followed by symptoms that included headache, confusion, disorientation, loss of memory, hypersomnia, and psychomotor retardation. He noted that the medications Dr. D'Souza prescribed had helped. After performing various diagnostic tests, including a brain MRI, EEG, and brain SPECT, Dr. Pagani diagnosed a cerebral contusion with post-concussive syndrome.

The defendant employer submitted a report based on neuropsychiatric evaluation by Dr. Granacher, who is board-certified in both neurology and psychiatry. Dr. Granacher obtained a detailed history and performed both physical and mental status examinations. He ordered extensive neuropsychological, intellectual, achievement, and personality testing. He also ordered a SPECT scan, which revealed functional defects in the right parietal and left occipital lobes of the claimant's brain.

A similar result from the same court can be found in Gammad v. ATP Agri-Services, Inc., Case No. 2010CA000085 (12th Jud Cir., Desoto County Fl. May 30, 2012). (A copy is attached as Exhibit PP),

7. Conclusion

Plaintiff has established by expert testimonial, peer-reviewed articles, standards of the applicable professional societies and case law that SPECT is scientifically valid and used by experts in numerous fields. As such SPECT should be admitted in this case.

E. MRI VOLUMETRY (NEUROQUANT) SATISFIES THE ADMISSIBILITY STANDARD IN NEW JERSEY.

Although defendants have not raised an objection to the admissibility of NeuroQuant, plaintiff will address its scientific validity so that there is a complete and accurate record regarding its validity.

While a patient at the brain injury rehabilitation program in Virginia Beach, Va., Frank Ferrante underwent a NeuroQuant evaluation. (See Exhibit C). That diagnostic test was later interpreted by Gregory O'Shanick, MD, a board certified neuropsychiatrist, Medical Director Emeritus of the Brain Injury Association of America and the author of numerous peer reviewed articles and chapters. (See Exhibit D).

Dr. O'Shanick utilized the NeuroQuant, SPECT and DTI with his clinical history and examination and his review of the medical records to reach an opinion as to his diagnosis of the injuries Frank Ferrante sustained in the June 1, 2008 crash involving the defendants. (See exhibit D).

1. WHAT IS NEUROQUANT?

"Decades of research and dozens of peer-reviewed publications have shown that traumatic brain injury (TBI) causes brain atrophy (for recent reviews, see (Bigler 2005; Bigler 2011)) Anderson, "Ventricular Dilation, Cortical Atrophy and Neuropsychological Outcome Following Traumatic Brain Injury," the Journal of Neuropsychiatry and Clinical Neurosciences 1995; 7:42-48 (Patients With TBI Had Significant Changes in Putamen/Globus Pallidus) and Wilde, et al., "Hippocampus, Amygdala and Basal Ganglia Morphometrics Children After Moderate to Severe Traumatic Brain Injury," Developmental Medicine and Child Neurology 2007, 49:294-299).

Despite the advances in the research settings, MRI brain volumetry was not available in routine clinical practice. However, technological advancements have remedied this situation. In the early years of structural brain imaging (1970s to 1980s), computed tomography (CT) scans and magnetic resonance imaging (MRI) scans were interpreted by visual inspection of the images. In the 1990s, researchers used computer-assisted methods to measure brain MRI volume. However, volumetry was laborious and time-consuming, and therefore limited to well-funded research settings.

2. DEVELOPMENT OF FREESURFER AND NEUROQUANT®.

In the early 2000s, researchers developed more automated, computer-based methods for measuring brain volume. Foremost among these was FreeSurfer, software which was (as the name implies) free and allowed the computer to automatically identify and measure brain regions, greatly enhancing the utility of volumetry. However, as public domain software, FreeSurfer is prohibited from being used commercially, markedly limiting its application in typical clinical settings.

In response to this limitation of FreeSurfer, in the mid-2000s, scientists and clinicians at CorTechs Labs developed NeuroQuant®, as essentially the portion of FreeSurfer which measured brain volume, customized for application in commercial settings (Birk 2009; Fischl 2011). To test the reliability and validity of NeuroQuant®, CorTechs Labs needed a sizable amount of normal control data collected using scientifically rigorous methods. Fortunately, other researchers were working to standardize MRI methods to optimize data collection and analysis and to encourage collaboration between researchers. The leading project has been the Alzheimer's disease Neuroimaging Initiative (ADNI), a consortium of researchers who collected MRI data and provided them for use by other researchers or clinicians. Although focusing on Alzheimer's disease, this project included

data from normal control subjects which could compare to data from other neuropsychiatric patients.

A critical first step in the ADNI project was developing a standardized image acquisition protocol that would be robust to intersite variation and would maximize the contrast between gray and white matter in the brain, an important consideration for automated image analysis algorithms (Jack_Jr, Bernstein et al. 2008). The ADNI data allowed for testing the reliability and validity of NeuroQuant® (Brewer 2009). In 2007, NeuroQuant® was cleared for marketing by the US FDA [510(k) K061855] as a medical device to measure brain MRI volume in human subjects (<http://www.cortechs.net/products/neuroquant.php>). The FDA found NeuroQuant® was highly reliable with the earlier, gold-standard approach based on computer-assisted, manual identification of brain regions. With the FDA's ruling it was essentially a "brain ruler," its use is not restricted to any patient subgroup and it can be used in normal control subjects, patients with TBI, or other patients.

NeuroQuant® was a major breakthrough for at least two reasons: (1) it reduced the time needed to identify brain regions from over 15 hours to 15 minutes, greatly enhancing its practical utility; and (2) since it is commercially available, it applies in typical clinical settings, unlike the vast majority of previous approaches.

3. NEUROQUANT SATISFIES THE STANDARD OF RELIABILITY AND VALIDITY.

Besides the data supporting the FDA application for NeuroQuant®, several published peer-reviewed studies support the reliability and validity of NeuroQuant® and its congener, FreeSurfer, for measuring brain volume in neuropsychiatric patients and normal control subjects.

As expected, given their close relationship, NeuroQuant® has been found to be reliable when compared with FreeSurfer (Kovacevic, Rafii et al. 2009). NeuroQuant® has been found to be reliable with a computer-supported manual technique using NeuroMorphometric software (Brewer, Magda et al. 2009). Also, the segmentation error rate of NeuroQuant® was found to be low (9 out of 822) (Heister, Brewer et al. 2011).

NeuroQuant® has been found to be valid in assessing Alzheimer's disease (Brewer, Magda et al. 2009; Heister, Brewer et al. 2011) and TBI (Ross, Ochs et al.)

The latter was the report of a patient with mild TBI who had hippocampal atrophy and impaired short-term memory. Similarly, FreeSurfer has been found to be valid in assessing Alzheimer's disease (McEvoy, Holland et al. 2011) and TBI (Merkley, Bigler et al. 2008; Bigler, Abildskov et al. 2010; McCauley, Wilde et al. 2010; Strangman, O'Neil_Pirozzi et al. 2010; Warner, Youn et al. 2010; Hudak, Warner et al. 2011).

The study by Warner et al (Warner, Youn et al. 2010) used a longitudinal design (obtaining over one brain scan) for assessing brain atrophy in TBI. A recent review of the literature found the longitudinal design was more powerful than the cross sectional design (obtaining only one scan) for detecting brain volumetric differences between normal controls and patients with TBI (Ross 2011). Besides a consistent pattern of progressive atrophy, the review found several studies in which greater rates of brain atrophy correlated with worse vocational outcome in patients with TBI (Ding, Marquez_de_la_Plata et al. 2008; Warner, Youn et al. 2010; Xu, McArthur et al. 2010).

The underlying principle that TBI causes brain atrophy is not subject to dispute. The idea that losing brain volume can be measured reliably and validly in persons with TBI has been supported by 30 years of scientific study. However, until developing computer-automated programs like FreeSurfer and NeuroQuant®, the measurement was time-consuming and impractical for routine use. Neuro-Quant® has made an accepted technique easier and quicker. It is a "brain ruler."

Several published peer-reviewed studies (described below) support the reliability and validity of NeuroQuant® and its congener, FreeSurfer, for measuring brain volume in neuropsychiatric patients and normal control subjects.

Because the core process of NeuroQuant® is fully computer-automated, its test-retest reliability on a single set of MRI images is 100 % (verbal communication in 2010, Kora Marinkovic, CorTechs Labs). In a study of hippocampal volume, NeuroQuant® was found to be reliable when compared with FreeSurfer (Kovacevic, Rafii, & Brewer, 2009), as expected, given the close relationship between the two software programs. NeuroQuant® has been found to be reliable with a computer-supported manual technique using neuroMorphometric software (Brewer, Magda, Airriess, & Smith, 2009).

The segmentation error rate (defined as the number of inaccurately identified brain regions divided by the total number of identified brain regions) of NeuroQuant® was found to be low (9 errors out of 822 brain regions identified) (Heister, Brewer, Magda, Blennow, & McEvoy, 2011). The test-retest reliability of NeuroQuant® was examined in a group of 20 normal controls subjects (Ross, Ochs, Seabaugh, & Henshaw, 2012a). In that study, 20 regions (19 brain regions and intracranial volume) were measured for each subject on two (separate) occasions.

Analyses showed excellent reliability for all regions except the ventral diencephalon, which showed fair to poor reliability. The latter study was conducted on a single platform (Dell PowerEdge 1950 computer, CentOS5 operating system) with a

single software program (NeuroQuant®). Other reports of reliability suggest that, if volumetry studies are conducted on different computing platforms or with different versions of software (e.g., FreeSurfer software), reliability should be tested across those platforms or software versions (Jovicich et al., 2009; Gronenschild et al., 2012).

David A. Ross, MD is a neuropsychiatrist in Virginia and one of the most prolific researchers on the use of NeuroQuant and TBI. His articles are considered to be authoritative. (See deposition of Gregory O'Shanick at page 83). The first study by Ross et al. was a case report using NeuroQuant® in a patient with mild TBI who had hippocampal atrophy and impaired short-term memory (Ross et al., 2012a). (A copy is attached as Exhibit CC1). The second study by Ross and colleagues was a group study using the longitudinal design to test the reliability and validity of NeuroQuant® in TBI (see discussion of longitudinal MRI studies below) (Ross et al., 2012b). (A copy is attached as Exhibit CC2). The third study by Ross et al. examined a sample of 20 outpatients with mild or moderate TBI and found NeuroQuant® was more sensitive for detecting signs of atrophy than the attending radiologists' traditional technique based on simple visual inspection (Ross et al., 2012c); the radiologists found atrophy in 10.0 % of patients, whereas NeuroQuant® found

atrophy in 50.0 % of patients (P00.02). (A copy is attached as Exhibit DD3).

Similarly, FreeSurfer has been found to be valid in assessing Alzheimer's disease (McEvoy et al., 2011) and TBI (Merkley, Bigler, Wilde, McCauley, Hunter, & Levin, 2008; Bigler et al., 2010; McCauley et al., 2010; Strangman, O'Neil Pirozzi, Supelana, Goldstein, Katz, & Glenn, 2010; Warner et al., 2010; Hudak et al., 2011). Two of the studies above used a longitudinal design (obtaining over one brain scan per subject over time) for assessing progression of brain atrophy in TBI (Warner et al., 2010; Ross et al., 2012b). A recent review of the literature found the longitudinal design was more powerful than the cross-sectional design (obtaining only one scan) for detecting brain volumetric differences between normal controls and patients with TBI (Ross, 2011). Besides a consistent pattern of progressive atrophy, the review found several studies in which greater rates of brain atrophy correlated with worse vocational outcome in patients with TBI (Ding et al., 2008; Warner et al., 2010; Xu et al., 2010).

The primary findings of the review paper recently were replicated in a group of mild TBI patients using NeuroQuant® (Ross et al., 2012b). In that study, 16 patients with mild TBI were compared to 20 normal controls. Vocational outcome was assessed with the Glasgow Outcome Scale-Extended and Disability

Rating Scale. That study found that patients with TBI had progressive atrophy over 2 years, on average, after injury. Consistent with the findings from the review paper, greater rates of atrophy were associated with inability to return to work or to return to normal relationships with family and friends.

Regarding NeuroQuant's acceptance in the general community, the most important indicator is its approval by the U.S. FDA in 2007[510(k) K061855]. Since then, its use has grown steadily. Neuro-Quant® is used in over 40 clinics and radiology centers across the USA. Another indicator of its acceptance by the general community is its coverage by Medicare, which often serves as a guide for coverage by other health insurance programs. Regarding insurance coverage for volumetric MRI (including NeuroQuant®), the Center for Medicare and Medicaid Services recommends that physicians use CPT code 76377. During the past few years, Medicare reimbursement for the additional post-processing has been consistently supported (McEvoy & Brewer, 2010), making it practical to use NeuroQuant® in clinical settings.

Regarding the five Daubert factors discussed above, the following conclusions can be made. NeuroQuant® is based on the tested and well-accepted theories that the brain atrophies after TBI, and the extent of atrophy can be measured. It improves upon

previous techniques because it is faster and more practical. Its reliability and validity have been supported by numerous peer reviewed publications. Its error rate has been tested and found to be low. Its use requires maintenance of certain standards and controls, including visual inspection of the segmented brain images; but such standards have been found to be relatively easy to achieve. Its general acceptance in the scientific community has been evidenced by its FDA approval and growing use among centers across the U.S.A. These data provide an adequate basis for the admissibility of NeuroQuant® under federal law and under the many state law standards modeled on the federal approach."

(See Review of the Evidence Supporting the Medical and Legal Use of NeuroQuant® in Patients with Traumatic Brain Injury. DE Ross, TJ Graham, AL Ochs - Psychological Injury and Law, 2013 attached as Exhibit CC4).

Dr. Ross, the author of the four articles attached as Exhibit DD1-4, was a student of Dr. O'Shanick. Dr. O'Shanick testified that he uses NeuroQuant everyday in his clinical practice. (See deposition of Gregory O'Shanick at page 21).

Volumetric structural analysis is also utilized at the Hospital of the University of Pennsylvania (Penn Medicine). (See report of Rubin C. Gur, Ph.D. attached as EXHIBIT R).

4. CONCLUSION

Plaintiff has produced both scholarly literature and expert testimony regarding the scientific validity of NeuroQuant. Furthermore, defendants have produced nothing by way of either medical literature or expert testimony to shed any doubt on its validity. As such, it should be admitted.

F. DEFENDANTS' HAVE PRODUCED NO COMPETENT TESTIMONY OF LITERATURE TO DISPUTE THE VALIDITY OF DTI, SPECT AND NEUROQUANT.

Defendants rely on the opinions expressed by Elizabeth Post, M.D., a retired neurosurgeon now living in Florida. While plaintiff has no criticism of Dr. Post's credentials as a neurosurgeon, by her own admission, Dr. Post is not an expert in neuroimaging or in DTI in particular.

Dr. Post began her clinical neurosurgical practice in 1985, at which time she performed both spinal and brain surgeries. However, in 1995, Dr. Post ceased performing brain surgery, limiting her neurosurgical practice to the spine. In 2006, Dr. Post retired from active medicine and moved to Naples, Florida with her husband who had retired. Since moving to Florida, Dr. Post has provided pro-bono medical services to a walk-in clinic in Naples, Florida. Approximately once every month, Dr. Post returns to New Jersey/Pennsylvania, where she spends a week examining approximately fifteen claimants at the request of

defense attorneys and insurance companies. As such, Dr. Post has not treated patients with brain injuries for approximately the past nineteen years. By her own admission, Dr. Post is not an expert in the field of neuroimaging and specifically not in diffusion tensor imaging, SPECT or NeuroQuant. A review of her CV, demonstrates that she has never published nor lectured on the topic of mild traumatic brain injury. She belongs to no organizations or societies whose main emphasis is mild traumatic brain injury.

Dr. Post rendered a report dated February 14, 2013. She reviewed various medical records, did a physical examination and an extremely brief mental status exam. Plaintiff has no objection to her testifying as to her impression (p. 26) and the basis for her impression. Likewise, plaintiff has no objection to Dr. Post criticizing the opinions of others or explaining why she does not believe that Mr. Ferrante sustained a traumatic brain injury.

On page 28 of her February 14, 2013 report, regarding SPECT, Dr. Post states:

While SPECT scanning seems to hold promise in the diagnosis of traumatic brain injury on the basis of cerebral blood flow measurements, its diagnostic value has not been established in peer-reviewed medical literature. At the moment this type of brain imaging is considered to be an experimental research tool, not a reliable diagnostic tool. The importance of the small decreases

in activity seen in the frontal and temporal lobes of Mr. Ferrante is not clear, but is certainly not 'proof' of a traumatic brain injury.

Regarding the diffusion tensor imaging, Dr. Post writes:

In his expert report, Dr. Benson points to the Diffusion Tensor Imaging that showed abnormalities in Mr. Ferrante's cerebral white matter as proof of a traumatic brain injury, but Diffusion Tensor Imaging is generally used to delineate demyelinating disease, not trauma. As with SPECT scanning, this is a new imaging technique and the significance of its findings in determining whether or not there has been a traumatic brain injury has not yet been proven. It is currently a research tool, and the validity of its findings is yet to be accepted in peer-reviewed publications. (p. 29)

In response to that report, plaintiff requested copies of the "peer-reviewed" articles referred to in Dr. Post's report.

In response, Dr. Post writes:

There apparently has been some misunderstanding. In the discussion section of my report, I stated that SPECT scanning has not been established as a definitive radiologic test to evaluate cerebral trauma and that the role for Diffusion Tensor Imaging to assess traumatic brain injury has not been accepted as a standard study in the medical literature. The point of these comments is that there are no peer-reviewed articles establishing the efficacy of these studies to date. In fact, if Mr. Stern has peer-reviewed literature that establishes these two methodologies as standard, reliable and recommended methods to assess brain injury, I would be interested in seeing them as I was unable to find any.

There are hundreds of articles supporting using DTI, SPECT and NeuroQuant. Despite this voluminous amount of literature, Dr. Post could find none of it. In response to Dr. Post's April 20, 2013 letter, defendants were provided with the Affidavit of Randall Benson, M.D., which listed numerous peer-reviewed articles regarding diffusion tensor imaging and traumatic brain injury. Defendants have also been provided with the research of David Ross, M.D., regarding NeuroQuant, and were provided with the curriculum vitae of Daniel Amen, M.D., which outlined the multitude of papers he has published in peer-reviewed journals regarding SPECT and traumatic brain injury.

In response to plaintiff's counsel's letter and attachments, Dr. Post authored her third and final letter dated August 20, 2013.

On the third page of her August letter, Dr. Post cites to the article from Michael Lipton, discussed earlier, entitled "A Decade of DTI and Traumatic Brain Injury: 10 Years and 100 Articles Later." (A copy is attached as Exhibit K3). As clearly stated in that article, the peer-reviewed literature supports the clinical use of DTI.

The Court has been provided with the sworn deposition testimony of Michael Lipton, and his affidavit in other litigated matters, providing his opinion that DTI is appropriate for clinical use.

Dr. Post's lack of qualification to discuss the scientific validity of DTI and SPECT, which is evidenced by her need to "query" a neurologist at Thomas Jefferson University in Philadelphia who specializes in cognitive disorders. The neurologist, Mijall Serruya, is a neurologist who has been practicing for a mere two years. It is interesting Dr. Post did not contact Andrew Newberg, M.D., Director of Research at Thomas Jefferson, who is one of the leading experts in the field and use of SPECT and traumatic brain injury. (His papers have been cited above as well). Nevertheless Dr. Surreya advised that DTI is used at Jefferson.

Likewise, Dr. Post indicates she has "personal knowledge of the neurology training program at NYU-Langone Medical Center and knows that interpretation of DTI is not being emphasized in their neurology residency program and is not considered part of the routine, diagnostic work-up for patients with traumatic brain injury." What is clear is that Dr. Post, as a retired neurosurgeon doing defense medical examinations for ExamWorks and other defense companies to supplement her retirement income, is unfamiliar with present-day clinical treatment in the diagnosis and treatment of patients with traumatic brain injury.

After being confronted with numerous medical literature citations, affidavits from various experts in the field of neuroimaging, positions of numerous medical associations and

societies, and evidence of the use of DTI at some of the top hospitals in the United States (many of which documents are attached as exhibits to this opposition brief), Dr. Post attempted at her deposition (a copy of which is attached as Exhibit DD), to deflect such overwhelming evidence, arguing that DTI and SPECT were not used at the hospitals for which she was familiar. However, even this statement is inaccurate. Finally, at the end of her deposition, Dr. Post acknowledged that her real criticism of SPECT and DTI was that these neuroimaging objective tests should not be used as the sole basis of a diagnosis of traumatic brain injury. (See the deposition of Elizabeth Post, MD at pages 86-87).

The majority of the criticism of Drs. Post seems to be that these tests, in isolation, cannot identify the cause of the abnormality. As indicated earlier, plaintiff does not disagree. Many tests lack specificity. That is why it is not unusual to see the note: "clinical correlation required". In making a diagnosis, a clinician must look at all available data and make a differential diagnosis.

As outlined above, defendants have built a straw man to knock down, as not one of plaintiff's experts based their diagnosis solely on these objective diagnostic tests. Rather, SPECT, DTI and NeuroQuant were relied on and were only a piece of the mosaic of evidence that plaintiff's experts relied upon

in arriving at their opinion that Frank Ferrante sustained a traumatic brain injury as a result of the crash of June 1, 2008. Drs. Greenwald, O'Shanick and Benson did just that. They relied on all of the information to make their diagnosis. That defendants' physicians disagree and reach a different diagnosis is not surprising. That they disagree with plaintiff's experts is what trials are all about and why we have juries.

G. DR. AMEN'S OPINION THAT PLAINTIFF'S COMPLAINTS ARE CONSISTENT WITH THE ABNORMALITIES FOUND ON SPECT IS ADMISSIBLE.

Defendant moves to strike a portion of Dr. Amen's de bene esse deposition, arguing that his opinion that the abnormalities found on SPECT are consistent with the subjective complaints expressed by Mr. Ferrante and of those of his mother's are based on facts not in the record. This argument is without merit.

As noted by defendants in their brief (page 12), Dr. Amen's deposition was taken before any other evidence was solicited. Subsequently the de bene esse deposition of Dr. O'Shanick was completed. There, Dr. O'Shanick introduced the facts which formed the basis for the hypothetical provided to Dr. Amen. Furthermore, neither Mr. Ferrante nor his mother has testified. To strike Dr. Amen's answer to a hypothetical before the completion of evidence is premature.

As acknowledged by defendants, an expert opinion based on hypothetical facts will not be characterized as a net opinion,

as long as those facts are in evidence in the case. The facts are in the case and such facts will be further amplified when the Ferrantes' testify.

H. THE TESTIMONY OF GREGORY O'SHANICK IS NOT MISLEADING.

Defendants argue that Dr. O'Shanick's testimony is misleading and therefore will not aid the jury. In support defendants quote from one passage of Dr. O'Shanick's testimony. (pages 89-91). Plaintiff is hard pressed to understand what is confusing or misleading about Dr. O'Shanick's answers.

I. A Rule 104 HEARING IS UNNECESSARY.

Defendants have requested a Rule 104 hearing. That request should be denied as it is time consuming and a waste of the parties' and Court's resources. Plaintiff has already completed the de bene esse depositions of Drs. O'Shanick and Amen. The only expert whom plaintiff would call at a 104 hearing would be Dr. Benson. Plaintiff has provided in the exhibits attached to this brief, the detailed affidavit of Dr. Benson as well as the deposition transcript of Dr. Post. It is unlikely that actual testimony of either will deviate. More importantly plaintiff has produced overwhelming evidence to support the validity of these diagnostic tests and defendants have cited to no literature or case decisions in opposition.

Where there is a challenge to the admissibility of proffered evidence or a proffered witness, the challenging party must make a threshold showing that an arguable issue exists as to that evidence before there is justification for a full preliminary hearing under N.J.R.E. 104. *State v. Long*, 119 N.J. 439, 487 (1990) and *State v. Ortiz*, 203 N.J. Super. 518, 522 (App. Div.), certif. den. 102 N.J. 335 (1985).

Here defendants have failed to make the threshold showing that an arguable issue exists. No hearing is required or necessary.

J. CONCLUSION

This Court should deny the Defendants' Motion to Exclude Evidence Related to DTI, SPECT and NeuroQuant. DTI, SPECT and NeuroQuant are generally accepted in the relevant scientific community, as amply illustrated by the voluminous peer reviewed literature, for diagnosing abnormalities in the brain. DTI, SPECT and NeuroQuant are demonstrably reliable, as the methodology described in peer reviewed articles, in clinical practice throughout the country and used by the United States Military to assist in diagnosing and treating mTBI. When courts have considered the general acceptance and/or reliability of DTI and SPECT they have unanimously found the evidence admissible with the proper expert and the literature made available to

them. The defense has not been able to identify one single case where DTI evidence was excluded under any test of admissibility.

For the above stated reasons, this Court should find DTI, SPECT and NeuroQuant evidence reliable and deny the defendants' motion.

Plaintiff's experts, all well qualified in their fields have testified that DTI, SPECT and NeuroQuant are used in the diagnosis of traumatic brain injury. As such defendant's motion must be denied in its entirety.

Respectfully submitted,

STARK & STARK
A Professional Corporation
Attorneys for Plaintiff

By: _____
BRUCE H. STERN

Dated: April 3, 2014

STATE OF MICHIGAN
COURT OF APPEALS

ANGELA R. FINI,

Plaintiff-Appellee/Cross-Appellant,

v

GENERAL MOTORS CORPORATION and
JIMMY FREDERICK HILL,

Defendants-Appellants/Cross-
Appellees.

UNPUBLISHED

April 8, 2003

No. 227592

Oakland Circuit Court

LC No. 97-538608-NI

Before: Cooper, P.J., and Murphy and Kelly, JJ.

PER CURIAM.

A jury awarded plaintiff damages of approximately \$4.26 million after trial in this automobile negligence case. On January 13, 2000, the trial court entered a judgment for plaintiff in the amount of \$2,615,000.¹ On May 5, 2000, the trial court entered an order denying defendants' motion for a new trial, but granting their motion for remittitur with respect to plaintiff's economic losses. Defendants appeal as of right from the trial court's January 13, 2000 judgment. Plaintiff cross-appeals from the trial court's subsequent grant of remittitur. We affirm in part and reverse in part.

I. Facts

On May 9, 1996, defendant Hill worked for General Motors Corporation (GM) at its proving ground in Milford. Defendant Hill testified that he left work at approximately 4:00 p.m. and was driving a 1996 Corvette.² It began to rain heavily as defendant Hill exited the proving ground and entered the eastbound lane of GM Road. He explained that GM Road is a two-lane road with a speed limit of fifty miles per hour.

¹ This figure represented the jury verdict (reduced to its present value), prejudgment interest, mediation sanctions, taxable costs, and attorney fees. Unless otherwise noted, the dollar amounts referred to in this opinion have not been reduced to their present values.

² Defendant Hill explained that the Corvette was a GM fleet vehicle that was available for employee use.

After traveling approximately two miles, defendant Hill claimed that the Corvette suddenly began fishtailing. He stated that he tried unsuccessfully to regain control of the Corvette by braking and turning the wheel. However, the Corvette crossed the centerline and ended up perpendicular to the road. Plaintiff's vehicle was traveling in the westbound lane of GM Road and collided with the Corvette. Defendant Hill believed that he was traveling at approximately forty-five miles per hour at the time of the accident.

After exiting the Corvette, defendant Hill approached plaintiff's vehicle and observed that she was unconscious. Emergency workers extracted plaintiff from her vehicle with the Jaws of Life. Gregory Flynn, a paramedic, testified that he and his partner were dispatched to the accident scene at 4:21 p.m. Upon their arrival at 4:34 p.m., Mr. Flynn noted that plaintiff was alert but unable to recall the incident. At 4:57 p.m., plaintiff's level of consciousness was assessed as being alert and orientated times one, which meant that she was alert to a person, place, *or* time. Shortly thereafter, plaintiff was transported to the hospital. Mr. Flynn stated that at 5:20 p.m., plaintiff was assessed as being alert and oriented times three, which meant that she was alert as to person, place, *and* time.

Plaintiff testified that she had no memory of the collision. However, she recalled someone in her vehicle asking questions. She also recalled being transported to the hospital. After arriving at Huron Valley Hospital, plaintiff remembered being in and out of consciousness. Plaintiff stated that her head, neck, and back caused her pain after the accident. According to plaintiff, she remained in the hospital for four days after the accident.

II. Jury Instructions

Defendants initially contend that the trial court erroneously refused to give a jury instruction concerning sudden emergency. We disagree. Claims of instructional error are reviewed de novo. *Case v Consumers Power Co*, 463 Mich 1, 6; 615 NW2d 17 (2000). Upon request in a civil case, the trial court must give a standard jury instruction if it is applicable and accurately states the law. MCR 2.516(D)(2); *Clark v Kmart Corp (On Remand)*, 249 Mich App 141, 145; 640 NW2d 892 (2002). The applicability of a standard jury instruction to a particular case rests within the trial court's discretion. *Clark, supra* at 145. However, claims of instruction error do not warrant reversal unless it is apparent to the reviewing court that failure to do so would be inconsistent with substantial justice. MCR 2.613(A); *Case, supra* at 6.

The sudden emergency doctrine is used to rebut an inference of negligence arising from the violation of a statute. *Young v Flood*, 182 Mich App 538, 541; 452 NW2d 869 (1990). An instruction on special emergency "is appropriate where a party is confronted with a situation that is 'unusual,' meaning varying from the everyday traffic routine confronting a motorist, or 'unsuspected,' meaning appearing so suddenly that the normal expectations of due and ordinary care are modified." *Id.* at 542, quoting *Vander Laan v Miedema*, 385 Mich 226, 232-233; 188 NW2d 564 (1971).

In the instant case, plaintiff alleged that defendants were negligent for violating MCL 257.626(b) (careless or negligent driving on a highway), MCL 257.627 (speed restrictions given existing conditions), and MCL 257.401 (liability of vehicle owner). The only pertinent statutory

provision that the sudden emergency instruction could apply to in this case would be MCL 257.627.³ According to MCL 257.627:

A person driving a vehicle on a highway shall drive at a careful and prudent speed not greater than nor less than is reasonable and proper, having due regard to the traffic, surface, and width of the highway and of any other condition then existing. A person shall not drive a vehicle upon a highway at a speed greater than that which will permit a stop within the assured, clear distance ahead. [Emphasis added.]

However, the sudden emergency doctrine does not apply to MCL 257.627(1) when the only excuse offered is a condition that the statute requires the driver to take into account. *Jackson, supra* at 399. The “any other condition” language in MCL 257.627(1) has been construed to encompass weather conditions and requires drivers to regulate their speed accordingly. *Jackson, supra* at 399. Because the only excuse offered by defendants in this case was the heavy rain, the trial court did not abuse its discretion by refusing to instruct the jury on the sudden emergency doctrine.

III. Admission of Evidence

Defendants next assert that the trial court erred when it allowed plaintiff to present a single photon emission computed tomography (SPECT) scan at trial. Specifically, defendants claim that SPECT scans are not considered reliable evidence within the scientific community to diagnose closed head injuries. Moreover, defendants contend that plaintiff failed to establish a proper foundation for admitting this evidence. We disagree. As a general rule, a trial court’s ruling concerning the admissibility of expert testimony will not be reversed on appeal absent an abuse of discretion. *Anton v State Farm Mut Automobile Ins Co*, 238 Mich App 673, 677; 607 NW2d 123 (1999).

A. Reliability

In defendants’ pretrial motion in limine, they argued that the trial court should omit any reference to the SPECT images of plaintiff’s brain because these scans are not generally accepted within the scientific or medical communities. The rules of evidence require trial courts to determine whether scientific evidence is relevant and reliable before it can be presented to a jury. MRE 702; *Nelson v American Sterilizer Co*, 223 Mich App 485, 489; 566 NW2d 671 (1997). Pursuant to MRE 702:

If the court determines that recognized scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise.

³ The sudden emergency doctrine does not apply to emergency situations brought upon by the individual’s own negligence. *Vsetula v Whitmyer*, 187 Mich App 675, 680-681; 468 NW2d 53 (1991); see also *Jackson v Coeling*, 133 Mich App 394, 400; 349 NW2d 517 (1984).

The trial court in this case denied defendants' motion in limine after reviewing a plethora of scientific literature, deposition testimony, and affidavits provided by both plaintiff and defendants. Specifically, the trial court determined that, assuming a proper foundation for the evidence could be established at trial:

vigorous cross examination and recitation of contrary evidence and careful instruction on the burden of proof are the means by which the respective parties can give the jury a full understanding of the scientific evidence being presented.

On appeal, defendants claim that the trial court abused its discretion by failing to "assume its role as gatekeeper in controlling the admission of only reliable evidence."

This Court recently determined that the *Davis-Frye*⁴ analysis was appropriate for purposes of determining the admissibility of SPECT scan evidence.⁵ *SPECT Imaging, Inc v Allstate Ins Co*, 246 Mich App 568, 579; 633 NW2d 461 (2001). Under *Davis-Frye*, the party offering novel scientific evidence must demonstrate that it has gained general acceptance within the scientific community. *Anton, supra* at 679. "General scientific recognition may not be established without the testimony of impartial experts whose livelihoods are not intimately connected with the evidence at issue." *Id.* When conducting a *Davis-Frye* analysis, a trial court should focus on the method, process, or basis underlying an expert's conclusions. *Id.* at 678-679.

Plaintiff provided the trial court with several affidavits and transcripts of deposition testimony from physicians, psychologists, and psychiatrists in the surrounding medical community. In general, these affidavits supported the proposition that SPECT scans have been recognized within the medical and psychological communities as a reliable tool for assisting in the diagnosis of closed head injuries.⁶ Furthermore, the articles provided by plaintiff suggest that SPECT scans are considered helpful in identifying abnormalities caused by head trauma not

⁴ *People v Davis*, 343 Mich 348; 72 NW2d 269 (1955); *Frye v United States*, 54 US App DC 46; 293 F 1013 (1923).

⁵ To the extent defendants rely on the standards set forth in *Daubert v Merrell Dow Pharmaceuticals, Inc*, 509 US 579; 113 S Ct 2786; 125 L Ed 2d 469 (1993), we note that "we are bound to follow [the *Davis-Frye*] standard until the Michigan Supreme Court overrules or modifies its decisions in this area." *People v McMillan*, 213 Mich App 134, 137, n 2; 539 NW2d 553 (1995). Nevertheless, it is unnecessary to apply the more relaxed *Daubert* analysis when the evidence satisfies the stricter *Davis-Frye* standard. See *id.*

⁶ With the exception of Dr. Ram Gunabalan, whose livelihood involved doing SPECT scans, all of these affiants appear to be proper and impartial experts who diagnose closed-head injuries. See *People v Barbara*, 400 Mich 352, 358; 255 NW2d 171 (1977).

readily apparent on other tests.⁷ Indeed, Joseph Masdeu, one of the authors of the 1996 article relied heavily upon by defendant, seemed to endorse the use of SPECT scans in a subsequent article as being helpful in revealing abnormalities that appear normal on CT or MRI scans. With regard to mild head trauma, he noted that “[t]he use of SPECT may have important implications for the classification and management of patients with mild head trauma.” We note that scientific and medical literature have been considered relevant in determining reliability. See *SPECT Imaging, Inc, supra* at 578; *People v Lee*, 212 Mich App 228; 537 NW2d 233 (1995).

Defendants suggest that the affidavits and depositions offered by plaintiff in this case were unpersuasive. However, on this record, we cannot conclude that the trial court abused its discretion when it determined that the SPECT images were admissible.⁸ The evidence demonstrated that SPECT scans were generally accepted within the scientific community as having an ability to show abnormalities in brain functioning. They are used in the same fashion that a CT scan might be used by an expert to evaluate a patient and reach a diagnosis.

2. Foundation

Defendants further argue that even if SPECT scans were generally accepted within the scientific community, plaintiff failed to establish a proper foundation for the admission of her SPECT scan. Specifically, defendants note that plaintiff’s expert, Dr. Bradley Sewick, was unqualified to testify about her SPECT scan because he was not a medical doctor or the actual tester. Defendants further suggest on appeal that because Dr. Sewick was unable to testify concerning the circumstances surrounding plaintiff’s test, they were denied an opportunity to conduct an effective cross-examination.

Dr. Sewick, a board certified neuropsychologist, has published articles concerning the relationship between SPECT imaging and neuropsychological testing. At trial, he testified, without objection, that plaintiff’s SPECT scan showed evidence of “massive frontal lobe brain damage.” Also without objection, Dr. Sewick identified the CT scan and SPECT scan as diagnostic testing that supported the conclusions he made with neurological testing. Dr. Sewick claimed that he used these diagnostic tests as part of a process of “clinical correlation.”

When plaintiff began to question Dr. Sewick regarding his experience with SPECT scans, defendants requested voir dire. Shortly thereafter, defendants again argued that SPECT imaging was an invalid technique for evaluating closed head injuries. The trial court noted that it addressed this issue in a previous motion in limine. Based on the evidence presented, the trial

⁷ Although Bradley Sewick was plaintiff’s trial witness, his 1996 article may be viewed as prepared by a disinterested and impartial expert because his livelihood is not intimately connected with the SPECT scan technique. *People v Tobey*, 401 Mich 141, 145; 257 NW2d 537 (1977). However, his 1997 paper is less helpful in determining the validation of the SPECT scan within the scientific community because it was co-authored by Dr. Gunabalan. See footnote 7, *supra*.

⁸ Defendants cite MCL 600.2955 as being critical to plaintiff’s claim. However, this Court indicated in *Greathouse v Rhodes*, 242 Mich App 221, 238-239; 618 NW2d 106 (2000), rev’d in part on other grounds 465 Mich 885 (2001), that a trial court’s evidentiary ruling should be evaluated under the rules of evidence.

court ruled that it would allow testimony regarding the SPECT scan as part of the various tools used to evaluate an individual's injuries. Defendants next sought to omit Dr. Sewick's testimony referencing plaintiff's SPECT scan because he lacked the appropriate qualifications to comment on it. The trial court concluded that the challenges being made to Dr. Sewick's testimony went more to the weight of the evidence, rather than its admissibility.

Pursuant to MRE 103(a)(1), it is incumbent on defendants to make timely objections or motions to strike. Nevertheless, under MRE 103(d), this Court may still take notice of plain errors affecting substantial rights. Even if evidence is properly objected to at trial, reversal is not required unless refusal to take such action appears inconsistent with substantial justice. MCR 2.613(A). An evidentiary error is not harmless if it was prejudicial. *Morrow v Bofferding*, 458 Mich 617, 634; 581 NW2d 696 (1998).

Defendants argue on appeal that the trial court erroneously believed the admissibility of the SPECT scan evidence was a matter of weight, rather than reliability. Considering the trial court's comments in context, however, it is apparent that it was referring to defendant's contention that Dr. Sewick was unqualified to testify about SPECT scans because he was not a medical doctor or the "tester." Indeed, the record reflects that the trial court had in fact previously ruled that SPECT scan evidence, with a proper foundation, was the type of evidence that the jury could consider as a tool used to evaluate an individual's injuries.

Defendants next appear to contest the validity or reliability of plaintiff's particular SPECT scan. Absent testimony from the individual who actually took the scan, defendants claim that they were unable to conduct an effective cross-examination with regard to the circumstances of the actual SPECT scan performed. Defendants note that Dr. Sewick was unable to provide any information concerning the performance of plaintiff's scan. This argument appears to focus on either the accuracy of the particular machine used to take the SPECT scan or the effect of plaintiff's condition on the machine's accuracy. However, defendants give cursory treatment to this issue in their appellate brief. See *Eldred v Ziny*, 246 Mich App 142, 150; 631 NW2d 748 (2001). In any event, we find no basis for relief. MCR 2.613(A). Given the fact that Dr. Gunabalan's report specifies the technique used in plaintiff's SPECT scan and contains an opinion that the technical quality of the scan was considered to be good, defendant has failed to establish plain error.

Furthermore, it does not appear that defendants specifically challenged the SPECT scan exhibit on this ground at trial. Rather, defendants' attorney challenged Dr. Sewick's qualifications to give testimony about the SPECT scan, regardless of the reliability of the actual SPECT scan taken. Notably, defendants argued that Dr. Sewick was unqualified because he was neither a medical doctor nor the tester. However, MRE 702 does not require that an expert have a particular specialty to give testimony about a matter. An expert can be qualified by knowledge, skill, experience, training or education. See *People v Whitfield*, 425 Mich 116; 122-123; 388 NW2d 206 (1986). Moreover, Dr. Sewick was an appropriate expert to testify regarding whether his neurological testing could be correlated with plaintiff's SPECT scan. In this process, he was entitled to rely on the expert findings and opinions of others. See *People v Dobben*, 440 Mich 679; 488 NW2d 726 (1992).

To the extent defendants claim that the evidence was inadmissible hearsay without an exception, this claim is not properly before this Court. Indeed, defendants did not specifically

make a hearsay objection to Dr. Sewick's testimony at trial. MRE 103(a)(1). An objection to evidence on one ground does not preserve an appellate attack on another ground. *People v Asevedo*, 217 Mich App 393, 398; 551 NW2d 478 (1996).

IV. Remittitur

Defendants also contest the trial court's refusal to grant their motion for a new trial or, in the alternative, remit the jury's award of noneconomic damages. Conversely, plaintiff argues that the trial court erred when it reduced the jury's award of future economic damages.

A trial court may grant a new trial when the damage award is excessive. MCR 2.611(A)(1)(c) and (d). However, if the only error is the excessiveness of the verdict, the trial court may deny a new trial if the nonmoving party consents to entry of judgment in an amount that the trial court finds to be the highest amount supported by the evidence. MCR 2.611(E)(1). An appellate court may not disturb a trial court's ruling in this regard absent an abuse of discretion. *Palenkas v Beaumont Hosp*, 432 Mich 537, 533; 443 NW2d 354 (1989); *Craig v Oakwood Hosp*, 249 Mich App 534, 539; 643 NW2d 580 (2002). Although the trial court should consider a number of factors, such as whether a verdict was induced by bias or prejudice, the trial court's inquiry should be limited to objective considerations related to the actual conduct of the trial or the evidence presented. *Palenkas*, *supra* at 532; *Phillips v Mazda Motor Mfg (USA) Corp*, 204 Mich App 401, 416; 516 NW2d 502 (1994). We consider the evidence in the light most favorable to the plaintiff when reviewing the trial court's exercise of discretion regarding remittitur. *Phillips v Deihm*, 213 Mich App 389, 405; 541 NW2d 566 (1995).

A. Noneconomic Damages

The jury awarded plaintiff \$600,000 for past-noneconomic losses and \$2,584,934.32 for future noneconomic losses, for a total of \$3,184,934.32. The future noneconomic losses were essentially computed at \$51,526.93 annually from November 1999 through 2049. Defendants claim that this award was grossly excessive. We disagree.

"Noneconomic losses include past and future disability and disfigurement, shame and mortification, mental pain and anxiety, annoyance, discomfiture, humiliation, denial of social pleasure and enjoyments, and fright and shock." *Craig*, *supra* at 568-569. However, because noneconomic awards cannot be proven with mathematical certainty, courts are encouraged to look to analogous cases for guidance. *Id.* at 569. Our Supreme Court observed in *Precopio v Detroit*, 415 Mich 457, 471; 330 NW2d 802 (1982), that:

no two cases precisely resemble one another, especially where unliquidated damages are involved. No two persons sustain the same injury or experience the same suffering. An appellate court should not attempt to reconcile widely varied past awards for analogous injuries "which in the abbreviated appellate discussion of them seem somewhat similar". *Gaspard v LeMaire*, 245 La 239, 270; 158 So2d 149, 160 (1963). However, if research uncovers a sufficient sample of reviewed awards, comparisons with analogous cases may prove of some value.

We further note that a dollar amount can never truly be placed on an individual's humiliation or pain and suffering. *Deihm*, *supra* at 405.

After reviewing the record, it does not appear that the trial court abused its discretion in denying defendants' request for remittitur. Contrary to defendants' claims on appeal, the evidence shows that plaintiff was unable to lead a normal life after the accident. Plaintiff testified that she has been unable to return to work or school. She claimed that her normal activities have been curtailed and that she was advised not to have more children. Plaintiff also indicated that there was a time after the accident that she was actually afraid that she would cause physical harm to her son. We note that plaintiff's explosive temper and inability to maintain emotional stability were concerns expressed by Dr. Terry Braciszewski and plaintiff's psychiatrist, Dr. Richard Feldstein.

Defendants further suggest that the jury's award was excessive when compared to verdicts in cases involving allegedly analogous injuries. Initially, defendants point out that the verdict in the instant case is substantially greater than the probably verdict analysis they obtained from Jury Verdict Research.⁹ However, defendants cite no basis for determining the accuracy of this verdict analysis. Further, they cite no authority for the proposition that a "probable verdict" amount provides an objective or relevant means of evaluating a verdict.¹⁰ Defendants' mere assertions regarding the relevancy of the probability analysis and the methods employed by Jury Verdict Research are insufficient to warrant appellate review of this issue.

Defendants also conducted a survey of specific verdicts in Michigan cases, from 1997-1999, involving allegedly similar brain and head injuries. According to defendants, only three of these cases resulted in a jury award exceeding one million dollars. However, in their appellate brief defendants merely cite to the verdict amounts. Absent more information about the nature of these cases, it is impossible for this Court to determine if the cases relied on by defendants are truly comparable. Again, a party may not leave it to this Court to search for and discover the basis of their claim. *Eldred, supra* at 146.

Defendants next cite case surveys from Michigan and other jurisdictions, obtained from Jury Verdict Research, that they claim involve comparable injuries. Defendants argue that case surveys were utilized in a federal district case that relied on *Palenkas, supra*, to assess if an award was excessive. See *Meyers v Wal-Mart Stores, East, Inc.*, 77 F Supp 2d 826 (ED Mich, 1999). However, the case surveys defendants provide in the instant case give little information for determining how they compare to plaintiff's injuries.

Defendants have failed to cite any judicially reviewed awards to support their position that the jury's award for noneconomic losses was excessive. Based on the evidence as a whole and the arguments presented, we cannot conclude that the trial court's decision in this case was "so palpably and grossly violative of fact and logic that it evidences perversity of will or the exercise of passion or bias rather than the exercise of discretion." *Churchman v Rickerson*, 240 Mich App 223, 233; 611 NW2d 333 (2000).

⁹ Defendants assert that Jury Verdict Research is an independent research organization that specializes in compiling and analyzing personal injury verdicts.

¹⁰ We note that the case analysis approach approved in *Palenkas, supra*, involved a case specific comparison of the verdicts in analogous cases to determine a range of appropriate awards.

B. Economic Losses

The jury originally awarded plaintiff \$1,074,360.40 for economic losses. The trial court subsequently reduced this award to \$9,013.60 a year, subject to an annual growth rate of three percent. On cross-appeal, plaintiff contends that the trial court abused its discretion when it remitted the jury verdict for economic damages. We agree.

Work loss under the no-fault act refers to the actual loss of income from work that an injured person would have performed after the loss of income exceeds the three-year limitation. *Ouelette v Kenealy*, 424 Mich 83, 87; 378 NW2d 470 (1985). However, work-loss is a matter of proof and is not necessarily restricted to the wage at the time of the accident. See *Pompa v Auto Club Ins Ass'n*, 446 Mich 460, 472; 521 NW2d 831 (1994). If a jury verdict is within the range of evidence, remittitur is inappropriate. See *Ritchie v Michigan Consolidated Gas Co (After Remand)*, 176 Mich App 323, 325; 439 NW2d 706 (1989).

Plaintiff was twenty-seven years old at the time of the May 9, 1996 accident. The record indicates that she obtained a GED in 1991 and worked as a traffic clerk in district court for approximately four months. In January 1992, plaintiff gave birth to her son and did not work outside the home for several years so that she could be a full-time mother. However, plaintiff took classes at a community college and began working as a housekeeper for Huron Valley Hospital in 1995. A month before her accident, plaintiff became a full-time unit clerk at the hospital and made in excess of eight dollars an hour. Ronald Smolarski, a certified rehabilitation economist, estimated plaintiff's future economic loss on the basis of her wage as a unit clerk. It appears that the jury essentially followed this economic projection in reaching its verdict.

Nevertheless, the trial court reduced plaintiff's future economic losses on the basis of her inconsistent work history. In its opinion, the trial court noted that plaintiff had never worked a full year prior to the accident or earned more than \$8,000 in a given year. Using the jury's verdict of \$9,013.60 for 1999 (from May 9, 1999), the trial court limited plaintiff's economic damages for each subsequent year to \$9,013.60, subject to an allowable growth rate of three percent for each year.

Viewing the evidence most favorable to plaintiff, the jury could have found that she would have continued her full-time employment as a unit clerk if she was not injured. We note that there was some disparity over plaintiff's exact hourly wage as a unit clerk. Plaintiff testified that she made \$8.10 an hour. However, Mr. Smolarski testified that plaintiff's employer informed him that she made \$8.20 an hour. The jury's verdict was slightly lower than Mr. Smolarski's assessment but clearly tracked the evidence presented. Because the jury's verdict was within the range of the evidence presented at trial, the trial court abused its discretion by remitting economic damages. *Id.* at 325. Consequently, we reverse the trial court's May 5, 2000 order granting defendants' motion for remittitur.

We affirm in part and reverse in part. We remand to the trial court to reinstate the jury award of January 13, 2000. We do not retain jurisdiction. Plaintiff may tax costs.

/s/ Jessica R. Cooper
/s/ William B. Murphy
/s/ Kirsten Frank Kelly

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891 N.E.2d 463 (2008)

Vincent DONNELLAN, Plaintiff-Appellee,
v.
FIRST STUDENT, INC., Defendant-Appellant.
(Earl F. McClendon, Defendant.).

No. 1-06-2418.

Appellate Court of Illinois, First District, Fourth Division.

June 19, 2008.

Rehearing Denied July 24, 2008.

466 *466 Edward M. Kay, Paula M. Catstensen, Clausen, Miller P.C., Chicago, IL, for Plaintiff-Appellant, **First Student**, Inc.

William J. Harte, Ltd., and The Healy Law Firm, (Martin J. Healy, Jr., Kevin T. Vuegeler, William J. Harte, Joan M. Mannix, of counsel), Chicago, IL, for Plaintiff-Appellee, Vincent **Donnellan**.

Justice MURPHY delivered the opinion of the court:

On February 11, 2002, plaintiff Vincent **Donnellan's** cargo van was rear-ended by a school bus driven by an employee of defendant **First Student**, Inc. Plaintiff, 31 years old on the date of the accident, had no adverse health issues at the time. Plaintiff alleged in his complaint that, as a result of the accident, he suffered numerous permanent physical and mental injuries. Defendant conceded its negligence in the accident, but disputed that the accident was the proximate cause of plaintiff's alleged injuries.

On April 7, 2006, following several days of trial, the jury returned a verdict in favor of plaintiff for \$6 million. Defendant seeks reversal of the jury verdict or, alternatively, reversal of the damages award and remand for new trial on damages or substantial remittitur. Defendant argues that the trial court abused its discretion and committed prejudicial error in allowing plaintiff's day-in-the-life video as demonstrative evidence but barred defendant's surveillance video. Defendant also argues that it was prejudiced by several evidentiary errors and the trial court's instructions to the jury. For the following reasons, we affirm the verdict of the jury.

467 *467 **I. BACKGROUND**

On September 11, 2002, plaintiff filed a complaint against defendant and Earl F. McClendon for injuries allegedly suffered due to defendant's negligence in the February 11, 2002, accident. At the time, McClendon was defendant's employee and driving the school bus that rear-ended plaintiff. Prior to trial, McClendon was voluntarily dismissed and defendant admitted negligence.

Prior to the commencement of trial on the issues of causation and damages, the trial court heard the parties' motions *in limine*. At issue on appeal are the trial court's decisions regarding plaintiff's day-in-the-life video, a surveillance video completed for defendant, and, following a hearing pursuant to Frye v. United States, 293 F. 1013 (D.C.Cir.1923), testimony on the results of a "Single Photon Emission Computer Tomography" (SPECT) scan of plaintiff's brain.

A. Plaintiff's Day-In-The-Life Video

The parties and the trial court watched the day-in-the-life video that the trial court described as a 4.5-minute video of plaintiff arriving at his therapist's office and going through physical therapy. Defendant argued that the video was not demonstrative, but substantive medical evidence, and that the audio and video depicted plaintiff in pain during his

therapy session. Defendant claimed that it was at a disadvantage from the late disclosure as it could not depose the therapist or videographer before trial. The trial court found that, with the proper foundation from someone with personal knowledge that the video truly and accurately depicts what it shows, the video would be allowed as demonstrative evidence without audio. The trial court further granted defendant the right to depose the physical therapist in the video.

B. Defendant's Surveillance Video

Plaintiff sought to bar the use of a surveillance video defendant had taken of plaintiff less than two months before trial. Two days before the case was assigned for trial, defendant produced a copy of the video to plaintiff. Plaintiff asserted that the video was produced at such a late date that he was prejudiced by his inability to explore the content of the video with any witnesses. Furthermore, plaintiff argued that the videotape was edited from the total film taken and sped up in such a way that it was not an accurate portrayal of plaintiff's physical abilities.

Defendant argued that the surveillance video was relevant to the jury's determination of the effect of the injury on plaintiff's daily lifestyle. Defendant also argued that the late disclosure was not an issue, especially in light of the day-in-the-life video that was produced the day before trial. The trial court granted the motion to bar the surveillance video at that time to allow an opportunity for the court to review the video. The parties agreed not to mention the video during opening argument.

At the end of plaintiff's case, the trial court revisited the issue and held a foundational hearing. Defendant presented the testimony of Michael Kobliska, the private investigator who conducted the surveillance of plaintiff on February 9, 2006. Kobliska testified that he took the video with a Super 8 camera and the original tape was then converted to compact disc format by a third party. Kobliska did not know if the video was compressed or edited. However, he admitted that some actions noted in his report were not shown in the video.

468 In response, plaintiff offered the testimony of Steven Grant, a media expert. Grant testified to the effect of converting a Super 8 tape to MPEG computer file on compact disc. Grant indicated that this *468 process compresses a file from 10,000 megabytes to 400 megabytes. He opined that this results in "tremendous changes" in the file.

In rendering its decision, the trial court **first** noted that there were issues with defendant's failure to disclose Kobliska as a witness during discovery and to seasonably supplement discovery. The trial court stated that it would not consider the copied videos because it had the original and the copies had been altered by the compression process. The trial court barred the original video solely on a balancing of the probative value of the video and the possibility of prejudice to plaintiff.

The trial court noted that defendant was offering the video as demonstrative evidence, but, pursuant to People ex rel. Sherman v. Cryns, 203 Ill.2d 264, 284-85, 271 Ill.Dec. 881, 786 N.E.2d 139 (2003), it could not allow the video if the threat of prejudice substantially outweighed the probative value of the video. The trial court found that the video had no probative value because it did not prove or disprove any facts at issue. However, the threat of prejudice was determined to be substantial because throughout the video, the view is obstructed. The trial court found that it is impossible to determine what activity is going on and if plaintiff is doing any work. It opined that this could prejudicially give the jury the impression that plaintiff was able to complete extensive work without pain.

C. The Frye Hearing

Defendant also objected to the use of the SPECT scan and testimony regarding the analysis of the scan. Defendant requested a *Frye* hearing on the SPECT scan technology. Plaintiff presented the testimony of Dr. Dan G. Pavel, who testified that he was board certified in nuclear medicine. Pavel testified that he was currently affiliated with the University of Illinois at Chicago Hospital as a professor and had served an 11-month sabbatical with the National Institute of Health from 1995 to 1996.

Pavel explained that a SPECT scan measures the amount of activity over an organ, in this case the brain, by detecting tracer compounds injected into the patient. Pavel testified that he had been involved with SPECT scans for about 14 years, including lecturing and publishing articles on their use in brain trauma, and that they have been in wide use in hospitals throughout the country for more than 20 years. Pavel testified that several articles on SPECT scans and brain trauma had been written over that time but that the technology was continually evolving.

Because of his years of experience, Pavel was able to identify abnormalities in plaintiffs SPECT scans and make a differential diagnosis as to potential causes. Pavel testified that, with the patient's history and the SPECT scan results, he concluded that the injuries were consistent, within a certain level of probability, with a traumatic brain injury. Pavel admitted that he did not compare plaintiffs scan with that of a "normal" baseline scan, but stated that no such scan exists and he could only base his conclusion on his years of experience of reviewing SPECT scans.

Pavel also admitted that he could not opine that a traumatic brain injury caused the abnormalities, but only that they were consistent with such an injury. Pavel responded that false positives could, theoretically, be caused by a patient's medication but, practically, this was very unlikely. Accordingly, the trial court found that Pavel could not testify that the SPECT scan allowed him to opine on a causal connection, but would be limited to stating, based on studies, literature and his own experience, that the scan was consistent *469 with a patient with a traumatic brain injury.

D. Plaintiff's Testimony

Plaintiff testified that he was born in Ireland in 1971 and moved to the Chicago area in 1996 where he found work as a carpenter. In 2000, plaintiff started an excavating company with a friend. In addition, he started a business that framed out residential buildings. At the time of the accident, plaintiff was driving his cargo van, which contained various tools and a generator separated from the front seats by a metal cargo cage. Plaintiff was stopped in the left lane, preparing to make a left turn. When plaintiff bent down to pick something up, McClendon rear-ended the van with the school bus. Plaintiff was hit in the back of the head by either the generator or a power tool that broke through the cargo cage and hit plaintiff. The van was pushed through the intersection and down into a ditch and rendered inoperable.

Plaintiff testified that he was dizzy and had a headache, but he refused treatment at the scene of the accident. A friend drove him home, where he went to bed. Later that day, plaintiff felt great pain and continued to have a headache so he went to the emergency room. Plaintiff was diagnosed with a cervical strain. Two days later, plaintiff returned to the emergency room due to pain in the lower back and neck.

Plaintiff testified to the years of consultations, treatments, and physical therapy he had received, and continued to receive, to treat his headaches and pain and sleep and vision problems and to work on regaining mobility. Plaintiff takes several medications but could not recall which types. For a period of time, plaintiff received painful steroid shots in the base of his neck to treat his headaches. While these treatments seemed to work, they were discontinued as plaintiff began to feel pain beyond the treatment time in the area that he received the shots. Plaintiff also continued to receive Botox treatments to try and strengthen his leg.

Plaintiff testified to his typical day and week. On Monday and Thursday, plaintiff attends therapy. On the other days of the week, plaintiff works for his friend Gavin Nicholas, as his health allows. Plaintiff works in a supervisory capacity at construction sites, assuring that the laborers, tradesmen and contractors are coordinated. After the accident, plaintiff obtained his commercial driver's license on his fourth attempt. While he still drives his car short distances, plaintiff can no longer drive trucks or operate heavy machinery. Plaintiff testified that he often has to close one eye and tilt his head to see properly when driving.

Plaintiff's wife, Rosanne **Donnellan**, a pediatrician, testified that she and plaintiff were engaged on December 24, 2001, and married on May 25, 2002, and that she was pregnant with their **first** child. Rosanne testified that she **first** noticed plaintiff's leg starting to turn in a few months after the accident until it eventually was turned in at all times. Rosanne stated that plaintiff had regular headaches, back spasms, vomiting due to pain, and sleep problems. In addition, plaintiff complained of double vision and, as a result, he no longer reads for enjoyment.

Rosanne testified that plaintiff suffers serious memory lapses. She testified that she was worried that this was a danger to plaintiff and their household. Rosanne also testified that plaintiff's problems have resulted in a drastic decrease in the couple's attendance at social functions because plaintiff does not want to suffer pain or people looking at him.

- 470 *470 Gavin Nicholas, a contractor, met plaintiff in 1999 and remains his close friend. Nicholas testified that plaintiff continues to work for him as a supervisor at construction sites. Plaintiff does not complete any labor or operate machinery, but he coordinates laborers and tradesmen to assure that work is getting done. Nicholas stated that plaintiff works as he is physically able and that he frequently takes breaks during the day, sometimes returning home or to Nicholas' home to take a nap.

E. Plaintiff's Diagnosis and Treatment

Dr. Gary M. Yarkony, board certified in physical medicine and rehabilitation since 1982, **first** saw plaintiff on July 12, 2002. Plaintiff complained of neck and back pain when he visited Yarkony. Yarkony suspected that plaintiff was suffering from a brain injury, including a cranial nerve injury that was causing a problem with plaintiff's eye muscle. Yarkony stated that this type of injury is typically associated with traumatic brain damage and he ordered an MRI of plaintiff's brain. Yarkony testified that the MRI did not demonstrate any issues and he utilized the later SPECT scan, which identified a brain injury, in his diagnosis. Yarkony also noted that he **first** observed plaintiff walking with an unusual gait on July 16, 2003, during his visit. Using a "little rehab doctor trick," he observed plaintiff walking in the parking lot as he left the examination to assure it was not an act.

Yarkony testified that plaintiff suffered a *coup contre coup* injury, meaning an injury to the brain at the site of impact, the back of plaintiff's brain, and the opposite side, the front of his brain. In addition, Yarkony diagnosed plaintiff with fourth nerve palsy, dystonia, myofascial pain, allodynia, occipital neuralgia, and depression. The result of these ailments are hypersensitivity to pain, cognitive dysfunctions, double vision, headaches, sleeping and mood problems and decreased ability to walk. Yarkony opined that plaintiff's symptoms will all naturally worsen as plaintiff ages and his body deteriorates.

Yarkony admitted that he did not diagnose dystonia or allodynia without input from plaintiff's wife. Yarkony stated that Rosanne **first** suggested that both of these ailments were possible and he admitted that he ultimately diagnosed plaintiff with them, because "she was right." Yarkony also admitted that he referred plaintiff to a movement disorder specialist in Chicago, but Rosanne took plaintiff to see a specialist at the Cleveland Clinic who did not diagnose plaintiff with dystonia.

Dr. Michelle Muellner of the Rehabilitation Institute of Chicago (RIC) testified that she treated plaintiff from April 2003 to July 2004 at the RIC chronic pain center. Plaintiff initially complained principally of neck and lower-back pain. Muellner initially concluded that plaintiff suffered chronic low-back pain with severe myofascial pain with both physical and psychological components. Muellner explained that chronic myofascial pain arises when the brain replicates the pain signal for the myofascial pain, pain between the muscle and connective tissues and ligaments, into a continual pain.

Muellner did not find evidence of neurologic compromise in her original diagnosis. Muellner testified that she was concerned that plaintiff was simulating or magnifying the symptoms and that he had exhibited several signs that triggered this fear, a concern that plaintiff's prior treating physician had shared with Muellner. However, she opined that he was not consciously exaggerating his symptoms.

- 471 Muellner testified that she was concerned that pending litigation was a stressor that could increase pain and prolong treatment. Muellner also was concerned *471 that plaintiff's wife had too much of an active a role in his treatment. She feared that this could inhibit his treatment as plaintiff would less readily take on his recovery, accept his injuries and move on in his rehabilitation. Muellner also advised plaintiff, who continued to work full-time during the early phase of her treatment of him, to pace himself or he would not have successful treatment.

Upon plaintiff's discharge from Muellner's care on July 13, 2004, her concluding diagnosis of plaintiff's injuries remained chronic myofascial pain and traumatic brain injury. Muellner opined that plaintiff's conditions resulted from the automobile accident at issue in this case. Muellner also testified that plaintiff would continue to suffer pain and memory loss as a result of his injuries and that he would not be able to return to his prior jobs as an excavator and carpenter.

Plaintiff presented the evidence deposition of Dr. James Kelly, a board-certified neurologist who, upon referral from Dr. Muellner, saw plaintiff twice in April and May 2003. Kelly testified that he diagnosed plaintiff with fourth cranial nerve palsy, which causes plaintiff's right eye to drift down, affecting plaintiff's motor skills and ability to read and drive. Kelly also determined that plaintiff suffered from a mild form of concussion or mild traumatic brain injury due to the symptoms he presented including headaches, migraine headaches, occipital neuralgia, dystonia, memory loss, sleep disturbances and personality changes. Kelly opined that these conditions were a result of the biomechanical injury suffered in the accident. Kelly did not believe that plaintiff was exaggerating his symptoms or that he was a malingerer. Kelly prescribed medications in addition to those prescribed by Muellner.

From November 11, 2003, to December 2005, Drs. Anita Rao and Santhanam Suresh, anesthesiologists at Children's Memorial Hospital, treated plaintiff for his headaches caused by occipital neuralgia. Rao testified at trial that Suresh, a pediatric specialist, had administered about 12 occipital nerve blocks to plaintiff. Rao related that these blocks involve several injections of local anesthetic into the base of the skull where the occipital nerve lies and they provide temporary relief of head and neck pain. These treatments were successful, but Suresh referred plaintiff to her so he could see an adult pain specialist.

Rao testified that she administered five additional occipital nerve blocks to plaintiff. In addition, Rao performed a radio frequency thermal ablation procedure in the hope of providing longer-lasting relief to plaintiff. This procedure involves insertion of a small needle with a current attached to it into the area of the nerve that heats up the area and slows down the firing of the nerve causing the pain. Rao testified that these treatments helped decrease plaintiff's pain but that at the end of the treatment period he was still suffering from headaches.

Dr. Pavel testified about the relationship of blood flow to the function of the brain and the SPECT scan that was administered in September 2004. Pavel testified at length about symptoms that result from decreased function in different areas of the brain. Consistent with the court's ruling on defendant's motion *in limine* following the *Frye* hearing, Pavel testified that the SPECT scan of plaintiff's brain presented some of these abnormalities and that they were consistent with a traumatic brain injury. Pavel testified over objection that it was his opinion the abnormalities identified in the SPECT scan were permanent in nature.

472 *472 Plaintiff presented the evidence deposition of Dr. J. Jerry Rodos, a board certified osteopathic physician practicing psychiatry, who **first** saw plaintiff on August 24, 2006. Rodos prescribed a brain SPECT scan to help determine what was happening in plaintiff's brain. Rodos testified that Dr. Pavel found that plaintiff's SPECT scan revealed a pattern of blood flow consistent with a traumatic brain injury.

Rodos ultimately diagnosed plaintiff as having headaches, chronic pain, double vision, memory and personality changes, and dystonia, a nerve injury that caused plaintiff's posture to tilt and his left foot to point inward. In addition, as a result of these conditions, Rodos found that plaintiff suffers from depression. Rodos concluded that all of these conditions resulted from the traumatic brain injury suffered in the car accident.

Rodos prescribed aquatherapy, neurobiofeedback, acupuncture, and various topical creams to treat these conditions. Rodos utilized additional medication and therapy to treat plaintiff's depression. Rodos also recommended vocational therapy to plaintiff, but he has not been willing to embrace that therapy. Although Rodos opined that plaintiff has not made great progress in understanding the nature of his injuries, he affirmatively stated that he was not a malingerer.

Dr. Robert Kohn, a neuropsychiatrist and board-certified neurologist, testified that he saw plaintiff in January and April of 2005 as a consulting physician at Rodos' request. Kohn testified that he had experience in using SPECT scans and that he had authored several articles with Pavel on the subject. Kohn explained the SPECT process and testified that he reviewed plaintiff's SPECT scan and, over objection, that it was consistent with a *coup contre coup* brain injury.

Kohn also testified that both plaintiff and his wife were present for the **first** examination and he interviewed both of them regarding plaintiff's health issues and history. Kohn testified that plaintiff appeared physically uncomfortable with dystonic posturing. After physical examination, review of plaintiff's file, scans, and medical and family history during his two office visits, Kohn concluded that plaintiff suffered from post-traumatic brain injury and dystonia, fourth cranial nerve palsy, and possibly occipital neuralgia. Kohn opined that the likely cause of plaintiff's conditions was the impact to the back of the head during the accident.

The evidence deposition of Dr. Jennifer Pallone, a board-certified neurologist, who was referred by Dr. Rodos to treat his pain and muscle spasms, was also presented. Pallone testified that she **first** saw plaintiff on September 19, 2005, and diagnosed him as suffering from closed head trauma, chronic headaches, and segmental dystonia. Pallone prescribed Botox injections to treat his dystonia and headaches. Pallone testified that the Botox injections help reduce muscle spasms and provide temporary relief of dystonia symptoms.

F. Defendant's Witness

As its sole witness, defendant presented the testimony of Dr. Robert Heilbronner, a clinical neuropsychologist, who examined plaintiff on December 8, 2005. Heilbronner testified that he reviewed the file of Dr. Jerry Sweet, a neuropsychologist at CRI who evaluated plaintiff on May 21, 2003, and May 28, June 2, and June 4, 2004. Sweet concluded that he could not properly estimate plaintiff's abilities because plaintiff had given a variable or insufficient effort during his evaluations. He also opined that plaintiff had somatization disorder — a preoccupation with physical symptoms without a physical cause.

473 *473 Heilbronner concurred with Sweet's opinions and concluded that plaintiff suffered from conversion disorder, a psychiatric condition, and not a brain injury or other medical condition. Heilbronner bolstered this diagnosis with his conclusion that Rosanne was overly nurturant to the point of co-dependency and the issue of litigation caused plaintiff's complaints to persist. Heilbronner did not claim that plaintiff did not suffer the various symptoms identified above, but opined these symptoms were exacerbated and continued due to the psychosocial reinforcers. Heilbronner admitted that plaintiff suffered the fourth cranial nerve injury and symptoms of left leg pain, neck pain and headaches as a result of the accident. However, he testified that comprehensive psychiatric treatment would significantly improve all aspects of plaintiff's condition.

G. Jury Instructions and Verdict

During the jury instruction conference, defendant sought to instruct the jury to not consider or include any amounts for loss of earnings, profits, salaries or benefits in any award for damages. The trial court refused defendant's tendered instruction regarding any evidence of a wage loss claim, stating that defendant could argue the issue in closing. The jury deliberated and returned a verdict of \$6 million for plaintiff. The jury itemized the award on the jury form as \$82,500 for the stipulated past medical expenses, \$3,417,500 for disability experienced and expected in the future, \$500,000 for disfigurement, and \$2 million for past and future pain and suffering. The trial court denied defendant's posttrial motion and this appeal followed.

II. ANALYSIS

A. Evidentiary Issues

1. Plaintiff's Day-in-the-Life Video

Defendant **first** argues that the trial court erred in admitting plaintiff's physical therapy video as demonstrative evidence. Defendant asserts that the video was not timely disclosed, an insufficient foundation was laid, and it improperly focused

on plaintiff's discomfort to elicit sympathy from the jury. Defendant argues that the failure to bar the video, especially in light of the trial court's decision to bar defendant's surveillance video, discussed below, resulted in reversible error. We review a trial court's admission of a day-in-the-life video for an abuse of discretion, which occurs only when no reasonable person would agree with the decision of the trial court. Velarde v. Illinois Central R.R. Co., 354 Ill.App.3d 523, 529, 289 Ill.Dec. 529, 820 N.E.2d 37 (2004).

Plaintiff's video, shot on March 17, 2006, is approximately five minutes long and contains footage of plaintiff exiting his car, walking into the rehabilitation center, and undergoing therapy on his leg and foot. Plaintiff produced the video to defense counsel on March 29, 2006, the day before trial proceedings began. Defendant argues that because the video was not disclosed until such a late date, in addition to the failure to disclose the physical therapist as a trial witness, it was deprived of any opportunity to challenge the evidence. Defendant contends that this evidence should have been barred pursuant to Rule 219(c). 210 Ill.2d R. 219(c).

Defendant continues to argue that plaintiff's video was not a day-in-the-life video as it did not simply demonstrate plaintiff's daily tasks and functions. Velarde, 354 Ill.App.3d at 535, 289 Ill.Dec. 529, 820 N.E.2d 37. Defendant points to several instances in the video where plaintiff grimaces and presents expressions of pain while his foot is manipulated by the therapist. Accordingly, defendant contends that the video was not demonstrative in any way but, rather was substantive evidence *474 improperly presented to bolster plaintiff's case and claim for damages, prejudicing defendant's case. Spyrka v. County of Cook, 366 Ill.App.3d 156, 169, 303 Ill.Dec. 613, 851 N.E.2d 800 (2006); French v. City of Springfield, 65 Ill.2d 74, 82, 2 Ill.Dec. 271, 357 N.E.2d 438 (1976).

Defendant points out that this case is unlike Georgacopoulos v. University of Chicago Hospitals & Clinics, 152 Ill.App.3d 596, 105 Ill.Dec. 545, 504 N.E.2d 830 (1987). In Georgacopoulos, this court affirmed the admission of a day-in-the-life video that included a portion where the plaintiff undergoes a painful physical therapy session. The court noted that the therapy session was only a portion of the 19-minute video and that the trial court described the tape as "tasteful." Georgacopoulos, 152 Ill.App.3d at 599, 105 Ill.Dec. 545, 504 N.E.2d 830. The court further distinguished that case from a federal case that found a day-in-the-life video more prejudicial than probative because it only showed a physical therapy session of the plaintiff that had suffered severe burns. Georgacopoulos, 152 Ill.App.3d at 599, 105 Ill.Dec. 545, 504 N.E.2d 830, citing Thomas v. C.G. Tate Construction Co., 465 F.Supp. 566, 569 (D.S.C.1979). Defendant argues that, as in the Thomas case, plaintiff's video was only of his physical therapy session and the display of pain by plaintiff was therefore more prejudicial than probative.

Finally, defendant argues that no proper foundation was laid for the video as required in Spyrka. Spyrka, 366 Ill.App.3d at 167, 303 Ill.Dec. 613, 851 N.E.2d 800. The video was shown during Rosanne's testimony. She was not present during the filming and she did not explain what was contained in the video. Defendant asserts that the fact that Rosanne had been to prior therapy sessions was not sufficient to lay a proper foundation. Cryns, 203 Ill.2d at 284-85, 271 Ill.Dec. 881, 786 N.E.2d 139.

Plaintiff responds that as demonstrative, not substantive, evidence, a day-in-the-life video is not subject to the same disclosure requirements as substantive evidence and therefore there was no discovery violation. Velarde, 354 Ill.App.3d at 530-31, 289 Ill. Dec. 529, 820 N.E.2d 37. Furthermore, plaintiff asserts that the physical therapist was listed in plaintiff's discovery responses and the trial court granted defendant the opportunity to depose her. The therapist appeared in response to plaintiff's trial subpoena, yet defendant did not question her. In addition, plaintiff notes that defendant had every opportunity to question plaintiff himself on cross-examination but did not.

Plaintiff asserts that the trial court properly rejected defendant's argument that the video was more documentation of a medical examination than demonstrative day-in-the-life evidence. Plaintiff notes that our courts have stated that day-in-the-life videos constitute demonstrative evidence which helps jurors understand witness testimony. Cisarik v. Palos Community Hospital, 144 Ill.2d 339, 341, 162 Ill. Dec. 59, 579 N.E.2d 873 (1991); Velarde, 354 Ill.App.3d at 530-31, 289 Ill.Dec. 529, 820 N.E.2d 37. Plaintiff contends that defendant's argument rests on the inaccurate claim that the video so focused on plaintiff's pain and effort that it was prejudicial as the video distinguished by Georgacopoulos.

Plaintiff concludes that a proper foundation was laid by Rosanne, who testified that she had attended two physical

therapy sessions in the past. She testified that the video accurately depicted how plaintiff exits his car, how he walks, and how his physical therapy is administered. Plaintiff argues that this is all that is required by **475 Spyрка and Cryns* to properly lay a foundation for demonstrative video evidence.

First, we agree that *Velarde* provides that, pursuant to *Cisarık*, day-in-the-life videos are demonstrative and not substantive videos. In addition, the very purpose of these videos is to illustrate evidence regarding a party's life at the time of trial. Accordingly, the disclosure prior to trial was not prejudicial. *Velarde*, 354 Ill.App.3d at 531-32, 289 Ill.Dec. 529, 820 N.E.2d 37. As succinctly outlined in *Cisarık*, a day-in-the-life video is akin to a photograph and admissible if a foundation is laid by someone having personal knowledge of the filmed object and that the video is an accurate portrayal of that. The video's probative value also must not be substantially outweighed by the danger of prejudice. *Cisarık*, 144 Ill.2d at 342, 162 Ill.Dec. 59, 579 N.E.2d 873.

Rosanne certainly knew plaintiff and could testify to his ability to drive, get out of a car and how he walked. She testified that she had attended plaintiff's sessions with the physical therapist twice and that the video was an accurate depiction of plaintiff and his therapy session. As with a photograph, Rosanne had personal knowledge of the contents of the video and the trial court properly accepted this as a foundation.

The trial court also found the danger of any prejudice did not outweigh its probative value. The video in this case is unlike those in *Spyрка* and *French*. In *Spyрка*, the video that was found to be prejudicial was a step-by-step animation of what happened to the plaintiff, not a general demonstrative exhibit to understand the medical condition suffered. Furthermore, the testifying doctor stated that he could not say the video accurately represented what happened to the plaintiff. *Spyрка*, 366 Ill.App.3d at 168-69, 303 Ill.Dec. 613, 851 N.E.2d 800. Likewise, in *French*, the video in question purported to familiarize the jury with the scene of an accident that occurred at night. The video, however was filmed in the day and in a fashion that mirrored the alleged chain of events in the case. Accordingly, in both cases, the videos were prejudicial because they preconditioned the minds of the jury to accept the plaintiffs' theories in each case. *Spyрка*, 366 Ill.App.3d at 169, 303 Ill.Dec. 613, 851 N.E.2d 800; *French*, 65 Ill.2d at 82, 2 Ill.Dec. 271, 357 N.E.2d 438.

As in *Georgacopoulos*, the video in this case was "tastefully" produced. The video was not produced to improperly precondition the jury on plaintiff's theory. Having viewed the video, it does not present a focus on plaintiff's pain and discomfort to the exclusion of anything else. While plaintiff does wince and/or grimace in different spots in the video, he also smiles and talks with the therapist. There is no undue focus on his pain, it simply focuses on a typical therapy session that the evidence at trial indicated would be required for the rest of plaintiff's life.

2. Defendant's Surveillance Video

Defendant argues that the trial court's error in admitting plaintiff's day-in-the-life video was compounded by its failure to allow the surveillance video. Defendant highlights that the trial court indicated during the hearing on defendant's motion to bar the day-in-the-life video that if it was going to be liberal about letting in video evidence for plaintiff it would have to be liberal for both sides. Defendant claims that the surveillance video was relevant to rebut plaintiff's video and the trial court erred in barring its surveillance video. Again, under *Velarde*, we review the admission of video evidence for an abuse of discretion. See also *Warrender v. Millsop*, 304 Ill.App.3d 260, 270, 237 Ill.Dec. 882, 710 N.E.2d 512 (1999).

*476 Defendant argues that surveillance videos are relevant and admissible substantive evidence concerning the extent of a plaintiff's injuries in a personal injury suit. *Shields v. Burlington Northern & Santa Fe Ry. Co.*, 353 Ill.App.3d 506, 509, 288 Ill.Dec. 916, 818 N.E.2d 851 (2004). Defendant contends that the surveillance video tended to disprove plaintiff's claims regarding the nature of his injuries and his inability to maintain a level of employment. Defendant argues that the trial court did not properly conduct a balancing test because it found that the probative value did not outweigh the danger of prejudice. Defendant contends that the test requires exclusion only if the probative value is substantially outweighed by the danger of prejudice. *Spyрка*, 366 Ill.App.3d at 167, 303 Ill.Dec. 613, 851 N.E.2d 800.

Defendant asserts that this court's ruling in *Carney v. Smith*, 240 Ill.App.3d 650, 181 Ill.Dec. 306, 608 N.E.2d 379 (1992), is controlling. In *Carney*, the plaintiff was injured in a car accident and presented various witnesses that testified

to his persistent pain and disability, including dragging his foot. Carney, 240 Ill.App.3d at 651-54, 181 Ill.Dec. 306, 608 N.E.2d 379. The defendant introduced two surveillance videos of the plaintiff moving effortlessly, carrying numerous objects and performing various tasks. Carney, 240 Ill.App.3d at 657, 181 Ill.Dec. 306, 608 N.E.2d 379.

The trial court overruled the plaintiffs objection to these videos. While the plaintiff admitted that many parts of the videos were consistent with his presentation of evidence and theory of the case and the videos did not show the plaintiff engaging in any vigorous activity, the court found that they did rebut the inference that the plaintiff was in constant pain. Accordingly, this court affirmed the admission of the videos because their probative value outweighed any prejudicial effect. Carney, 240 Ill.App.3d at 657-58, 181 Ill.Dec. 306, 608 N.E.2d 379.

In addition, defendant argues that the late disclosure of the surveillance video did not warrant exclusion as a discovery sanction pursuant to Rule 219. 210 Ill.2d R. 219(c). Defendant highlights that the purpose of a discovery sanction is not to punish a party, but to ensure fair proceedings. Smith v. P.A.C.E., 323 Ill.App.3d 1067, 1075, 257 Ill.Dec. 158, 753 N.E.2d 353 (2001). Defendant argues that plaintiff was not prejudiced by the late disclosure of the video because Kobliska was deposed and available to testify at trial and the original tape was also available to alleviate concerns regarding distortion. However, defendant maintains that it was prejudiced by allowing plaintiff's day-in-the-life video at such a late date, without a chance for it to provide rebuttal.

Plaintiff responds that the trial court properly denied showing defendant's copied versions of the video because the testimony of both Kobliska and Grant identified issues whether these versions accurately portrayed what they purported to show. As for the original version, plaintiff notes that, at trial, defense counsel argued that the surveillance videos were offered as demonstrative evidence in conjunction with Kobliska's testimony, while on appeal, defendant argues that the video is admissible as substantive evidence. Plaintiff argues that defendant has therefore waived this issue for its failure to stand on the theory presented at trial. Shannon v. Boise Cascade Corp., 208 Ill.2d 517, 527, 281 Ill.Dec. 845, 805 N.E.2d 213 (2004).

477 Plaintiff argues that, waiver notwithstanding, the trial court properly determined that the surveillance video was not probative of the issue being contested. Therefore it concluded that its probative *477 value did not outweigh the possible prejudice. Plaintiff concludes that the cases cited by defendant are factually inapposite and actually support his case. Plaintiff argues that in each case, the surveillance video at issue captured the plaintiffs acting inconsistent with their claims at trial. Furthermore, each case resulted in affirmance of the trial court's discretionary decision.

Plaintiff contends that the trial court was correct in concluding that there was no probative value to the video because it only demonstrated activity that plaintiff admitted. Plaintiff admitted that he can drive and works overseeing construction sites when capable. The surveillance video, plaintiff argues, by its very nature is prejudicial because it suggests that he had been caught doing something he claimed he could not. Plaintiff contends that defendant misrepresents the content of the video because views are obscured for moments that defendant argues plaintiff walks without his cane and over uneven ground. Furthermore, the video could improperly give the impression that plaintiff was capable of constant activity and, thus, was correctly determined to be prejudicial. Carroll v. Preston Trucking Co., 349 Ill. App.3d 562, 285 Ill.Dec. 611, 812 N.E.2d 431 (2004).

First, if the surveillance video is substantive evidence as defendant argues, it was properly excluded. Neither Kobliska nor the video was disclosed by defendant during discovery. Kobliska testified that he filmed the video in February 2006, informing defendant on February 9, 2006, that he had made a videotape. The fact that defendant did not receive the final copy of the video until March 21, 2006, does not remove the requirement of disclosure or the duty to seasonably supplement disclosure pursuant to Rule 214. 166 Ill.2d R. 214. However, the video was offered as demonstrative evidence and, despite defendant's arguments, it was not barred by the trial court as a discovery sanction. The trial court simply prefaced its holding by noting defendant's failures to promptly supplement disclosures and disclose Kobliska as a trial witness.

The trial court then weighed the probative value of the video against the possible prejudice pursuant to *Cryns*. We agree that the trial court did not abuse its discretion in barring the video as demonstrative evidence. The video did not counter any claims made by plaintiff. Plaintiff maintained that he worked and drove when he was physically able. The video

shows just that. However, the danger of undue prejudice outweighed any probative value.

In *Carroll*, the defendant offered a surveillance video of the plaintiff, who had made a worker's compensation claim, walking without a cane, moving a ladder, operating a chainsaw, and completing other labor-intensive work in his yard. *Carroll*, 349 Ill.App.3d at 564-65, 285 Ill.Dec. 611, 812 N.E.2d 431. The *Carroll* court opined that the video was probative to show the extent of the plaintiff's incapacitation and that the defendant could have used the plaintiff as a foundational witness. *Carroll*, 349 Ill.App.3d at 566, 285 Ill.Dec. 611, 812 N.E.2d 431. However, it held that the trial court did not abuse its discretion because the unfair prejudice that resulted from the editing showing the plaintiff completing physical tasks. This left the impression that he could maintain such activity for long periods of time when they were completed over a short time period. *Carroll*, 349 Ill.App.3d at 567, 285 Ill.Dec. 611, 812 N.E.2d 431.

478 While, under *Carney* and *Carroll*, it could be said that the trial court erred in saying that the video was "not probative to any issue" because the video was probative *478 to counter plaintiff's claims of constant pain, the harm of prejudice outweighed any probative value. Despite defendant's contention that Kobliska testified that the video was not edited to demonstrate only the period plaintiff was working and that he filmed at every moment that he could, the video leaves the impression that plaintiff was working for extended periods of time. Unlike *Carney*, there is no direct rebuttal of plaintiff's claims to boost its probative value.

The trial court highlighted that the video is obscured frequently and there were other times where the plaintiff is just sitting in a car. The trial court opined that it was impossible to determine if these obscured moments were downtime or active and, as in *Carroll*, determined this could lead to the impression that plaintiff was actively working on the site. Under *Carroll*, this conclusion was not an abuse of discretion.

3. Frye Hearing on the SPECT Scan and Related Testimony

Defendant argues that the trial court erred in concluding that the SPECT scan was generally accepted scientific evidence under *Frye*. Defendant also contends that even if the trial court's ruling on the SPECT scan was correct, plaintiff's witnesses improperly testified regarding their use of the scan in treating plaintiff. The admissibility of evidence is a matter that typically rests squarely within the discretion of the trial court. *Agnew v. Shaw*, 355 Ill.App.3d 981, 988, 291 Ill.Dec. 460, 823 N.E.2d 1046 (2005). However, in reviewing a trial court's *Frye* analysis, we conduct *de novo* review and may rely on materials outside the record, including legal and scientific articles and opinions from courts of other jurisdictions. *In re Commitment of Simons*, 213 Ill.2d 523, 530-32, 290 Ill.Dec. 610, 821 N.E.2d 1184 (2004).

First, defendant argues that this court should adopt the test set forth by the United States Supreme Court in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 113 S.Ct. 2786, 125 L.Ed.2d 469 (1993), because it constitutes a clarification of the standard for admission of scientific evidence. Plaintiff asserts that defendant waived this issue for its failure to raise it until the posttrial motion. However, defendant discussed *Daubert* in both its motion *in limine* seeking to bar the SPECT scan evidence and in its posttrial brief.

While our supreme court has recently noted that Illinois courts have not addressed the issue of whether *Daubert* should supplant *Frye*, it has continued to hint that this issue is ripe for its consideration. See *People v. McKown*, 226 Ill.2d 245, 247, 314 Ill.Dec. 742, 875 N.E.2d 1029 (2007). However, Illinois case law is replete with references that Illinois law is "unequivocal" in that the exclusive test for the admission of expert testimony is the general acceptance test of *Frye*. *Donaldson v. Central Illinois Public Service Co.*, 199 Ill.2d 63, 76, 262 Ill.Dec. 854, 767 N.E.2d 314 (2002). Although we are bound to precedent until our supreme court adopts a new test, the issue bears quick review. See *Mekertichian v. Mercedes-Benz U.S.A., L.L.C.*, 347 Ill.App.3d 828, 836, 283 Ill.Dec. 324, 807 N.E.2d 1165 (2004).

Under the general acceptance test of *Frye*, scientific evidence is admissible if the methodology underlying the opinion is "sufficiently established to have gained general acceptance in the particular field in which it belongs." *Frye*, 293 F. at 1014. The focus of this test is on the underlying methodology of the opinion and not the ultimate conclusion. *Agnew v. Shaw*, 355 Ill.App.3d 981, 988, 291 Ill.Dec. 460, 823 N.E.2d 1046 (2005). For federal cases however, *Daubert* held that the *Frye* standard *479 was superseded by the adoption of the Federal Rules of Evidence. *Daubert*, 509 U.S. at 587.

113 S.Ct. at 2793-94, 125 L.Ed.2d at 479.

Like *Frye*, *Daubert* seeks to determine the soundness of an expert's methodology. Unlike the simple and open general acceptance requirement of *Frye*, *Daubert* provides "general observations" to consider in determining whether a standard of evidentiary reliability has been reached that would assist the trier of fact in understanding the fact at issue. *Daubert*, 509 U.S. at 591-93, 113 S.Ct. at 2795-97, 125 L.Ed.2d at 481-83. Though "flexible" and not exhaustive, *Daubert* listed the following considerations to be examined: whether the methodology has been tested; whether the theory or technique has been submitted for peer review or publication; if there is a known or knowable rate of error; if the theory or practice has been generally accepted in the proper scientific community; and the existence of standards controlling the technique. *Daubert*, 509 U.S. at 593-95, 113 S.Ct. at 2796-98, 125 L.Ed.2d at 482-84.

Accordingly, it is plain that *Daubert* provides additional guidance to courts in determining the standard of evidentiary reliability of scientific evidence. As the *Daubert* court noted, debate and scholarship on the merits of the *Frye* test are legion. Over the 85 years of developing law since the decision in *Frye*, many established tests have been supplanted by the courts and legislature. While we are in no position to make such a change, we agree it may be due time for our supreme court's worthy consideration, though the facts of this case are likely insufficient for a proper challenge to the rule.

As noted above, the trial court in this case properly followed *Donaldson* and conducted a *Frye* hearing. The trial court concluded that testimony could be heard on plaintiff's SPECT scan, but limited to the conclusion that it was consistent with a finding of traumatic brain injury and not that it could prove causation. Defendant argues that the trial court erred in this conclusion because it rested on Pavel's testimony alone. In addition, it argues that the trial court erred in allowing other experts to testify in violation of this ruling. For further support, defendant also cites to scientific articles and case law from foreign jurisdictions.

The two 1996 scientific journal articles cited by defendant opined that the few controlled experimental studies in using SPECT scans have left the use of the technology in forensic situations speculative. See Society of Nuclear Medicine Brain Imaging Council, *Ethical Clinical Practice of Functional Brain Imaging*, 37 J. of Nuclear Med. (July 1996); American Academy of Neurology, *Assessment of Brain SPECT*, 46 Neurology 278-285 (1996). Defendant also relies heavily on case law from the court of appeal of California. See *People v. Yum*, 111 Cal. App.4th 635, 637-39, 3 Cal.Rptr.3d 855, 855-57 (2003). The *Yum* court found that, based on the testimony of the defendant's expert and the prosecution's expert witness, the defendant had not shown that SPECT scans had achieved general scientific acceptance to diagnose brain trauma and post-traumatic stress disorder. *Yum*, 111 Cal.App.4th at 639, 3 Cal.Rptr.3d at 857.

Defendant also argues that Pavel's testimony during the *Frye* hearing was insufficient. Defendant cites to Pavel's admissions that there is no data on the known error rate for false positive scans, that double-blind studies have not been conducted, that it is possible that drug use might skew the results of a scan, and that there is no accepted methodology in using a SPECT scan for diagnostic purposes. *480 Defendant notes that Pavel did not conduct a blind assessment of plaintiff's scan as he was informed of plaintiff's history. In addition, Pavel did not compare plaintiff's scan to a "normal" scan to identify abnormalities.

Finally, defendant argues that the trial court erred in allowing Rodos, Yarkony and Kohn to testify regarding the scan. Yarkony testified that he reviewed the SPECT scan and Pavel's report. Yarkony testified that, as he was not a neuroradiologist, he would have to rely on the report interpreting the scan, but opined that the scan confirmed the diagnosis of traumatic brain injury. Likewise, Rodos testified he was not an expert in SPECT scans, but, as with Yarkony, he was allowed to testify that Pavel's interpretation showed the scan was diagnostic. Rodos further opined that he told plaintiff to halt the medications he was taking before the scan because they could skew the results. Kohn testified that plaintiff's SPECT scan showed damage to both hemispheres of the brain, specifically identifying a *coup contre coup* injury.

Defendant contends that, with respect to Kohn, plaintiff violated Rule 213(f)(2) in failing to disclose that Kohn would testify to the SPECT scan. Official Reports Advance Sheet No. 26 (December 20, 2006), R. 213(f)(2), eff. January 1, 2007. Defendant admits that Kohn was disclosed by plaintiff and defendant did not notice his deposition even though it

had every opportunity to do so. Defendant maintains that the spirit of the amended rule was violated because plaintiff did not specifically state Kohn would testify to the SPECT scan. See White v. Garlock Sealing Technologies, LLC, 373 Ill.App.3d 309, 323-24, 311 Ill.Dec. 570, 869 N.E.2d 244 (2007). Defendant concludes that plaintiff's tactical gamesmanship surprised and prejudiced defendant in direct violation of the spirit of open disclosure because Kohn's trial testimony went far beyond what it expected from the disclosure.

We agree with plaintiff's response that, while it is questionable that a *Frye* hearing was necessary in this case because SPECT scans are not novel science, the trial court prudently conducted a hearing. Perhaps 10 years ago there would be no question that a hearing was required and defendant's proffered scientific articles would have been cause to deny the evidence. Certainly, if *Daubert* were the test, this case would have been considerably closer based on a full review of the enunciated "considerations" of that test. However, as it stands, Pavel testified during the *Frye* hearing that, at the date of trial, the SPECT technology had been widely used for over 20 years and that virtually all university hospitals and many larger hospitals conduct SPECT scans.

Pavel testified to his personal experience of almost 15 years with SPECT scans, almost entirely with brain SPECT scans. Pavel has authored scientific articles on its use in this capacity as well. As to the methodology, Pavel indicated SPECT scan analysis is similar to X-ray or other imaging analysis. Students are taught what normal scans look like in medical school, and based on this, continuing literature and gathered experience, Pavel makes determinations regarding the scan result. Pavel admitted that he could not conclude what caused an injury, but reviewing a scan, he could identify abnormalities consistent with certain injuries.

481 The trial court actively questioned Pavel during the hearing, specifically on his process and the conclusions that he could make. As a result, the trial court ultimately limited his testimony to whether the SPECT scan was consistent with a traumatic brain injury. Pavel's testimony about the extensive use of SPECT scans *481 and detailed explanation about the process of analyzing the scans was sufficient to support the introduction of the evidence. Pavel was not discredited as a witness and supported his testimony to the trial court's satisfaction. It was not an error to find this testimony sufficient and that the 1996 articles defendant relied on at trial, and here on appeal, were dated and did not diminish Pavel's testimony. Furthermore, unlike in *Yum*, where the testimony of two doctors did not support introduction of SPECT scans as a diagnostic tool for brain trauma and traumatic stress disorder, here Pavel's testimony was extensive and sufficient. The trial court's limitation on the testimony against statements that the scans were diagnostic further distinguishes this case from *Yum*.

We also note plaintiff's citation to Illinois courts that have allowed SPECT scan evidence in various cases. See People v. Urdiales, 225 Ill.2d 354, 312 Ill.Dec. 876, 871 N.E.2d 669 (2007); Matuszak v. Cerniak, 346 Ill.App.3d 766, 282 Ill.Dec. 62, 805 N.E.2d 681 (2004). In addition, other jurisdictions have accepted this evidence after applying the *Daubert* test. See Rhiling v. Jancsics, 1998 WL 1182058, 8 Mass. L. Rep. 373 (1998). Similar to this court, the *Rhiling* court was presented with evidence regarding the use of SPECT brain scans for 15 years and determined that under *Daubert*, their use at trial would aid the trier of fact in determining if abnormalities in brain function existed. We believe that, even if the trial court followed *Daubert*, as defendant contends would have been proper, its motion *in limine* would still have been properly denied. Pavel testified that he has submitted articles for publication, SPECT scans are in wide use throughout the profession, and baseline images are presented in medical schools teaching this technology. Furthermore, three additional doctors — Yarkony, Rodos and Kohn — testified to their use of SPECT scans in this type of case.

With respect to the testimony of these doctors, plaintiff asserts that these doctors were not subject to the *Frye* hearing. As treating doctors, plaintiff argues, each witness simply presented medical opinion testimony regarding their diagnoses of plaintiff and were outside the reach of *Frye*. Noakes v. National R.R. Passenger Corp., 363 Ill.App.3d 851, 857-58, 300 Ill.Dec. 593, 845 N.E.2d 14 (2006). Furthermore, plaintiff argues that each witness was disclosed during discovery and their treating records were also disclosed. In particular, plaintiff points to the medical records of Kohn and Rodos that indicated Kohn reviewed the SPECT scan and opined there was under perfusion in the anterior and posterior areas. Plaintiff concludes that defendant was fully apprised of the fact these doctors were witnesses and the records upon which they would testify and defendant's failure to depose Kohn cannot be cured by arguing disclosure was improper.

We agree that the trial court did not abuse its discretion in allowing the treating doctors to discuss their use of the SPECT scan. As the *Noakes* court stated, where opinion testimony is based on the physician's personal knowledge and practical experience and not "studies and tests," it is not subject to a *Frye* test. *Noakes*, 363 Ill.App.3d at 857-58, 300 Ill. Dec. 593, 845 N.E.2d 14. Each doctor's experience and qualifications were presented to the jury and each testified to how the SPECT scan was used in their determination that plaintiff had suffered a traumatic brain injury. The fact that some relied on Pavel's report does not remove the fact that is how each doctor diagnosed and treated plaintiff. *Frye* hearings establish whether the process or methodology is generally acceptable, not an ultimate conclusion or opinion as these doctors provided. Defendant was afforded *482 the opportunity to review the doctors' records in full and was free to fully depose each of these doctors and present countering opinions to persuade the jury of its case.

B. Jury Instructions

Defendant contends that the trial court committed reversible error by refusing its requested instruction advising the jury that lost wages, profits or income was not at issue in the case. A particular jury instruction is proper if it is sufficiently clear, fairly and correctly states the law, and is supported by some evidence in the record. *Rios v. City of Chicago*, 331 Ill. App.3d 763, 776, 265 Ill. Dec. 71, 771 N.E.2d 1030 (2002). In determining whether jury instructions were inadequate, we will remand for a new trial only if the trial court clearly abused its discretion. *Villa v. Crown Cork & Seal Co.*, 202 Ill. App.3d 1082, 1087, 148 Ill. Dec. 372, 560 N.E.2d 969 (1990).

We find that the trial court did not abuse its discretion in refusing defendant's requested jury instruction. Defendant argues that the trial court granted its motion *in limine* barring the wage loss claim and asserts that this "directed finding" required the limiting instruction. Defendant does not cite to this motion in the record, and this court could not locate the motion. The record indicates the trial court granted this motion without objection or further detail.

Plaintiff correctly notes that at the outset of trial he informed the judge that there was no wage loss claim. Plaintiff reiterated during defendant's motions *in limine* that there was no lost wage claim and added it was withdrawn because with plaintiff's new company, it was too difficult to prove. Defendant then argued during closing that it was curious that plaintiff had not made a lost wage claim. Plaintiff responded during rebuttal that no lost wage claim was filed because it would be too speculative.

Both parties also argued during closing that the jury was not to consider any income or lost future income during deliberations. The trial court tendered instructions detailing what elements of damage it could consider. The trial court found no reason to confuse the jury with an instruction on an issue not before it. Instead, it stated that defendant could argue the point to the jury.

Defendant's presentation and reliance on *Wille v. Navistar International Transportation Corp.*, 222 Ill. App.3d 833, 165 Ill. Dec. 246, 584 N.E.2d 425 (1991), are misguided. In *Wille*, the trial court denied the plaintiff's motion *in limine* to bar evidence or argument that he assumed the risk of injury. At the close of evidence, the trial court entered a directed verdict on that issue, but refused to instruct the jury on the directed verdict, noting that plaintiff's counsel could cover that issue in closing. Defense counsel proceeded to extensively argue in closing, over objection, that plaintiff's actions were the proximate cause of the injury. *Wille*, 222 Ill. App.3d at 837, 165 Ill. Dec. 246, 584 N.E.2d 425. This court reversed for the trial court's failure to fully instruct the jury as to the applicable law because it did not instruct the jury of the directed finding. This error was especially prejudicial because the defendant's closing argument on this issue covered 11 pages of trial transcripts. *Wille*, 222 Ill. App.3d at 839-40, 165 Ill. Dec. 246, 584 N.E.2d 425.

In this case, there was no need for a directed verdict or directed finding as plaintiff withdrew any lost wage claim. Although the motion is not of record, defendant apparently moved to bar any discussion or evidence of lost earnings, past or future. No evidence on lost wages was presented because plaintiff had withdrawn the claim. *Wille* is also distinguishable *483 because, here, defendant raised the issue in closing and plaintiff limited his rebuttal comments to a brief paragraph responding that he did not advance a lost wage claim as it would be speculative and overreaching. This in no way is comparable to an extensive argument on causation. The jury was informed by both parties there was no lost wage claim and the jury instructions clearly provided the elements of damage the jury could consider.

C. Improper Damages Award

Finally, defendant contends that the jury award of \$6 million was excessive and should be reversed with remand for further proceedings on that issue or a substantial remittitur must be entered. The question of damages is specifically reserved for the trier of fact, and we will not substitute our judgment lightly. We may reverse or modify a damages award as excessive only if it is unfair and unreasonable, if it results from passion or prejudice, or it is so excessively large that it shocks the conscience. Mikolajczyk v. Ford Motor Co., 374 Ill.App.3d 646, 671, 312 Ill.Dec. 441, 870 N.E.2d 885 (2007), appeal allowed 225 Ill.2d 637, 314 Ill.Dec. 826, 875 N.E.2d 1113 (2007).

Defendant argues that the jury's award is radically disproportionate to the economic loss such that the award bears no relationship to plaintiff's losses. Defendant notes that the noneconomic loss determined by the jury was over 70 times greater than the economic loss of the stipulated medical bills. Defendant argues that this fact alone makes the verdict shocking and excessive as a matter of law. In support of remittitur, defendant cites a case from the Mississippi Supreme Court where a substantial remittitur was affirmed due to hugely disproportionate noneconomic damages. Defendant also argues that this court should reverse where the award bears no relationship to the loss suffered. Gill v. Foster, 157 Ill.2d 304, 315, 193 Ill.Dec. 157, 626 N.E.2d 190 (1993).

Defendant notes that damages must be proved to be recovered. Chrysler v. Darnall, 238 Ill.App.3d 673, 680, 179 Ill.Dec. 721, 606 N.E.2d 553 (1992). Furthermore, defendant argues that the jury may make a just estimate of damages and it may not base its award purely on guesswork. Levin v. Welsh Brothers Motor Service, Inc., 164 Ill.App.3d 640, 655, 115 Ill.Dec. 680, 518 N.E.2d 205 (1987). Defendant argues that plaintiff's counsel "pulled figures from the air" for the verdict request to the jury of \$8 million for disability, \$500,000 for disfigurement, \$5 million for future pain and suffering, and \$82,500 for medical costs.

Defendant argues that plaintiff merely suffered a mild traumatic brain injury resulting in a cranial nerve injury, headaches, back and shoulder pain, a movement disorder, and depression. Defendant points out that plaintiff still works as a construction supervisor, still walks, talks, eats, sees, hears, tastes, smells, carries trays of coffee, drives, shops, pumps gas, operates a cell phone, and attends rehabilitation. Defendant further notes that plaintiff was not rendered a paraplegic or quadriplegic, incontinent or bed-ridden. Accordingly, defendant concludes that the noneconomic damages award lacks support in the record.

Plaintiff responds by highlighting the great discretion granted to the jury in setting the amount of a verdict. Velarde, 354 Ill.App.3d at 539-40, 289 Ill.Dec. 529, 820 N.E.2d 37. Plaintiff notes that Velarde also cites several factors that may be used in reviewing compensatory damages, including the permanency of the condition, the possibility of future deterioration, the extent of medical expenses, and the restrictions imposed due to the injuries suffered. Velarde, 354 Ill.App.3d at 540, 289 Ill.Dec. 529, 820 N.E.2d 37. Plaintiff also *484 argues that Illinois does not require any particular ratio of economic loss to noneconomic loss and that the evidence presented at trial supported the jury's award.

First, as we affirmed the trial court's evidentiary findings above, we need not consider defendant's argument that the alleged errors also demonstrate the damages award resulted from passion, prejudice and improper considerations. In addition, we need not consider the foreign jurisdiction case cited by plaintiff when Illinois case law sufficiently covers this subject. Next, we agree with plaintiff that Gill supports plaintiff's argument. Gill reiterates the principle that the jury is vested with great discretion in fashioning an award in rejecting a claim damages were disproportionate to the loss suffered. In addition, we note that defendant has argued that more than mere guesswork is required to fix damages based on Levin; however, that case specifically discusses the computation of lost earning capacity. Levin, 164 Ill.App.3d at 655, 115 Ill.Dec. 680, 518 N.E.2d 205.

While a damage award for noneconomic damages such as those suffered by plaintiff is subject to even less precision than economic damages or lost wages, it still must be a product of the evidence and not passion such that it is shockingly excessive. As defendant indicated, a "plethora of medical evidence," was presented at trial. That evidence indicated plaintiff's life will be negatively affected for the remainder of his life, with a life expectancy of more than 40 years.

While it is true that plaintiff has retained a certain amount of ability to function since the accident as defendant enumerates, the evidence also showed that each of those activities listed by defendant is limited by plaintiff's lost mobility, increased pain, and depression. Furthermore, testimony was given indicating that, as plaintiff aged and his body deteriorated, his symptoms would likely worsen. While \$6 million is a large sum, it is by no means so large as to shock the conscience as compensation for the lifetime of consequences that plaintiff and his family face due to the physical and mental limitations posed by his injuries.

III. CONCLUSION

Accordingly, for the aforementioned reasons, the decision of the trial court is affirmed.

Affirmed.

NEVILLE, P.J., and CAMPBELL, J., concur.

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2004-Ohio-3754

Ron Baxter, Plaintiff,

v.

Ohio Department of Transportation, Defendant.

Case No. 2004-04949-AD.

Court of Claims of Ohio.

Filed June 23, 2004.

Ron **Baxter**, 1516 Canterbury Road, Marion, **Ohio** 43302, Plaintiff, Pro se.

Ohio Department of Transportation, 400 E. Williams Street, Delaware, **Ohio** 43015, for Defendant.

ENTRY OF DISMISSAL

{¶1} On April 26, 2004, plaintiff was ordered to either pay the \$25 filing fee or to file a poverty affidavit with supporting documentation. Plaintiff has failed to comply with the court order. Therefore, plaintiff's action is DISMISSED, without prejudice, pursuant to Civ.R. 41(B)(1). The court shall absorb the costs of this case. The clerk shall serve upon all parties notice of this entry of dismissal and its date of entry upon the journal.

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805 N.E.2d 681 (2004)**346 Ill. App.3d 766****282 Ill.Dec. 62**

Phillip MATUSZAK and Judy Matuszak, Plaintiffs-Appellants,
v.
Gerald CERNIAK and St. Joseph Medical Center, Defendants-Appellees.

No. 3-02-0320.

Appellate Court of Illinois, Third District.

February 25, 2004.

682 *682 David A. Novoselsky, David A. Novoselsky & Associates, Leslie J. Rosen (argued), Novoselsky Law Offices, Chicago, for Judith A. Matuszak, Phillip Matuszak.

Daniel P. Slayden, Hinshaw & Culbertson, Joliet, Joshua G. Vincent (argued), Chicago, for St. Joseph Hospital.

Pamela D. Gorcowski (argued), Rooks, Pitts & Poust, Joliet, for Dr. Gerald Cerniak.

Justice McDADE delivered the opinion of the court:

Plaintiff, Phillip Matuszak, brought a medical malpractice action against his treating physician and hospital for damages allegedly sustained during a colonoscopy procedure. The trial court entered judgment on a jury verdict for defendants, and plaintiff timely appealed. In this appeal, plaintiff presents only one issue for review: Whether the trial court committed reversible error in allowing defendant's expert witness to render speculative opinions regarding the possible causes of his injury. We find the court did not err and we affirm.

FACTS

This present lawsuit arises from plaintiff's 1996 colonoscopy involving the use of the drug Versed. The record reveals that in July of 1996, plaintiff developed abdominal cramping and had blood in his stools. After he had been evaluated by his family physician, it was recommended that he undergo a colonoscopy in order to further assess his digestive tract.

Colonoscopy is a procedure in which a flexible, lighted instrument connected to a video screen is inserted into the rectum and moved around to permit examination of a patient's large intestine. Plaintiff's colonoscopy was performed on July 26, 1996, by Dr. Gerald Cerniak at St. Joseph's Medical Center.

Prior to the procedure, Dr. Cerniak ordered the administration of three drugs, Demerol, Phenergan and Versed, to induce conscious sedation, calming and anti-nausea effects to reduce patient discomfort during the procedure. Versed, which acts directly on the patient's central nervous system, causes respiratory depression, which in turn could lead to hypoxia, a lack of oxygen in the blood.

During the procedure, the monitoring of oxygen saturation after the administration of Versed is a critical function, since a patient whose blood oxygen drops below a certain level for even a short period of time can suffer brain damage, and possibly death. Along with other devices for monitoring his vital signs, a pulse oximeter, a device attached to the patient's finger, was used during plaintiff's colonoscopy to record pulse as well as to determine oxygen saturation in the blood. The oximeter sounds an alarm if the blood oxygen falls below the critical 90% level.

683 Judy Dunham and Barbara Scott, registered nurses employed by St. Joseph's *683 Medical Center, monitored Matuszak's vital signs and oxygen saturation level at specific intervals during the colonoscopy. The first notation that the

nurses made on plaintiff's medical chart showed that at 10:50 a.m., plaintiff had been given 75 milligrams of Phenergan and 50 milligrams of Demerol. A five-milligram dose of Versed was administered at 11:55 a.m. Plaintiff's chart showed that he had an oxygen saturation level of 98% at that time, a reading in the upper range of normal. At noon, plaintiff received another five milligrams of Versed; his oxygen saturation was recorded at 90%, the lowest point within the normal range. By 12:15 p.m., his blood oxygen had risen to 96%, and it remained at that level until the procedure was completed at 12:25 p.m. There was no evidence that the pulse oximeter alarm ever sounded.

Plaintiff was discharged from St. Joseph's at 1 p.m. It was shown that he had lunch at a local restaurant, visited several stores and shops, and later that evening, engaged in sexual relations with his wife. Testimony at trial indicated that such sexual activity is not possible within 24 hours of an hypoxic event. Several days after the procedure, plaintiff became confused and disoriented, causing his wife to worry. Plaintiff was hospitalized in mid-August 1996, after a period of confusion, lethargy, and severe headaches.

Plaintiff's wife Judy testified that plaintiff developed symptoms of confusion and disorientation immediately after the colonoscopy. She stated that plaintiff's prior medical impairments included headaches, dizziness, ear infections, and upper respiratory tract infections. Additionally, she testified that plaintiff had been using the drug Valium on a regular basis for relief from injuries he sustained in a 1968 automobile accident.

Subsequent hospital examinations revealed decreased blood flow to both sides of plaintiff's brain. A Single Photon Emission Computed Tomography (SPECT) scan, performed at Loyola University Medical Center, provided evidence of diminished brain activity. The scan showed diminished blood flow in the temporal lobe and parietal area of plaintiff's brain. Following the initial tests and hospitalization, plaintiff continued to exhibit the above mentioned symptoms, plus angry outbursts, paranoia, and short-term memory problems.

He was next examined at the Mayo Clinic in Rochester, Minnesota. Doctors at the Mayo Clinic performed a differential diagnosis, which accounts for or rules out other medical conditions that may cause or contribute to plaintiff's present symptoms and complaints. This diagnosis led them to conclude that plaintiff suffers from a "cognitive dysfunction of unknown etiology."

The pertinent issue at trial was whether defendants deviated from the standard of care in failing to properly administer the appropriate amount of the drug Versed. Plaintiff therefore presented the testimony of various standard-of-care experts at trial, including Dr. William Cahill, who specializes in internal medicine and is board certified. Dr. Cahill testified that Dr. Cerniak gave plaintiff "too much Versed, which is a very dangerous drug. * * * [H]e gave it too quickly. He didn't wait long enough in between the individual doses to be sure on what the effect of the drug was. He didn't know what it was. He gave it too quickly." Dr. Cahill further stated that the oxygen saturation level of 90% was below normal and subsequently caused irreversible damage to plaintiff's brain. He explained that, when a brain is deprived of oxygen, it will recover unless and until a threshold is reached, and after that time, *684 permanent injury results. Dr. Cahill concluded that such a threshold was reached in this case.

Plaintiff next presented the testimony of Dr. William Berger, a board-certified anesthesiologist. Dr. Berger described defendants' use of the medication as "way too much" throughout the colonoscopy procedure. He also opined that a "reasonable physician" should "guard against * * * giving this much Versed." He further stated that the risk of brain injury existed in this case when plaintiff's oxygen saturation reading was recorded at 90%.

However, it appeared that plaintiff's medical experts who testified on causation could not definitely conclude that the administration of Versed on July 26 caused either an hypoxic event or plaintiff's conditions. Dr. Ronald Petersen, plaintiff's treating physician at the Mayo Clinic, informed the jury that it was unlikely that hypoxia was the cause of plaintiff's conditions. Dr. Petersen examined plaintiff's SPECT scan results and concluded "that the SPECT blood flow pattern, interpretations, are nonspecific."

Dr. Morris Fishman, plaintiff's treating physician during his hospitalization at Loyola, testified that the testing that had been performed on plaintiff could not conclusively establish the origin of his symptoms. Dr. Fishman stated that based on his examination and treatment of plaintiff, he could not find "clear evidence for any meaningful structural neurological

injury. Nor could [Dr. Fishman] on the basis of the available evidence relate it to the colonoscopy in July." Both doctors relied on differential diagnosis to arrive at their conclusions. Each identified several possible causes for plaintiff's symptoms, including Alzheimer's disease, stroke, elevated urinary arsenic level, rheumatoid arthritis, depression, and an infectious disease process suggested by elevated protein levels found in plaintiff's cerebral spinal fluid. Both experts considered those alternatives and ruled them out. Having also ruled out an hypoxic event as a likely cause, both of plaintiff's treating experts reached the conclusion that plaintiff suffered from a "cognitive dysfunction of unknown etiology."

Defendants called Dr. Davidson, who also utilized differential diagnosis to develop the following opinion concerning the cause of plaintiff's conditions:

"Q. [defense attorney]: Doctor, within a reasonable degree of medical certainty, will you share with the ladies and gentlemen of the jury what you consider to be an appropriate differential diagnosis of the condition of [plaintiff]?"

A [Dr. Davidson]: I agree with the Mayo Clinic diagnosis as cognitive dysfunction of unknown etiology. The differential includes some degenerative disease of the brain, such as Alzheimer's disease, a progressive degenerative disease and there's several types. Secondly, a static cognitive dysfunction, which is made worse by an ongoing psychiatric difficulty or emotional difficulty.

Thirdly, he was in a car accident in the 1960's, which caused a significant head injury, at least significant for them to do a number of spinal taps. Fourthly, he did have some abnormalities in his work-up that weren't entirely explained, such as high arsenic level in his urine.

He has a history of rheumatoid arthritis, which can cause brain problems, he has an unexplained elevated white count. He had an antinuclear antibody that was slightly positive, all suggesting he may have an immunological problem. Also he sees an infectious disease doctor, who's told him that he has too many infections. So he might have a problem with his immune system.

* * *

685 *685 Q. Now, Doctor, based upon your review of the records and the testimony, depositions in this case, do you have an opinion whether that cognitive dysfunction is related to a hypoxic episode that occurred on July 26 of 1996.

A. Yes, I have an opinion.

Q. What is that?

A. There's no evidence in any of these records that he had an hypoxic episode."

Plaintiff objected on the ground that this opinion was speculative. The trial court overruled the objection.

Dr. Davidson next explained that differential diagnosis is a standard scientific technique for identifying the cause of a medical problem by eliminating the likely causes until the most probable one is isolated. He made plaintiff's differential diagnosis "by reviewing the [medical records] and the transcripts of the depositions." The result of his diagnosis left some of plaintiff's conditions as possible causes of his cognitive dysfunction and ruled out hypoxia.

On cross-examination, plaintiff's trial counsel confronted Dr. Davidson with Dr. Petersen's testimony, which excluded Alzheimer's disease as a possible cause of plaintiff's symptoms:

"Q. [Plaintiff's attorney:] Am I correct that you feel one of the differential diagnoses that you have made, at least, is some progressive dementing illness, such as Alzheimer's?"

A. That's a possibility.

Q. Are you aware that * * * Dr. Petersen did not feel Alzheimer's was likely, yet, you disagree with that?

A. No. I don't think it's likely. It's part of my differential. If I thought anything is likely, I would say this is the diagnosis to a reasonable degree of medical certainty. I am saying that these are the possibilities. Now, I am not saying that [plaintiff] likely has Alzheimer's. I just list it as one of the possibilities."

Plaintiff filed his timely appeal, alleging that the trial court's refusal to bar Dr. Davidson's "speculative and prejudicial" testimony constituted reversible error.

ANALYSIS

Generally, expert testimony is admissible if the proffered expert is qualified as an expert by knowledge, skill, experience, training, or education and the testimony will assist the trier of fact in understanding the evidence. Friedman v. Safe Security Services, Inc., 328 Ill.App.3d 37, 262 Ill.Dec. 278, 765 N.E.2d 104 (2002). The decision to admit opinion testimony lies within the trial court's sound discretion, and a reviewing court will not reverse its decision absent an abuse of discretion. Van Holt v. National R.R. Passenger Corp., 283 Ill.App.3d 62, 218 Ill.Dec. 762, 669 N.E.2d 1288 (1996).

On appeal, plaintiff claims that the trial court should have barred Dr. Davidson from rendering any opinion regarding other possible causes of plaintiff's conditions. Plaintiff does not challenge Dr. Davidson's credentials but instead maintains that his differential diagnosis opinion was not admissible because he failed to rule out other possible causes in reaching his conclusion. We find this argument without merit.

It is permissible for a medical expert to testify concerning his or her opinions in terms of possibilities or probabilities. Baird v. Adeli, 214 Ill.App.3d 47, 157 Ill.Dec. 861, 573 N.E.2d 279 (1991). The expert may testify to what might or could have caused an injury despite any objection that the testimony is inconclusive. Geers v. Brichta, 248 Ill.App.3d 398, *686 187 Ill.Dec. 940, 618 N.E.2d 531 (1993). The testimony need not be based on absolute certainty, but only a reasonable degree of medical and scientific certainty. Nowicki v. Union Starch & Refining Co., 1 Ill.App.3d 92, 272 N.E.2d 674 (1971). It remains for the trier of fact to determine the facts and the inferences to be drawn from the testimony. Mesick v. Johnson, 141 Ill.App.3d 195, 95 Ill.Dec. 547, 490 N.E.2d 20 (1986).

Our conclusion is consistent with the Illinois Supreme Court decision in Field Enterprises v. Industrial Comm'n, 37 Ill.2d 335, 226 N.E.2d 867 (1967). In Field, the claimant's husband died while working at his employer's factory. One of claimant's medical experts opined that the cause of death was "organic heart disease of some type and that decedent died of heart failure because of it." Field, 37 Ill.2d at 338, 226 N.E.2d 867. Another medical expert, however, testified that the cause of death was an acute coronary episode with a myocardial infarction. The employer's medical witness stated that a number of conditions could have caused the decedent's death in view of his medical history. The Industrial Commission found in favor of the claimant and awarded her compensation for her husband's death. On appeal, the employer argued that the Commission's finding that the decedent died of a heart attack was purely speculation and unsupported by the evidence. The employer maintained that the Commission's finding was not proper in that case because the claimant failed to present evidence to negate the other reasonable causes for the decedent's death. Our supreme court affirmed the finding of the commission, holding that "[t]he claimant was not required to negate every other possible cause of death to establish death by reason of a heart attack as a legitimate inference from the evidence." Field, 37 Ill.2d at 339, 226 N.E.2d 867.

We are also provided direction by decisions of the federal courts addressing the precise issue raised here. In Heller v. Shaw Industries, Inc., 167 F.3d 146 (3rd Cir.1999), the Third Circuit Court of Appeals held that a medical expert's causation opinion should not be excluded because he or she fails to rule out every possible alternative cause of a patient's medical problem. In Heller, the plaintiff brought a personal injury suit against a carpet manufacturer, alleging respiratory problems after its carpet was installed in her home. Plaintiff's medical expert was able to rule out, after conducting a differential diagnosis, various possible causes of the plaintiff's respiratory problems. He also offered a number of plausible alternative causes, including dust from other carpets, benzene and 2-butoxyethanol from other

sources, and paint and new hardwood floors in the house. The trial court granted the defendant's motion to exclude the expert's testimony because he failed to rule out all alternative possible causes of the plaintiffs' illness.

The circuit court reversed. Chief Circuit Judge Edward Becker, writing for the majority, reasoned: "[T]o require the experts to rule out categorically all other possible causes for an injury would mean that few experts would ever be able to testify..." Heller, 167 F.3d at 156, quoting Capra, *The Daubert Puzzle*, 32 Ga. L.Rev. 699, 728 (1998). Judge Becker further explained that the alternative causes suggested by the medical expert only affected the weight that the jury should give the expert's testimony and "not the admissibility of that testimony." Heller, 167 F.3d at 157. See also Westberry v. Gislaved Gummi AB, 178 F.3d 257, 265 (4th Cir.1999) ("[A] differential diagnosis that fails to take serious account of other potential causes may be so lacking that it *687 cannot provide a reliable basis for an opinion" * * *).

In the instant case, we similarly find that the admissibility of Dr. Davidson's opinion does not depend upon his ability to disprove every possible cause of plaintiffs' injury. Dr. Davidson gave his opinion, based upon a reasonable degree of medical certainty, that plaintiffs' injuries were caused by an unknown etiology.

Dr. Davidson utilized the process of differential diagnosis to reach his conclusion. In performing his diagnosis, he considered several alternative causes of plaintiffs' conditions including plaintiffs' prior car injury, an immunological disorder, rheumatoid arthritis, or Alzheimer's disease. Dr. Davidson stated that he relied on other experts' testimony and was aware of plaintiffs' medical history. He also reviewed plaintiffs' clinical test results, including the SPECT scan results and the Mayo Clinic differential diagnosis. His conclusion was, in fact, the same as that of Drs. Petersen and Fishman, two of plaintiffs' own experts, even though he did not rule out all other possible causes as they did. None of them found hypoxia to be a likely cause of plaintiffs' symptoms. We conclude that his testimony assisted the jury in understanding the evidence and the trial court did not abuse its discretion in admitting this testimony.

Plaintiff next argues that "there was no reliable evidence that any of these conditions caused [plaintiffs'] condition." He draws our attentions to the cases of Reed v. Jackson Park Hospital Foundation, 325 Ill.App.3d 835, 259 Ill.Dec. 460, 758 N.E.2d 868 (2001), and Gariti v. Karlin, 127 Ill. App.2d 166, 262 N.E.2d 179 (1970).

In *Reed*, the trial court barred defendant's medical expert from testifying that there was a 20% chance the plaintiff's eye could have been saved had the eye injury been discovered at the emergency room rather than four days later. The appellate court affirmed, holding that the expert "lacked the knowledge of the condition of plaintiff's eye" when he entered the emergency room. Reed, 325 Ill.App.3d at 844, 259 Ill.Dec. 460, 758 N.E.2d 868. In *Gariti* the defendant's medical expert testified that defendant motorist suffered from a diabetic attack, which caused his vehicle to swerve across the center line and collide with the plaintiff's car. The reviewing court considered this testimony highly speculative and improper because there was no evidence that the defendant was diabetic before the accident or that his vehicle crossed the center line before the collision.

Both *Reed* and *Gariti* suggest that when an expert's opinion is totally lacking in factual support, it is nothing more than conjecture and guess and should not be admitted as evidence. See also Wilson v. Bell Fuels, Inc., 214 Ill.App.3d 868, 158 Ill.Dec. 406, 574 N.E.2d 200 (1991).

In this case, however, there is certainly evidence in the record—from plaintiff's medical history and from clinical tests—to support the differential diagnosis. Dr. Davidson also offered good explanations as to why his diagnosis was reliable. For example, the evidence showed that plaintiff had a history of rheumatoid arthritis. Dr. Davidson testified that rheumatoid arthritis was one of the conditions that would predispose plaintiff to his current neurological difficulties. Further, Dr. Davidson listed plaintiff's prior automobile accident as a possible contributing factor. He pointed out that plaintiff had suffered a serious head injury from his 1968 car accident for which prescription pain medication was appropriate. We believe these examples are sufficient to give Dr. Davidson reliable ground for his conclusion, even *688 though plaintiff did not agree with that conclusion.

CONCLUSION

For these reasons, we conclude that no reversible error occurred as a result of Dr. Davidson's testimony. The judgment of the circuit court of Will County is affirmed.

Affirmed.

HOLDRIDGE, P.J., and BARRY, J., concur.

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IN THE COURT OF APPEALS OF OHIO
TENTH APPELLATE DISTRICT

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FRANKLIN CO. OHIO

2002 DEC 19 PM 12:39

CLERK OF COURTS

Margaret I. Baxter et al.,

Plaintiffs-Appellants,

v.

Ohio Department of Transportation
et al.,

Defendant-Appellee.

ORIGINAL

No. 02AP-537

00-COC-08681

(REGULAR CALENDAR)

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O P I N I O N

Rendered on December 19, 2002

*Frank A. Ray Co., L.P.A., Frank A. Ray, Savage, Garner,
Elliott & O'Brien, and Joe C. Savage, for appellants.*

*Betty D. Montgomery, Attorney General, Michael J. Valentine
and John P. Reichley, for appellees.*

APPEAL from the Court of Claims of Ohio

TYACK, P.J.

{¶1} On August 11, 2000, Margaret Ilene Baxter, Martin Baxter, Earl W. BaxterMoore, Patricia L. BaxterMoore, Danielle I. BaxterMoore, and Agapi G. BaxterMoore filed a complaint in the Court of Claims of Ohio against the Ohio Department of Transportation ("ODOT"). The Office of Risk Management ("ORM") was later added as a defendant. The complaint arose out of an automobile collision involving the named plaintiffs and an ODOT employee driving a state vehicle. Margaret and Martin Baxter are the parents of Patricia BaxterMoore, who is married to Earl BaxterMoore. The BaxterMoorees have two minor daughters, Danielle and Agapi.

ON COMPUTER

{¶2} The complaint set forth many claims for relief, including claims sounding in personal injury/negligence and loss of consortium. Eventually, the defendants admitted liability, and the sole issue remaining for trial was whether ODOT's negligence proximately caused damages and the nature and extent of any such damages. In addition, the defendants settled with Margaret and Martin Baxter and with Earl BaxterMoore as to all but his loss of consortium claim.

{¶3} A trial was held on November 5 and 6, 2001. In addition to the trial testimony, the parties submitted several trial depositions. The parties filed post-trial briefs.

{¶4} On April 10, 2002, a decision and judgment entry were journalized. The trial court found, in part, that Patricia BaxterMoore had suffered a mild concussion as a result of the motor vehicle accident. The trial court awarded \$19,081.91 for property damages, \$25,000 for loss of income, \$30,000 to Patricia BaxterMoore for noneconomic damages, \$20,000 on Earl BaxterMoore's loss of consortium claim, and \$5,000 each to the BaxterMoore's minor children for their loss of parental consortium claims.

{¶5} The BaxterMoore's (hereinafter collectively referred to as "appellants") have appealed to this court, assigning the following as error:

{¶6} "1. THE TRIAL JUDGE ERRONEOUSLY OVERRULED PLAINTIFFS' MOTION TO EXCLUDE INADMISSIBLE PORTIONS OF DR. BOUMAN'S TESTIMONY.

{¶7} "2. IN HIS DECISION AND JUDGMENT ENTRY, THE TRIAL JUDGE ERRED BY DENYING FUTURE DAMAGES WHEN HE RENDERED A FACTUAL FINDING THAT PATRICIA BAXTERMOORE'S BRAIN DAMAGE 'COULD' IMPROVE WITH TREATMENT.

{¶8} "3. THE TRIAL JUDGE'S DECISION AND JUDGMENT ENTRY ARE AGAINST THE MANIFEST WEIGHT OF THE EVIDENCE."

{¶9} In their first assignment of error, appellants contend the trial court erred in denying their motion to exclude certain portions of the testimony of an expert witness called by ODOT/ORM (hereinafter "appellees"). Dawn E. Bouman, Ph.D., testified at a deposition on October 23, 2001. As indicated above, the trial was held on November 5 and 6, 2001. On the first day of trial, November 5, 2001, appellants filed a motion to strike certain portions of Dr. Bouman's testimony, asserting that such testimony was not

admissible expert testimony under the test set forth in *Stinson v. England* (1994), 69 Ohio St.3d 451. On the second and last day of trial, November 6, 2001, Dr. Bouman's deposition was admitted without objection. On November 13, 2001, appellees filed a memorandum contra appellants' motion to strike portions of Dr. Bouman's testimony. On December 11, 2001, the trial court filed an entry denying appellants' motion.

{¶10} As to any issue involving waiver, we find that appellants properly preserved any possible error. During Dr. Bouman's deposition itself, appellants' counsel objected to the testimony at issue. He then filed a written objection/motion to strike with the trial court on the first day of trial. Given all of this, appellants did not waive any alleged error by failing to object at trial to the admission of Dr. Bouman's deposition.

{¶11} We now turn to the issue of whether certain testimony of Dr. Bouman should have been excluded. Appellants contend this testimony did not meet the test set forth in *Stinson*. Specifically, appellants point to Dr. Bouman's testimony that Patricia BaxterMoore "might" get slightly better if Dr. Bouman's recommendations were followed. Appellants assert that such testimony was improper because it was not stated in terms of probability.

{¶12} In *Stinson*, the Supreme Court held:

{¶13} "The admissibility of expert testimony that an event is the proximate cause is contingent upon the expression of an opinion by the expert with respect to the causative event in terms of probability. * * * An event is probable if there is a greater than fifty percent likelihood that it produced the occurrence at issue. * * * Inasmuch as the expression of probability is a condition precedent to the admissibility of expert opinion regarding causation, it relates to the competence of the evidence and not its weight. * * * Consequently, expert opinion regarding a causative event, including alternative causes, must be expressed in terms of probability irrespective of whether the proponent of the evidence bears the burden of persuasion with respect to the issue." *Id.* at paragraph one of the syllabus.

{¶14} The testimony at issue here is not the same type of testimony of which the Supreme Court spoke in the first paragraph of the syllabus of *Stinson*. *Stinson* was dealing with causation in the context of whether an event is the proximate cause of an occurrence. Here, Dr. Bouman was simply testifying as to what might help Patricia

BaxterMoore. The sole issue at trial was damages, and Dr. Bouman's testimony in this regard went to the amount of future damages Patricia BaxterMoore might have been entitled to, if any, and such testimony did not address causation as discussed in *Stinson*.

{¶15} The primary rule governing admissibility of expert testimony is contained in Evid.R. 702 which states that if scientific, technical or other specialized knowledge will assist the trier of fact in understanding the evidence or in determining a fact at issue, a witness who qualifies as an expert by knowledge, skill, experience, training or education may testify thereto in the form of an opinion or otherwise. There has been no contention that Dr. Bouman was not an expert. As such, her testimony was generally admissible as expert opinion. The issue becomes whether her testimony was probative of any issue, which is a different standard than admissibility which was at issue in *Stinson*. The issue of the probative value of Dr. Bouman's testimony will be addressed at length below.

{¶16} Given all of the above, the trial court did not err in denying appellants' motion to strike and in admitting Dr. Bouman's testimony. Accordingly, appellants' first assignment of error is overruled.

{¶17} Appellants' second and third assignments of error are interrelated and, therefore, will be addressed together. Appellants contend the trial court erred in failing to award future damages and that its judgment was against the manifest weight of the evidence. Specifically, appellants argue the trial court erred in denying future damages on the basis that Patricia BaxterMoore "could" improve with treatment. Appellants assert that the trial court made erroneous factual conclusions and based its decision on Dr. Bouman's testimony, which contradicted her written report. Appellants contend that the evidence clearly showed that Patricia BaxterMoore will never make a meaningful or significant recovery, regardless of the treatment she may receive. Accordingly, appellants request this court reverse the trial court's damages judgment and remand the matter for a re-determination of damages based on these facts.

{¶18} Judgments supported by some competent, credible evidence going to all the essential elements of the case will not be reversed by a reviewing court as being against the manifest weight of the evidence. *C.E. Morris Co. v. Foley Construction Co.* (1978), 54 Ohio St.2d 279, syllabus. Here, the trial court concluded, in pertinent part:

{¶19} "Based upon the evidence presented at trial, the court finds that the collision proximately caused a puncture wound to [Patricia BaxterMoore's] right arm and a mild concussion. The court further finds that the testimony of Dr. Bouman was more persuasive than that of Dr. Granacher, and that [Patricia BaxterMoore's] condition could improve if she were to follow recommendations for treatment that were made by Dr. Bouman." (Decision at 4-5.)

{¶20} As indicated above, the trial court's award included \$25,000 for loss of income and \$30,000 for noneconomic damages. The court made no award representing future economic damages. For the reasons that follow, we find the trial court's judgment was against the manifest weight of the evidence because, in part, it failed to make an award for future economic damages.

{¶21} Prior to setting forth the evidence presented in detail, it will be helpful to emphasize the main facts which are, in essence, undisputed. First, as a result of the motor vehicle accident, Patricia BaxterMoore suffered a mild traumatic brain injury. Such brain injury, referred to as "post-concussive syndrome," resulted in Patricia BaxterMoore suffering significant memory and attention deficits and depression. As to the attention and memory problems, essentially all of the experts and treating professionals agreed that given the length of time from the accident and Patricia's failure to improve, these conditions were permanent. As to the depression component, essentially all of the experts and treating professionals agreed that the brain injury caused Patricia's depression. Thus, in general, we will not go through the abundance of evidence from the varying witnesses relating to these essential facts, as they were largely undisputed.

{¶22} By way of brief background, Patricia BaxterMoore was involved in a motor vehicle collision on October 7, 1998. She was almost 37 years old at the time. During Patricia's first year of college, she began to lose her sight and was later diagnosed with macular degeneration. By the age of 20 or 21, she was declared legally blind. All the evidence showed that Patricia functioned remarkably well despite her disability. She married Earl, who is also blind, and they had a healthy daughter, Danielle. Patricia and Earl lived independently, including in New York City and Seattle, Washington. Patricia had no prior history of psychological problems. Prior to the accident, Mr. and Mrs. BaxterMoore had started their own computer hardware and software business for the

visually impaired, and the business was progressing well. Patricia provided, in essence, all of the technical support for the business and was the "heart and soul" of the business. (Tr., Vol. II at 14.) Approximately two months prior to the accident, the BaxterMoorees adopted a blind girl, Agapi, from Greece.

{¶23} According to Patricia, everything changed after the accident. (Tr., Vol. I, at 74.) Again, Patricia suffered a mild concussion in the collision, and she developed post-concussive syndrome. She experienced frequent headaches. (Knox deposition at 11.) She had trouble with her memory and concentration; she could not think of the "right words." Id. She forgot conversations, and her short-term memory was affected more than her long-term memory. Id. She had no patience and was unable to work under pressure or not at all. Id. As for her role in the computer business, she was no longer able to explain to clients how to fix their computers. Id. By the time of trial, the BaxterMoorees no longer had their business, and Earl was, essentially, taking care of everything—household and otherwise.

{¶24} Robert P. Granacher, M.D., is a psychiatrist with a subspecialty in forensic psychiatry, and a substantial amount of his practice involves head injuries. (Granacher deposition at 7-8.) Dr. Granacher examined Patricia BaxterMoore on April 22 and 23, 1999 and generated a report. Id. at 11. He performed a Single Photon Emission Computed Tomography ("SPECT") scan and numerous neuropsychological tests on Patricia. Id. at 21-22. The SPECT scan should not be given in the absence of the neuropsychological testing. Id. at 22. The SPECT scan showed alteration of blood flow in two major parts of Patricia's brain—the occipital area, which was related to her rod and cone disease (which caused her blindness), and the parietal areas, which Dr. Granacher stated was related to the problems stemming from the accident. Id.

{¶25} Dr. Granacher indicated that Patricia BaxterMoore has two "primary problems." Id. at 26. She has a cognitive disorder of attention and memory due to brain dysfunction, and she has a mood disorder, i.e., depression. Id.

{¶26} Dr. Granacher saw Patricia two years later, in May 2001. Id. at 28. She was more depressed, had significant impairment of attention, and a significant reduction in thought and motor speed. Id. at 30. Dr. Granacher stated that Patricia tested worse on everything. Id. at 31. Dr. Granacher further stated:

{¶27} “* * * [M]ost brain injuries after a period of time become static. If the person’s cognitive state changes, it must have an explanation other than a change in structure of the brain. And that explanation in this case is she has now developed a progressively worsening organic mood disorder, depression, from the original post-concussive injury.” Id. at 31.

{¶28} Dr. Granacher went on to state that at 12 to 18 months, from a neurological standpoint, a person has reached maximum medical improvement from any closed-head injury. Id. at 32. Here, Mrs. BaxterMoore’s worsening condition was due to her depression, and her overall condition, including the depression, was a direct outcome of the motor vehicle accident. Id. at 32, 39. Dr. Granacher stated that her problems are permanent given that it had been three years since the accident. Id. at 39-40.

{¶29} Craig A. Knox, M.D., is board certified in neurology, and 100 percent of his time is spent specializing in persons with memory disorders or brain injury. (Knox deposition at 6-7.) Dr. Knox saw Patricia BaxterMoore on June 29, 1999 and July 21, 1999. Id. at 8, 15. Dr. Knox diagnosed her with post-concussive syndrome due to the motor vehicle accident and indicated that this was causing most of her memory and attention problems. Id. at 18. He also felt that there was “some component of depression going on which was a potentially treatable component.” Id. He prescribed her various medications, including Imipramine, an antidepressant. Id. at 15. Patricia noticed that her moods were more level when she was on the Imipramine. Id.

{¶30} Dr. Knox stated that the most common symptoms of post-concussive syndrome were headaches, poor memory, poor concentration, dizziness, depression and perhaps some neck pain. Id. at 19. He indicated that most patients show considerable improvement three to six months after the head injury and that some improvement can occur perhaps a year or two later. Id. at 20. If the symptoms are still occurring three years later, they are probably permanent. Id. at 21.

{¶31} Dr. Knox noted that Patricia’s CAT scan, MRI and EEG came back normal; however, he stated that it is quite rare that such tests would show abnormalities in persons who have had a head injury. Id. at 34-35, 37, 48. Dr. Knox testified that the two most sensitive tests to detect any significant problems with the brain after a head injury are neuropsychological tests and a SPECT scan. Id. at 37-38. Dr. Knox noted that the

neuropsychological tests and SPECT scan performed on Patricia BaxterMoore by Dr. Granacher were abnormal. *Id.* at 36.

{¶32} Dr. Bouman is a licensed clinical psychologist who works predominately in rehabilitation and neuropsychology and treats people with traumatic brain injuries. (Bouman deposition at 4.) Dr. Bouman performed a neuropsychological exam of Patricia BaxterMoore on July 3, 2001. *Id.* at 13. In essence, Dr. Bouman's tests results were the same as Dr. Granacher's—Patricia suffered from severe attention and memory deficits and depression. *Id.* at 21; Bouman report. Dr. Bouman attributed Patricia's condition to the motor vehicle accident. (Bouman deposition at 39.)

{¶33} At this point, we must point out that the trial court indicated that while Dr. Granacher had opined that the SPECT scan provided objective evidence of diminished brain activity, other evidence showed that the results of the SPECT scan did not correspond to Patricia BaxterMoore's attention and memory deficits. (Decision at 4.) Indeed, Dr. Knox testified that the SPECT scan results did not confirm the injuries or abnormalities, specifically, the memory and attention problems, experienced by Patricia BaxterMoore. (Knox deposition at 53-54.) Dr. Knox testified that the SPECT scan showed no diminished activities in the frontal or temporal lobes, which pertain to attention and memory. *Id.* at 52. In addition and on essentially the same bases, Dr. Bouman testified that the SPECT scan results did not correlate to attention or memory deficits. (Bouman deposition at 21.)

{¶34} However, Dr. Knox stated that the SPECT scan results did not rule out the type of injury here and that he had other patients who had significant head injuries and yet had normal SPECT scans. (Knox deposition at 65.) Dr. Knox stated that the neuropsychological testing is the most likely test to show abnormalities and that Dr. Granacher had performed 11 such exams on Patricia BaxterMoore. *Id.* at 66. Dr. Knox testified that Dr. Granacher had done extensive neuropsychological testing on Patricia and that he would have performed them on Patricia had Dr. Granacher not because they are that important. *Id.* at 66-67.

{¶35} On cross-examination, Dr. Knox was asked if he agreed that with all the diagnostic tests performed, from an objective standpoint, there was nothing to suggest Mrs. BaxterMoore was suffering from attention or memory problems. *Id.* at 55. Dr. Knox

responded that there was an "abundance of evidence" to support the diagnosis. *Id.* He based this on his direct contact with Mrs. BaxterMoore and on the results of the neuropsychological testing performed by Dr. Granacher. *Id.* at 56. On re-direct, Dr. Knox indicated that despite the cross-examination and what he knows, he was still of the opinion that Patricia BaxterMoore suffered from post-concussive syndrome caused by the accident and that the symptoms she had been reporting over the years were true and genuine symptoms of the head injury. *Id.* at 67. Further, Dr. Bouman testified that SPECT scans were not in her area of expertise and that she would defer to Dr. Granacher's interpretation. (Bouman deposition at 43.)

{¶36} Finally, Dr. Granacher testified that the SPECT scan confirmed Patricia BaxterMoore's brain problems. (Granacher deposition at 26.) Dr. Granacher stated that one cannot use the SPECT scan to accurately localize where problems are occurring in the brain—that it is not designed to do that—and that no one could do so accurately because of Mrs. BaxterMoore's visual impairment. *Id.* Again, Dr. Granacher stated that one of the problems in her brain that was detected by the SPECT scan was related to the motor vehicle accident. *Id.* at 22.

{¶37} Given the above, to the extent the trial court disregarded Dr. Granacher's testimony and opinions as a whole, due to his opinion on the SPECT scan results and any contrary testimony, this was against the manifest weight of the evidence. The evidence from all the experts as to the SPECT scan in general and the specific results here confirm Dr. Granacher's opinions. Thus, the trial court erred to the extent it concluded that Dr. Granacher's opinions were unpersuasive.

{¶38} Indeed, the overwhelming majority of the evidence shows that Patricia BaxterMoore suffered from significant memory and attention deficits and depression, and virtually all the experts and professionals, including Drs. Knox and Bouman, agreed that all of these problems stemmed from the accident.

{¶39} We now turn to the main issue: whether the trial court should have awarded future economic damages. This issue turns on the evidence relating to Patricia BaxterMoore's condition and her prognosis. Again, virtually all the witnesses agreed that Patricia suffered from significant problems due to the motor vehicle accident. As to the memory and attention deficits, the evidence shows that such deficits are permanent and,

for the most part, cannot be treated. For this reason alone, the trial court erred in failing to award Patricia future economic damages. Further, the trial court's decision was obviously based on its interpretation of Dr. Bouman's testimony that Patricia's condition was caused by depression and that such condition was treatable. For the reasons that follow, however, we find that the trial court erred in failing to award future economic damages based on Dr. Bouman's testimony.

{¶40} Again, all experts and professionals agreed that Patricia BaxterMoore suffered from moderate to severe depression. More significantly, Drs. Knox, Granacher, and Bouman agreed that the depression was caused by the accident. (Knox deposition at 67; Granacher deposition at 26, 31, 45, 48, 62; Bouman deposition at 38-39, 44-46; and Bouman report.) In his report, Dr. Knox indicated that Mrs. BaxterMoore's depression was a "potentially treatable condition." Further, his report stated:

{¶41} "Dr. Granacher has stated that in his opinion she does not have the mental capacity to engage in any work and that she has a 25% Class III neuropsychiatric impairment. She and her husband have a computer business in which they fix computers for visually impaired individuals. In general, I would agree with Dr. Granacher's comments, although it is certainly possible that over the next several months her symptoms may improve to the point where she may be able to return to work." (Knox report at 2.)

{¶42} We note that Dr. Knox only stated that Patricia's depression was "potentially" treatable. Thus, this evidence cannot serve as a basis to deny future economic damages. If anything, it supports an award to cover long-term treatment for her depression. In addition, Dr. Knox only indicated that it was "possible" Patricia's symptoms might improve over the next several months and that she "may be able" to return to work. Dr. Knox's report was made in September 1999. As indicated above, Patricia's symptoms not only did not improve after September 1999, they worsened.

{¶43} Dr. Granacher testified that it was much more difficult to treat a "closed-head injury depression" than it was a "natural-occurring depression," even with medication. (Granacher deposition at 33.) Dr. Granacher stated that in closed-head injuries, depression is the most common psychiatric outcome. *Id.* at 48. Dr. Granacher stated that generally, people will cycle out of depression, but Patricia has not. *Id.* at 40.

Dr. Granacher opined that Patricia's depression was permanent. Id. He stated that Patricia BaxterMoore was one the most depressed persons after a head injury that he had seen in years, that it would not be easy to treat her, and that antidepressants would only help a little. Id. at 44-45. He did not expect that she would come back to even a moderate recovery, even with treatment. Id. at 45. He stated that it was not likely she would become independent and could go back to work. Id. at 46. As for counseling, Dr. Granacher stated, "* * * it would be a help; it's not curative but—and it's the compassionate humanitarian thing to do." Id. at 47.

{¶44} Dr. Granacher stated that the mood disorder was contributing to Patricia's cognitive problems, that the two were intimately intertwined, and that you could not separate one from the other. Id. at 62-63. He testified that depression is treatable and that he could not say what Patricia's response to treatment would be. Id. at 63. Finally, Dr. Granacher testified as follows:

{¶45} "Post-concussive depression, as I've pointed out, occurs in at least half of these kinds of head injuries. It can be severely debilitating and often is the major debilitating outcome. As I told the Judge, depression is a brain disorder not some little emotional problem because things aren't going well in your life. She has a brain disease and depression is part of that brain disease, and her brain disease came from this motor vehicle accident. It includes a cognitive component and a depressive component. They are intimately intertwined and cannot be separated. They both come and derive from this accident.

{¶46} "* * *

{¶47} "* * * [C]ognitive enhancers and the antidepressants may improve her ability to function, but at her level of current impairment, and we—we have to take her as she is. We had a blind lady, so we are talking about treating a blind lady. We're not talking about treating the people sitting around this table. The best we're going to bring her to is some improved level of function, but she's still going to be very impaired. She's going to still be a blind lady who now has a[n] attentional memory deficit and a depression, even though we may have improved the quality of the attentional deficit memory disorder and depression." Id. at 73-75.

{¶48} Dr. Bouman spoke in general terms about what can cause depression. (Bouman deposition at 27-28.) She opined that Patricia's depression was treatable. Id. at 29-31. Dr. Bouman testified that "[a]s I stated in my written evaluation from 7-3-01, I do believe that implementation of the following recommendations might offer Ms. BaxterMoore at least a slight relief of her symptoms." Id. at 30. Specifically, Dr. Bouman's report stated:

{¶49} "Although I do not believe that dramatic changes could be made in Ms. BaxterMoore's presentation, particularly given the length of time since her injury is approaching three years, I do believe that implementation of the following recommendations might offer Ms. BaxterMoore at least slight relief of her symptoms.

{¶50} "1. I strongly recommend that Ms. BaxterMoore engage in individual and/or family psychotherapy focusing on adjustment to disability, education regarding traumatic brain injury and compensatory techniques and redefining family roles. While major depression is responsive to such treatment, this would, of course, only assist with a slight portion of her attentional problems.

{¶51} " * * *

{¶52} "5. Lastly, although Ms. BaxterMoore does not presently have ability to engage in gainful employment for which she is trained due to the severe difficulties she is experiencing with attention, concentration and memory, it is possible that with extensive aggressive treatment in all the areas recommended above, she would be able to engage in gainful employment on at least a very limited part time basis. If the following treatment recommendations can be followed and are maximally effective, Ms. BaxterMoore would require significant vocational rehabilitation support, whether privately and/or through the Bureau of Vocational Rehabilitation, to resume employment. Again, this depends on numerous optimal circumstances occurring to promote additional compensation. It is not expected that Ms. BaxterMoore would experience any additional medical healing at this time, but may be able to receive some relief of symptoms and learn alternate coping strategies and compensatory techniques." Bouman report at 6.

{¶53} Dr. Bouman further testified that with treatment, it was probable that Patricia would be able to perform daily activities, take care of her children and return to some form of gainful employment. (Bouman deposition at 36-37.) However, this testimony was in

the context of her report which, again, stated only that her recommendations "might" offer Patricia "slight" relief. Dr. Bouman testified that she stood by the statements in her report. Id. at 53. Lastly, Dr. Bouman testified that she could not guarantee it, but that most likely, "aggressive treatment * * * would assist" Patricia, and Patricia would be able to return to work "on a part-time basis." Id. at 54-55.

{¶54} All of the above evidence shows that Mrs. BaxterMoore's depression, at the very least, will take aggressive measures to treat. Even if Dr. Bouman's testimony and opinions were accepted, Dr. Bouman herself stated that she did not believe dramatic changes will be made and only that her recommendations "might" offer "slight" relief. In addition, while Dr. Bouman stated that depression is treatable, she never indicated specifically the extent to which Patricia's depression could be relieved. Indeed, according to Dr. Bouman, *if* Mrs. BaxterMoore obtained relief, it would be due to "aggressive" and "extensive" treatment, and even this would only offer slight assistance. As for returning to work, again, Dr. Bouman stated in her report that with such treatment, Mrs. BaxterMoore would be able to engage in employment only on a "very limited" part-time basis.

{¶55} In summary, no witness testified that Patricia BaxterMoore's condition, including her depression, would significantly improve even with treatment. The one witness who opined that Patricia could obtain some relief, return to daily activities and return to "very limited" part-time work, said so only if Patricia received "aggressive" and "extensive" treatment. Given this evidence, at the very least, future economic damages should have been awarded to provide for such treatment and for appellants' economic needs while Mrs. BaxterMoore attempts such treatment. In making such award, it should also be kept in mind that no witness testified that Patricia BaxterMoore can be totally or even significantly cured.

{¶56} In addition, it is significant that a medical doctor, with a specialty in psychiatry and a practice involving traumatic brain injury, as opposed to a psychologist, who may not prescribe antidepressants, opined that Patricia will not likely see even a moderate recovery. As discussed at length above, Dr. Granacher's testimony and opinions were, in essence, not negated by other testimony and should not have been disregarded by the trial court. This, along with the fact that Dr. Bouman's testimony lacked a clear opinion of the extent of any potential recovery, supports a re-determination

of damages. If anything, Dr. Bouman's testimony supports a finding that Patricia BaxterMoore may only experience slight improvement with treatment. A re-determination of damages must not only include future economic damages to account for the aggressive and extensive treatment needed by Mrs. BaxterMoore, but must include the factor that Mrs. BaxterMoore will never fully recover, even with such treatment. There was ample evidence, especially the testimony and report of Jack M. Sink, Ed.D, from which to make such award(s).

{¶57} We also note that because there will be a re-determination of damages to include future economic damages and given the extent of Mrs. BaxterMoore's injuries and her poor prognosis, the trial court must also re-determine the amounts awarded to her family in their loss of consortium claims and the amount awarded Mrs. BaxterMoore for her non-economic damages.

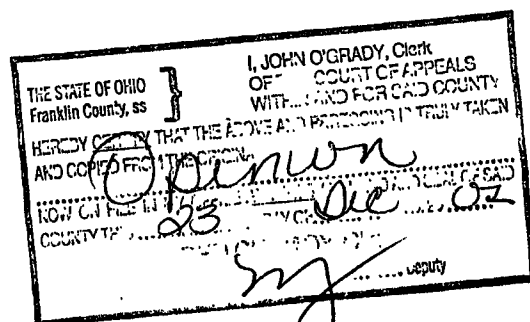
{¶58} For all of the above reasons, the trial court erred in failing to award future damages and, as indicated above, its judgment as a whole was against the manifest weight of the evidence. Accordingly, appellants' second and third assignments of error are sustained.

{¶59} In summary, appellants' first assignment of error is overruled. Appellants' second and third assignments of error are sustained. The judgment of the Court of Claims of Ohio is reversed, and this cause is remanded to such court with instructions to re-determine damages in accordance with this opinion.

*Judgment reversed and cause remanded
with instructions.*

BROWN, J., concurs.

LAZARUS, J., concurs in judgment only.



5

709 So.2d 552 (1998)

Carol BERRY, as personal representative of the Estate of Roy Lee Berry, Jr., deceased,
Appellant,

v.

CSX TRANSPORTATION, INC., Appellee.

James CHRISCO, Appellant,

v.

CSX TRANSPORTATION, INC., Appellee.

Nos. 95-3131, 95-3618.

District Court of Appeal of Florida, First District.

March 3, 1998.

554 *554 Joel D. Eaton of Podhurst, Orseck, Josefsberg, Eaton, Meadow, Olin & Perwin, P.A., Miami; Korn, Zehmer & Gellatly, P.A., Jacksonville (**Berry**); Lane & Gossett, P.C., Brunswick, Georgia (**Berry**); The Beckham Firm, Jacksonville (Chrisco); Gary F. Easom of Easom & Pierce, Jacksonville (Chrisco), for Appellants.

Joseph P. Milton and Eric L. Leach of Milton, Leach & D'Andrea, P.A., Jacksonville; Robert P. Smith and James C. Goodlett of Hopping Green Sams & Smith, Tallahassee, for Appellee.

VAN NORTWICK, Judge.

In these consolidated appeals, James Chrisco and Carol **Berry**, as personal representatives of the Estate of Roy Lee **Berry**, Jr., deceased, appeal from a final judgment and a partial final summary judgment,^[1] respectively, which were entered after the trial court excluded the testimony of appellants' expert witnesses. In their actions brought pursuant to the Federal Employers' Liability Act, 45 U.S.C. § 51, *et seq.* (FELA), appellants allege that appellee, **CSX** Transportation, Inc., exposed **Berry** and Chrisco, railroad employees of **CSX**, to excessive levels of organic solvents causing them to suffer from toxic encephalopathy.^[2] In both cases, asserting that the expert opinions were not generally accepted in the scientific community and relying upon *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923), and its Florida progeny, **CSX** objected to the proposed expert testimony that long-term exposure to excessive levels of organic solvents can and did cause appellants' toxic encephalopathy. The record reflects that appellants' proposed expert testimony was grounded upon numerous peer-reviewed and published epidemiological studies demonstrating an association between exposure to organic solvents and toxic encephalopathy.^[3] The trial court nevertheless found that the proposed expert opinions were not based on a "scientific principle or discovery" that has been sufficiently established to have gained general acceptance in the particular field to which it belongs. Accordingly, by separate orders, the trial court disqualified all of the appellants' experts.

This is the first time a Florida appellate court has been asked to decide the issue of what evidence must be *Frye* tested in the context of toxic tort litigation. We commend the trial court for its thorough and exhaustive review of the proposed expert testimony. We believe, however, that the trial court went beyond addressing the threshold question of admissibility of expert testimony under *Frye*, which was the issue before it, and in effect engaged in an analysis of the weight to be assigned to the expert testimony or the sufficiency of the evidence. As a result, even though appellants adequately demonstrated the reliability of their experts' proposed testimony, the trial court erroneously ruled that

555 testimony inadmissible. Thus, we reverse the final judgment and partial final judgment *555 and remand these actions for proceedings consistent with this opinion.

Procedural Background

Roy Lee **Berry**, Jr., deceased, worked as an electrician for **CSX** for over 20 years. James Chrisco worked as a machinist for **CSX** for over 10 years. Their suits alleged exposure to unreasonably hazardous levels of organic solvents in their workplace at **CSX**. The four organic solvents at issue in this case are trichloroethane (TCA), trichloroethylene (TCE), perchloroethylene (PCE), and mineral spirits. The trial court conducted a lengthy evidentiary hearing in **Berry's** suit in connection with **CSX's** motion to disqualify the opinion testimony of **Berry's** treating physician, Michael Kelly, M.D. In support of Dr. Kelly's proposed testimony, **Berry** proffered the supporting testimony of several other expert witnesses. **CSX** also filed a similar motion in the Chrisco suit. Although the trial court entered separate orders disqualifying the expert testimony in each case, the court considered essentially the same evidence in both cases. Thus, for purposes of this appeal, the evidence and cases will be considered together.

The Frye Reliability Standard

The issue of the admissibility of expert testimony is governed by the Florida Evidence Code, section 90.702, Florida Statutes (1995). That section provides:

Testimony by experts.—If scientific, technical, or other specialized knowledge will assist the trier of fact in understanding the evidence or in determining a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education may testify about it in the form of an opinion; however, the opinion is admissible only if it can be applied to evidence at trial.

Like its federal counterpart, Federal Rule of Evidence 702, section 90.702 is "silent as to any requirement that there be general acceptance of a newly developed scientific technique or principle in the particular field in which it belongs." Hawthorne v. State, 470 So.2d 770, 783 (Fla. 1st DCA 1985)(Ervin, J., concurring and dissenting). This "general acceptance" test applied to scientific evidence had been espoused decades earlier in the case of Frye v. United States, 293 F. 1013 (D.C.Cir.1923). The *Frye* court succinctly stated the test as follows:

Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.

Id. at 1014.

After the adoption of the Florida Evidence Code, of which section 90.702 is part, disagreement arose among the district courts of appeal as to whether (i) the relevancy test under section 90.702 combined with the so-called balancing test of section 90.403 or (ii) the *Frye* test was to be applied to determine the admissibility of novel scientific evidence. See Hawthorne, 470 So.2d at 783-787 (Ervin, J., concurring and dissenting; see also Ehrhardt, *Florida Evidence*, § 702.3 at 526 & 528 n. 18 (1997)). This debate ended when the Florida Supreme Court decided Stokes v. State, 548 So.2d 188 (Fla.1989).

In *Stokes*, the Florida Supreme Court held that posthypnotic testimony may not be admitted unless it meets the *Frye* test. Stokes, 548 So.2d at 194-95. "This test requires that the scientific principles undergirding this evidence be found by the trial court to be generally accepted by the relevant members of its particular field." Hadden v. State, 690 So.2d 573, 576 (Fla.1997). In reaching its conclusion in *Stokes*, the Court explained its rationale for continuing the application of the *Frye* test:

The underlying theory for this rule [*Frye*] is that a courtroom is not a laboratory, and as such it is not the place to conduct scientific experiments. If the scientific community considers a procedure or process unreliable for its own purposes, then *556 the procedure must be considered less reliable for courtroom use.

Stokes, 548 So.2d at 193-94.

Later, in *Hadden*, the court further amplified the reasons supporting its allegiance to the *Frye* reliability test:

[W]e firmly hold to the principle that it is the function of the court to not permit cases to be resolved on the basis of evidence for which a predicate of reliability has not been established. Reliability is fundamental to issues involved in the admissibility of evidence. It is this fundamental concept which similarly forms the rules dealing with the admissibility of hearsay evidence.... Novel scientific evidence must also be shown to be reliable on some basis other than simply that it is the opinion of the witness who seeks to offer the opinion.

Hadden, 690 So.2d at 578.

At the same time, a similar debate was ongoing in the federal courts concerning whether *Frye* or Federal Rule of Evidence 702 should govern the admissibility of scientific evidence. The United States Supreme Court answered this question in *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 113 S.Ct. 2786, 125 L.Ed.2d 469 (1993). In what has become known as the "scientific validity" test, the *Daubert* court set forth four non-exclusive factors that courts should consider in determining the admissibility of such evidence: "(1) testability (or falsifiability), (2) error rate, (3) peer review and publication and (4) general acceptance." David L. Faigman, David H. Kaye, Michael J. Saks & Joseph Sanders, *Modern Scientific Evidence: The Law and Science of Expert Testimony* § 1-3.3 (1997) (herein *Modern Scientific Evidence*).^[4]

As might be expected, the Florida Supreme Court was faced with the decision whether to continue following *Frye* or to adopt *Daubert*. In *Flanagan v. State*, 625 So.2d 827 (Fla.1993), the court noted the United States Supreme Court's decision in *Daubert*, but "reaffirmed the applicability of *Frye*." Ehrhardt, *Florida Evidence* § 702.4 (1997 Edition).

Flanagan was followed by the court's decision in *Ramirez v. State*, 651 So.2d 1164 (Fla.1995), wherein the court emphasized that

the burden is on the proponent of the evidence to prove the general acceptance of both the underlying scientific principle and the testing procedures used to apply that principle to the facts of the case at hand ... The general acceptance under the *Frye* test must be established by a preponderance of the evidence.

Id. at 1168. In *Ramirez*, the court delineated a four-step process for applying *Frye* in passing on the admissibility of expert opinion testimony concerning a new or novel scientific principle:

First, the trial judge must determine whether such expert testimony will assist the jury in understanding the evidence or in determining a fact in issue.... Second, the trial judge must decide whether the expert's testimony is based on a scientific principle or discovery that is "sufficiently established to have gained general acceptance in the particular field in which it belongs." *Frye v. United States*, 293 F. 1013, 1014 (D.C.Cir.1923)... The third step in the process is for the trial judge to *557 determine whether a particular witness is qualified as an expert to present opinion testimony on the subject in issue.... Fourth, the judge may then allow the expert to render an opinion on the subject of his or her expertise, and it is then up to the jury to determine the credibility of the expert's opinion, which it may either accept or reject....

Ramirez, 651 So.2d at 1167.

Finally, we note that the appropriate standard for our review of a *Frye* issue is *de novo*. *Brim v. State*, 695 So.2d 268, 275 (Fla.1997); *Hadden*, 690 So.2d at 579.^[5] Thus, we review the trial court's ruling on the admissibility of expert opinion testimony, which is purportedly based on an underlying novel scientific principle or technique, as a matter of law, rather than under an abuse of discretion standard. *Id.*; see also *Vargas v. State*, 640 So.2d 1139, 1144 (Fla. 1st DCA 1994), quashed on other grounds, 667 So.2d 175 (Fla.1995). Our *de novo* review of the *Frye* issue in these cases includes an examination of three methods of proof: (1) expert testimony, (2) scientific and legal writings, and (3) judicial opinions. *Flanagan v. State*, 586 So.2d 1085, 1112 (Fla. 1st DCA 1991) (Ervin, J., concurring and dissenting).

Scientific Background

The evidence and testimony in these cases span several fields, most notably epidemiology and toxicology. As recognized by the trial court, the epidemiological research upon which the numerous experts relied related to studies of subjects ranging from "Danish painters to Venezuelan gluemakers and from Silicon Valley chipmakers to Michigan autoworkers." Because of the highly technical nature of this epidemiological evidence, to facilitate understanding of these cases and the arguments of the parties, it is necessary for us to provide a brief, but by no means exhaustive, discussion of certain scientific terms and concepts employed by the parties.

"Epidemiology" is a branch of science and medicine which uses studies to "observe the effect of exposure to a single factor upon the incidence of disease in two otherwise identical populations." DeLuca v. Merrell Dow Pharm., Inc., 911 F.2d 941, 945 (3d Cir.1990), quoting Bert Black & David E. Lilienfeld, *Epidemiological Proof in Toxic Tort Litig.*, 52 Fordham L.Rev. 732, 755 (1984). Epidemiology focuses on the question of general causation, that is, whether a substance is *capable of causing* a particular disease, rather than specific causation, that is, whether the substance did cause the disease in a specific individual. Federal Judicial Center, *Reference Manual on Scientific Evidence*, 126 (1994)(herein the *Reference Manual*).

To establish that a given substance was a necessary causal link to the development of an individual's disease, in theory a scientist might obtain reliable information by engaging in experimental studies with human beings. For example, to determine whether exposure to a certain level of a suspected toxin is associated with a particular disease, the scientist might compare two randomly selected groups of people. One of the groups would be exposed to certain doses of the toxin over a prescribed length of time and the other group would not. For obvious ethical reasons, however, experimental studies with human beings are proscribed where the subject chemical agent is known or thought to be toxic. See Ethyl Corp. v. United States Envtl. Protection Agency, 541 F.2d 1, 26 (D.C.Cir.), cert. denied, 426 U.S. 941, 96 S.Ct. 2663, 49 L.Ed.2d 394 (1976); *Reference Manual* at 129.

Because of these ethical proscriptions, rather than experimental methods, epidemiologists use observational methods to study persons exposed to a suspected toxic substance to determine whether an association exists between exposure to the chemical and the development of a disease. These epidemiological studies use "statistical methods to detect abnormally high incidences of disease in a study population and to associate these incidences with unusual exposures to suspect environmental factors." (emphasis supplied). *In re "Agent Orange" Prod. Liab. Litig.*, 611 F.Supp. 1223, 1231 (E.D.N.Y.1985) *558 quoting Michael Dore, *A Commentary on the Use of Epidemiological Evidence in Demonstrating Cause-in-Fact*, 7 Harv. Envtl. L.Rev. 429, 431 (1983); *In re Swine Flu Immunization Prods. Liab. Litig.*, 508 F.Supp. 897, 907 (D.Colo.1981), *aff'd sub nom., Lima v. U.S.*, 708 F.2d 502, 507 (10th Cir.1983)("Where ... the exact organic cause of a disease cannot be scientifically isolated, epidemiologic data becomes highly persuasive.").

Through epidemiological studies, scientists can assess the existence (and strength) or absence of an *association* between an agent and the disease. But "[a]ssociation is not *causation*." *Reference Manual* at 126. Association is a term used to describe the relationship between exposure to a chemical agent and disease that occurs more frequently together than one would expect by chance. *Id.* at n. 7. Establishing an association does not necessarily mean that there is a causal effect between the exposure and the disease. *Id.* Causation, by comparison, constitutes an association between two events in which one event is a necessary link in a chain of events that results in the effect. *Id.* Nevertheless, while "[e]pidemiological methods cannot prove causation ...," epidemiological studies can provide a basis on which an epidemiologist can infer and opine that a certain agent causes a disease. *Id.*

In the event an epidemiological study finds an association between exposure to a substance and a disease, scientists can analyze the study to consider whether the reported association reflects a cause-and-effect relationship or, alternatively, is a spurious finding. *Id.* at 157. "Researchers first look for alternative explanations for the association, such as bias or confounding factors...." *Id.* The primary types of biases are selection bias and information bias. "Selection bias occurs when the exposed group is selected in a way that makes it more or less susceptible to disease for reasons independent of exposure." Michael D. Green, *Expert Witnesses and Sufficiency of Evidence in Toxic Substance Litigation: The Legacy of Agent Orange and Bendectin Litigation*, 86 Nw. U.L.Rev. 643, 649 (1997). Similarly,

information bias exists where the participants incorrectly give information about either exposure or health effects. This may exist where an interviewer whose "awareness of the identity of cases and controls ... may influence the structure of the questions and the interviewer's manner, which in turn may influence the response." David E. Lilienfeld & Paul D. Stolley, *Foundations of Epidemiology* 237 (1994).

Although epidemiologists cannot totally control such variables as the genetic background or lifestyle choices of their human subjects or the amount and duration of their exposure to the studied substance, *Reference Manual* at 129, the researchers have systematic methods for assessing the characteristics of the people in the study and their risk of disease to rule out known sources of bias and errors. *Id.* at 127. For example, to eliminate information bias, whenever possible an interviewer should conduct "blind" interviews without prior knowledge of the cases and controls. *Foundations of Epidemiology* at 237.

Further, even when a statistical association exists and no bias is present, the association may be the result of some other confounding factor, or a so-called "confounder." A confounding factor may be itself a risk factor for the disease or associated with the exposure of interest. *Reference Manual* at 158. As an example, assume a study finds that individuals with grey hair have a higher rate of death than those with another hair color. Instead of hair color impacting on death, however, the test results might be explained by the confounding factor of advanced age. Thus, when a researcher finds an association between an agent and disease, he or she must determine whether the association is causal or the result of confounding. *Id.*

After the researcher has analyzed the epidemiological study for alternative explanations for an association, researchers then consider generally accepted guidelines for determining whether the association between exposure to a substance and a disease is causal. See *Smith v. Ortho Pharm. Corp.*, 770 F.Supp. 1561, 1575-76 (N.D.Ga.1991). Although the
559 guidelines are composed of various *559 criteria,^[6] in the instant cases the factors of strength of association, consistency with other research, and biological plausibility are raised in the arguments of the appellee.

Strength of Association. Epidemiologists commonly use "relative risk" to measure the strength of the association between exposure and disease. *Reference Manual* at 126. Relative risk is the ratio of the risk of disease among the group exposed to the chemical agent compared to the risk of disease among the unexposed group. *Id.* at 176. For example, a relative risk of 2.0 indicates that the risk of developing a disease in the exposed group is two times higher than the risk of developing that disease in the unexposed group. A relative risk of 1.0 indicates no association. The higher the relative risk, the stronger or more powerful is the association between exposure to the substance and development of the disease.^[7]

Scientists use the concept of a "confidence interval" as the means by which an epidemiologist can express confidence in a specific finding of relevant risk. For instance, if relative risk in a study is found to be 2.0, the epidemiologist can estimate the range of numeric values above and below 2.0 in which the relationship of a study sample would be likely to fall if the same study were repeated numerous times. *Id.* at 173. "The width of the confidence interval provides an indication of the precision of the point estimate or relative risk found in the study ..." *Id.* In this appeal, citing Black & Lilienfeld, *supra*, 52 Fordham L.Rev. at 757, the railroad urges that the confidence interval should be expressed with estimated 95% accuracy, that is, as a range in which relative risk will predictably fall 95 times out of 100 replications of the study.

Consistency with Other Research. The validity of scientific conclusions is often based upon the replication of research findings, and consistency in these findings is an important factor in making a judgment about causation. See *Kehm v. Proctor & Gamble Co.*, 580 F.Supp. 890, 901 (N.D.Iowa 1982), *aff'd*, 724 F.2d 613 (8th Cir.1983) (noting the persuasive power of multiple independent studies, each of which reached the same finding of an association between the toxic shock syndrome and tampon use); *Cadarian v. Merrell Dow Pharm., Inc.*, 745 F.Supp. 409, 412 (E.D.Mich.1989) (holding a single Bendectin study insufficient to support an expert's opinion, because "the study's authors themselves concluded that the results could not be interpreted without independent confirmatory evidence").

Biological Plausibility. Biological plausibility involves the application of the "existing knowledge about human biology

and disease pathology to provide a judgment about the plausibility that an agent caused a disease." *Reference Manual* at 172. Thus, for example, a conclusion that high cholesterol is a cause of coronary heart disease is biologically plausible because cholesterol is found in atherosclerotic plaques. *Id.* at 163.

560 Briefly, we turn to another scientific discipline, toxicology. Toxicology is defined as "the study of the adverse effects of chemical agents on biological systems." *Id.* at 185. One of the central tenets of toxicology is that "the dose makes the poison" implying that all chemical agents are harmful—it is only a question of dose. *Id.* Thus, even water if consumed in large enough quantities can be toxic. *Id.* A toxicologist attempts to determine at what doses foreign agents produce their effects, and animal studies are used by toxicologists to predict toxic responses in humans. *560 *Id.* In toxicology, a dose-response relationship is a relationship in which a change in amount, intensity, or duration of exposure is associated with a change—either an increase or decrease—in risk of disease. *Id.* at 173.

The Scientific Evidence Below

The appellants proffered the testimony or affidavits of expert witnesses Dr. W. Lynn Augenstein, Dr. Richard L. Lipsey, Dr. Edward L. Baker, Jr., Dr. Douglas H. Linz, and Dr. Michael Kelly in the **Berry** case.

Dr. Augenstein. Dr. W. Lynn Augenstein, a medical doctor with a board certification in medical toxicology who teaches at the University of Florida Health Science Center, reviewed approximately 150 journal articles, textbooks, and notes of international conferences. He opined that, of the epidemiological studies which had been performed, the studies correlating long-term exposure to organic solvents and toxic encephalopathy outweigh the negative studies by eight or nine to one. He acknowledged that there were negative studies, but he opined that these studies dealt with short term or low level exposures.

Regarding toxic encephalopathy, he explained that it is usually divided into three categories: minimum, moderate and severe. In the lowest category of toxic encephalopathy, a patient suffers from tiredness, mood problems, irritability, sleep disturbances, possibly some poor memory function, depression, headaches and dizziness. A patient suffering moderate toxic encephalopathy shows more specific neurologic signs that would be detectable on neuropsychological testing: memory problems; slower reaction times; and problems with spacial orientation. The patient has more persistent mood and behavioral problems. In the severe category, there is significant global brain dysfunction. The individual is almost in a vegetative state where he cannot function, has very poor memory, and there are significant findings on x-ray tests showing brain atrophy. Dr. Augenstein opined that it is not necessary for a worker to become unconscious in order to suffer toxic encephalopathy.

He further explained that the dose-response relationship, which is a cornerstone of toxicology, is very difficult to assess in an epidemiological study because epidemiological studies are performed on a retrospective basis.

Dr. Lipsey. Richard Lipsey, Ph.D., who stated his profession as a pesticide environmental toxicologist, concurred that in his review of the literature, there was a general consensus in the scientific community that long-term exposure to excessive levels of organic solvents can and does cause toxic encephalopathy.

Dr. Baker. Edward L. Baker, Jr., M.D., is board-certified in occupational medicine and internal medicine. In addition to his doctor of medicine degree, he has two masters degrees from Harvard University, a Master of Public Health with emphasis on epidemiology and a Master of Science with emphasis on epidemiology and occupational health. He has practiced medicine in the Occupational/Environmental Health Clinic at Emory University; has been employed as a professor at Harvard, where he directed research into the health effects of organic solvents; has served as Deputy Director of the National Institute for Occupational Safety and Health, the federal agency responsible for research in occupational health; and, at the time of the evidentiary hearing, was the Director of the Public Health Practice Program Office at the federal government's Center for Disease Control and Prevention.

Dr. Baker has authored chapters for at least four medical textbooks which address the subject at issue; he has published 98 journal articles of which approximately 20 are directly related to the subject at issue; and he has served on

the editorial boards, as peer reviewer for submitted articles, of several journals and publications, including the American Journal of Industrial Medicine. He was the only United States scientist to participate in an international conference of scientists, convened in Copenhagen in 1985 by the World Health Organization to reach a consensus on the chronic effects of organic solvents on the central nervous system. The report generated from the Copenhagen conference concludes that "epidemiological and experimental data indicate that long-term occupational *561 exposure to organic solvents may cause adverse effects in the central and peripheral nervous systems." Dr. Baker participated in a second international conference which produced the same consensus opinion. As a result of a conference held in 1990, it was agreed that "chronic toxic encephalopathy does occur in workers with excessive exposure to solvents."

Significantly, as can be seen from his credentials, Dr. Baker began studying the effects of solvents well before this litigation arose and arrived at his conclusions independent of his involvement in this lawsuit.^[8] As a result of his very considerable study on the subject, he has concluded that long-term excessive exposure to organic solvents can cause toxic encephalopathy.

Specifically, he opined that if an individual is exposed more than ten years to a concentration that is sufficient to cause acute symptomology (intoxication, light-headedness, dizziness, inebriation) on a regular basis, that person is at risk for developing toxic encephalopathy. He said it was a general consensus in the scientific community that there is a risk of toxic encephalopathy in people excessively exposed to solvents. The only real debate at present, according to Dr. Baker, was over the safe levels of exposure and the degree of reversibility of the damage. He disagreed with appellee's experts that, for there to be a causal relationship, a patient must have been rendered unconscious by the exposure.

Dr. Baker testified that the Occupational Safety and Health Administration (OSHA) has published recommended maximum safe exposure levels for the various solvents at issue in this case. OSHA has arrived at a number 350 parts per million as an eight-hour time-weighted exposure for the workplace for TCA that is deemed to be a safe level. Nonetheless, as Dr. Baker recognized, this level does not take into consideration solvent exposure through the skin. He opined that solvents penetrate the skin and can get into the body through percutaneous exposure as well as through inhalation exposure. Thus, even a workplace allegedly below the safe level of 350 parts per million might nonetheless subject a worker to excessive exposure.

Although he was uncertain of the exact biological "mechanism" by which these solvents cause damage, Dr. Baker offered a biologically plausible explanation. He explained that solvents typically accumulate in fat-rich tissues and that the adipose tissues of the brain are tissues that have a high fat content. He postulated that since many organic solvents are highly lipid soluble, they can accumulate in the brain or in the adipose tissue.

Dr. Linz. Douglas H. Linz, M.D., who is board-certified in internal medicine and occupational medicine, submitted an affidavit. His speciality included diagnosing and treating injuries and conditions caused by acute and chronic overexposure to chemicals and solvents. Initially, Dr. Linz had been asked by **CSX** to examine several of the railroad's employees who, like appellants, worked in the diesel shop. He opined that the employees had suffered neurological and neuropsychological conditions caused by their recurrent exposures to solvents while working for the railroad and that there was a medically significant pattern among the examined diesel shop employees of the railroad who were suffering from solvent-induced brain injury. The employees had described heavy exposures: large amounts of solvents were used at full strength; the solvent was sprayed under pressure which atomized it; respirators were not worn; and employees washed their hands and clothes in solvent. They had the following complaints: headaches; dizziness; nausea; feelings of drunkenness *562 and/or confusion; and acute mucosal complaints. He opined that it was well recognized that repeated exposures such as the kind noted above over a period of years can result in neurological and neuropsychological conditions including organic brain damage.

Dr. Linz came to the conclusion that the diesel employees had suffered solvent induced brain damage only after interviewing the patients and discussing with them their general health, their medical histories, and their occupational histories; reviewing the manufacturer safety data sheets on the solvents which were provided to him by the railroad (which included the solvents that are at issue in this case); reviewing the medical records of the employees; performing physical examinations on the men; reviewing diagnostic studies such as neuropsychological evaluations and balance

testing performed on the men; reviewing the scientific literature which has been published with regard to solvents; and after eliminating other causes to a reasonable degree of medical certainty. He opined that the overwhelming epidemiological evidence confirms the relationship between long-term exposure to solvents and brain damage.

Dr. Kelly. Michael Kelly, M.D., is board-certified in internal medicine and occupational medicine. Currently he is the Medical Director of Occupational Health Services and Chief of Medicine at St. Lawrence Hospital in Lansing, Michigan. He has extensive experience in diagnosing and treating solvent-exposed workers from all over the country, including approximately 200 railroad workers. He opined that it was a general consensus in the medical and scientific community that long-term exposure to organic solvents can cause toxic encephalopathy.

In arriving at his conclusion that Mr. **Berry** suffered from solvent-induced toxic encephalopathy, Dr. Kelly employed a differential diagnosis^[9] procedure which he opined was the standard methodology utilized in the field of occupational health. He took a history from both Mr. **Berry** and his wife concerning his current medical problems. After reviewing Mr. **Berry's** work history and symptoms, Dr. Kelly opined that **Berry** had been exposed to very high levels of organic solvents in excess of OSHA standards, which excessive exposure had been confirmed by other railroad employees. Dr. Kelly also conducted a thorough physical examination. He caused various laboratory tests to be performed on **Berry**, and obtained an MRI and an EEG of **Berry**. He referred **Berry** to a neuropsychiatrist for evaluation, which revealed that **Berry** had severe cognitive defects. A psychiatrist to which **Berry** was also referred reported back that **Berry's** cognitive defects were more likely consistent with toxic encephalopathy than with mere depression. Dr. Kelly had a SPECT scan of **Berry** performed, and the physician who performed the scan reported that it showed that **Berry** suffered diminished activity and function in several areas of the brain, consistent with neurotoxic insults. Dr. Kelly asked **Berry** questions about cigarettes, alcohol and other possible confounders.

Regarding his occupational history, Mr. **Berry** told Dr. Kelly that he used materials out of a 55 gallon drum hooked up to house air, as he called it, to spray off the locomotives. He worked in the pit area under the locomotive. He would dip his hands in the material, and wash his clothes with it. He described being wet with the solvent material. He developed headaches, and was tired and lethargic. He had to take naps when he came home from work. Dr. Kelly opined that these symptoms indicated **Berry** had been exposed to "pretty high exposure levels occurring over a fairly long period of time." **Berry** could not remember names, could not remember directions, and could not remember his assignment at work. He was frequently angry, irritable, and was having some sleep disturbances. His gait was abnormal. When he walked, his feet were wide apart indicating a balance disturbance. Regarding **Berry's** cognitive difficulties, Dr. Kelly concluded that **Berry's** ability to interpret visual spacial configurations was at best low average, whereas one would expect an *563 electrician to be able to visualize diagrams and remember them.

Regarding a biologically plausible explanation for the toxic encephalopathy, Dr. Kelly concurred with Dr. Baker that solvents have the ability to dissolve fatty materials. He felt that this characteristic allowed them to damage the body. He added that the fact these solvents are chlorinated probably adds to their toxicity, because the chlorine atom is more difficult for the body to metabolize and prolongs the exposure. He said there was no support for the notion that it is necessary to have an acute exposure causing unconsciousness before a person can suffer toxic encephalopathy.

CSX presented the expert testimony of Dr. Raymond Harbison and Dr. Robert James.

Dr. Harbison. Raymond Harbison, Ph.D., a toxicologist on the faculty of the University of Florida, opined that there was no biologically plausible explanation for a solvent exposure to cause toxic encephalopathy. As an example, he said that TCA is rapidly eliminated from the body and does not damage the nervous system because it cannot be converted to a chemical that interacts with the nervous system to cause damage. His testimony regarding TCE and PCE was similar. According to him, nothing in the molecular structure of the chlorinated hydrocarbon is able to produce any pathology in the nervous system. Contrary to plaintiffs' experts, he opined that TCA cannot "bioaccumulate in the brain." He maintained that it was generally accepted among toxicologists that TCA is not able to cause toxic encephalopathy unless there has been a dose sufficient to impair respiration resulting in lowering of the oxygen level in the body or unconsciousness. However, he admitted no study supports his contention that unconsciousness was required.

He was generally of the opinion that the literature contained insufficient evidence of a real causal connection between

long-term exposure to organic solvents and toxic encephalopathy because real exposures could not be determined without making accurate air quality measurements, and because only precisely controlled double blind studies could be expected to establish causation. According to him, one should not use patient history to make the diagnosis but should use analytical data and be able to conduct measurements of the actual exposure received. Contrary to Dr. Kelly, he opined that a patient's symptoms could not be used to measure exposure. Instead, to make the diagnosis of toxic encephalopathy one would have to evaluate such factors as the level of chemicals in the workplace, the available ventilation, the temperature, and the air exchange rates in the work area.

Dr. Harbison opined that, before the toxicological scientific community would acknowledge the validity of an epidemiological study relating exposure to disease, there would have to be a known verified exposure, valid testing that is objective, and this testing methodology must have been subjected to a double blind evaluation where neither the investigator nor the individual who was being evaluated knew what the exposure was or what the potential outcome should be.

Dr. James. Robert James, Ph.D., also a toxicologist on the faculty at the University of Florida, presented an analysis of the studies demonstrating an association between exposure to organic solvents and toxic encephalopathy. Dr. James opined that most of the studies were negative and that of the ones which were positive, when flawed methodology was considered as well as other factors, only a few studies could be considered truly positive. Based upon his reanalysis, he said the studies did not demonstrate that long-term exposure to excessive amounts of organic solvents can cause toxic encephalopathy or that this hypothesis was generally accepted by the scientific community at this time. He advocated his reanalysis of the studies as more credible because it eliminated from the classification of positive studies those studies which failed to provide clear and convincing evidence of strong associations and big differences. The studies he eliminated he characterized as false positive studies which had not controlled for confounders. He conceded that he and Dr. Baker had obviously interpreted the literature differently.

564 *564 While it was his opinion that epidemiology and toxicology use essentially the same type of analysis, nonetheless, Dr. James testified that toxicologists use a more rigorous standard to evaluate the data before determining whether or not a substance causes a particular disease in any population. He rejected studies that do not show a strong dose-response relationship, commenting that if the response does not change as a result of the dose or there is not a dose-response curve, the chemical agent is not the cause of the disease.

To the extent other scientific evidence is deemed relevant, it is discussed in other parts of this opinion.

Trial Court's Order

In the proceedings below, **CSX** challenged the admissibility of the appellants' expert testimony, contending that the plaintiffs' theory of general causation was based on "junk science" which did not meet the *Frye/Ramirez* test of reliability and that Dr. Kelly's specific causation testimony was not credible. The trial court found that the central issue in these cases was the general acceptance of the scientific principles underlying the testimony of appellants' expert witnesses. The appellants argued that *Frye* does not require that the experts' opinions themselves must be generally accepted; but, rather, that only the scientific techniques or methodology upon which the expert relies must be generally accepted in the scientific community. The trial court rejected this argument, ruling that *Frye* not only applies to scientific methodology, but that the scientific conclusion of the expert witness itself must be generally accepted in the scientific community to which it pertains.

The trial court concluded that there remains a substantial disagreement within the scientific community as to whether or not organic solvents can cause brain damage. In reaching this conclusion, the court recited the findings of numerous of the epidemiological studies upon which the appellants relied. In these studies, the researchers found an association between exposure and injury, but used the seemingly equivocal term of "association" rather than causation. Moreover, these studies admitted the controversial nature of this subject, and several called for further investigation. The trial court was plainly troubled by the "qualifying phrases and disclaimers" used in the articles. This lead the trial court

to the conclusion that there remains a substantial disagreement within the scientific community as to whether or not organic solvents, particularly the ones at issue in the instant case, can cause brain damage, particularly chronic toxic encephalopathy, of the nature allegedly experienced by the plaintiff[s] in [these] case[s]. Said another way, the Court concludes that it is *not* generally accepted that exposure to organic solvents causes the condition of which the plaintiff[s] complain.

Arguments of the Parties

Appellants argue that the effect of the trial court's admissibility ruling was to decide the causation issue itself—that is, whether exposure to the four solvents causes toxic encephalopathy—which is a jury issue. They contend that the trial court erred as a matter of law in concluding that it was the experts' ultimate opinions, rather than the underlying methodology from which they derived their opinions, that had to be *Frye* tested. See, e.g., *Ferebee v. Chevron Chem. Co.*, 736 F.2d 1529, 1535 (D.C.Cir.), cert. denied, 469 U.S. 1062, 105 S.Ct. 545, 83 L.Ed.2d 432 (1984); accord *Osburn v. Anchor Lab., Inc.*, 825 F.2d 908, 915-16 (5th Cir.1987), cert. denied, 485 U.S. 1009, 108 S.Ct. 1476, 99 L.Ed.2d 705 (1988); and *Cella v. United States*, 998 F.2d 418, 425 (7th Cir.1993). Appellants argue that the "principle or discovery" language in *Frye* upon which the trial court seized to arrive at its conclusion that an expert's opinion must be generally accepted in the medical community was merely language used by the *Frye* court to label the novel "systolic blood pressure deception test" at issue in that case. They submit that an expert opinion derived from the generally accepted methodology of the science of epidemiology—where numerous published, peer-reviewed epidemiological studies and medical textbooks provide support for the opinion—is reliable, and therefore admissible.

565 *565 Regarding the trial court's exclusion of Dr. Kelly's specific opinion on causation, appellants argue that Dr. Kelly followed a "differential diagnosis" methodology which is the standard methodology utilized in the field of occupational health. *In re Paoli R.R. Yard PCB Litig.*, 35 F.3d 717, 758 (3d Cir.1994), cert. denied sub nom., *General Elec. Co. v. Ingram*, 513 U.S. 1190, 115 S.Ct. 1253, 131 L.Ed.2d 134 (1995); *Hines v. Consolidated Rail Corp.*, 926 F.2d 262, 274 (3d Cir.1991). Further, although the trial court was troubled by the fact that Dr. Kelly had merely estimated the levels of exposure to the organic solvents, appellants argue that this was necessary as the railroad had not monitored the work rooms, and therefore verifiable knowledge of the levels of solvents does not exist. Thus, Dr. Kelly could only rely upon an informed estimate derived from the statements of **Berry** and the other people who worked in the shops everyday to arrive at a diagnosis. If this estimate is erroneous, submit the appellants, **CSX** will have the opportunity to dispute the claimed levels of exposure at trial.

CSX argues that the causal proposition—that long term exposure to TCA, TCE, PCE and mineral spirits at workplace level sufficient to produce transient irritation, dizziness or disorientation, but not hypoxia or anoxia,^[10] can cause irreversible central nervous system damage—must pass the *Frye* test. Appellee contends that upon a *de novo* review of this issue, this court will be compelled to conclude that this causal proposition does not pass the *Frye* test. **CSX** directs our attention to several publications which show some epidemiologic disagreement about causality between long-term exposure to organic solvents and toxic encephalopathy. Further, **CSX** criticizes the studies upon which appellants' experts rely, contending these studies did not sufficiently take into account the presence of confounders or information bias, or involved exposure to much more damaging chemicals than those at issue in the instant cases. Finally, **CSX** argues that these studies are deficient because they fail to offer a biologically plausible explanation for the stated effects and do not adequately address the dose response relationship.

CSX suggests that for an epidemiological study to show a statistically significant association between a certain risk factor and disease in the exposed group such that causation may be inferred by the scientists, there must be a relative risk greater than 2.0 within a 95% confidence interval greater than 1.0, and that the calculations must adequately guard against selection and information biases and other confounders. After reviewing the studies, **CSX** argues there are only three positive studies, or at most five positive studies, and of those, four were subject to obvious selection and information bias.

The appellants reply that the microscopic level of critical analysis to which the railroad has resorted belongs only to the

experts. They suggest that neither the trial court nor this court can assume the role of an amateur scientist, examine the materials upon which the expert scientists rely, draw its own scientific conclusion as to whether the material support the opinions of the plaintiffs' experts or not and then declare one set of opinions the victor by excluding the other set of opinions from evidence. See Joiner v. General Elec. Co., 78 F.3d 524, 530-33 (11th Cir.1996), *rev'd on other grounds*, U.S., 118 S.Ct. 512, 139 L.Ed.2d 508 (1997); In re Joint E. & S. Dist. Asbestos Litig., 52 F.3d 1124, 1137 (2d Cir.1995).

Frye Analysis

At the outset of our *Frye* analysis, we must resolve the issue over what must be *Frye* tested in this case—the opinion testimony of the witnesses or the underlying scientific principle or methodology utilized by the experts in arriving at their opinions. *Frye* expressly addressed whether it is the expert opinion or the underlying principle and methodology from which the opinion is deduced which must be generally accepted in the scientific community. The *Frye* court explained: "the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular *566 field in which it belongs." Frye, 293 F. at 1014.

Further, the federal cases following *Frye* have applied the *Frye* test to the underlying scientific principle or methodology on which the opinion is based. See, e.g., Cella v. United States, 998 F.2d 418, 425 (7th Cir. 1993) ("the *Frye* standard requires that the methodology and reasoning used by an expert in reaching a conclusion be generally accepted within the relative scientific community"); Christophersen v. Allied-Signal Corp., 939 F.2d 1106, 1111 (5th Cir.1991) (in applying *Frye* test ask whether the expert, in reaching his conclusion, used a well founded methodology or mode of reasoning), *cert. denied*, 503 U.S. 912, 112 S.Ct. 1280, 117 L.Ed.2d 506 (1992); Peteet v. Dow Chem. Co., 868 F.2d 1428, 1433 (5th Cir.1989) (as long as expert's methodology is well-founded, the nature of his conclusion is generally irrelevant, even if it is controversial or unique), *cert. denied sub nom.*, Dow Chem. Co. v. Greenhill, 493 U.S. 935, 110 S.Ct. 328, 107 L.Ed.2d 318 (1989); Osburn v. Anchor Lab., Inc., 825 F.2d 908, 915 (5th Cir.1987) ("an expert's opinion need not be generally accepted in the scientific community before it can be sufficiently reliable and probative in support of a jury finding"), *cert. denied*, 485 U.S. 1009, 108 S.Ct. 1476, 99 L.Ed.2d 705 (1988); Ferebee v. Chevron Chem. Co., 736 F.2d 1529, 1535-36 (D.C.Cir.) (rejecting defendant's argument that expert opinion testimony must be generally accepted in the scientific community before it can be introduced as evidence), *cert. denied*, 469 U.S. 1062, 105 S.Ct. 545, 83 L.Ed.2d 432 (1984).

The Florida Supreme Court has, until recently, consistently described the *Frye* test as a standard which "requires a determination, by the judge, that the *basic underlying principles* of scientific evidence have been sufficiently tested and accepted by the relevant scientific community." Brim, 695 So.2d at 272 (emphasis added). In *Hadden*, however, the court stated that it would "not permit factual issues to be resolved on the basis of *opinions* which have yet to achieve general acceptance in the relevant scientific community." Hadden, 690 So.2d at 578 (emphasis added). Specifically, the court held in *Hadden* that "a psychologist's opinion that a child exhibits symptoms consistent with ... 'child sexual abuse accommodation syndrome'... has not been proven by a preponderance of scientific evidence to be generally accepted by a majority of experts in psychology" and that such opinion could not be used in a prosecution for child abuse where a proper objection is raised to its introduction. *Id.* at 575. The court distinguished such testimony from pure opinion testimony (testimony which is personally developed through clinical experience) on the grounds that profile and syndrome evidence rely on conclusions based upon studies and tests. "Consequently, the expert's opinion was based upon diagnostic standards which must pass the *Frye* test." *Id.* at 581.

However, we decline to interpret this language in *Hadden* as meaning that in all cases expert opinion testimony, not otherwise developed through clinical experience, must be *Frye* tested. Instead, we believe that this language in *Hadden* must be confined to the facts in that case and the psychological syndrome testimony which was being proposed. It is clear that the syndrome testimony in *Hadden* was not based upon scientifically accepted methodology. As Judge Ervin opined in his dissenting opinion in Hadden v. State, 670 So.2d 77, 89 (Fla. 1st DCA 1996) (en banc), approved by the supreme court, the diagnosis of sexual abuse through a syndrome analysis is not a generally accepted method of diagnosing sexual abuse nor is there a consensus among experts that it is useful as substantive evidence of guilt. *Id.*

at 579.

In *Hadden*, the expert's opinion testimony was inextricably intertwined with an unacceptable diagnostic methodology. This circumstance is factually and legally distinguishable from the proposed expert opinion causation testimony in the instant toxic tort case. The proposed expert opinions here are based upon peer reviewed published epidemiological studies undertaken independently of the instant action and clearly recognized in the case law as important sources of evidence of toxic causation. As the Third Circuit observed in *DeLuca*, 911 F.2d at 954:

567 *567 The reliability of expert testimony founded on reasoning from epidemiological data is generally a fit subject for judicial notice; epidemiology is a well-established branch of science and medicine, and epidemiological evidence has been accepted in numerous cases.

Commentators have further explained: Epidemiological studies have been well received by courts trying mass tort suits. Well conducted studies are universally admitted. The widespread acceptance of epidemiology is based in large part on the belief that the general techniques are valid.

Modern Scientific Evidence at § 28-1.1; see also Green, 86 Nw. U.L.Rev. at 659, 663-64 (1992).

Thus, we hold that, under *Frye* and its Florida progeny, when the expert's opinion is well-founded and based upon generally accepted scientific principles and methodology, it is not necessary that the expert's opinion be generally accepted as well. We find persuasive the rationale of the court in *Christophersen*:

[I]n *Osburn* [*Osburn v. Anchor Lab., Inc.*, 825 F.2d 908 (5th Cir.1987)] the plaintiffs and the defendant's experts relied on essentially the same diagnostic methodologies but drew opposite conclusions from the available information. We did not attempt to determine which expert's conclusion was more in line with the consensus in the scientific community. Instead we stated, "a jury must be allowed to make credibility determinations and weigh conflicting evidence in order to decide the likely truth of a matter not itself initially resolvable by common knowledge or lay reasoning." *Id.* at 916. "An expert's opinion need not be generally accepted in the scientific community before it can be sufficiently reliable and probative in support of a jury finding." *Osburn*, 825 F.2d at 915.

939 F.2d at 1111 (emphasis added).

Our conclusion is supported by the opinion of the Florida Supreme Court in *Brim*. There, the court recognized that *Frye* allows opposite opinion testimony from experts relying upon the same generally accepted scientific principles and methodologies. In *Brim*, the court was faced with a *Frye* challenge to DNA test results. The *Brim* court held that, for DNA test results to be admissible, both the first step of the testing process (which relies upon principles of molecular biology and chemistry) and the second step (which involves a calculation of population frequency statistics) must satisfy *Frye*. *Brim*, 695 So.2d at 269. With regard to the second step, the court found that *multiple* statistical calculations might simultaneously satisfy *Frye*.^[11] *Id.* at 272. "It is clear that scientific unanimity is not a precondition to a finding of general acceptance in the scientific community." *Id.* The court explained that although two conflicting scientific principles cannot simultaneously satisfy *Frye*, it would allow multiple reasonable statistical calculations when based upon generally accepted principles of population, genetics and statistics. *Id.*

For all these reasons, we must respectfully disagree with the trial court's conclusion that it was the appellants' expert opinion testimony that was required to be *Frye* tested in these cases.

Turning to the trial court's further reasoning for denying admissibility—that the underlying epidemiological studies were equivocal as to causation—we find that the trial court ultimately misunderstood the nature of epidemiological studies and was unnecessarily concerned that the studies did not prove causation. As discussed above, epidemiological studies are designed to assess the existence and strength or absence of an association between an agent and a disease. *Supra*, page 557. As Dr. Baker explained in his testimony, epidemiological studies do not fix the cause—they merely demonstrate the probabilities of cause. See also Green, 86 Nw. U.L.Rev. at 647 ("At best, epidemiology assesses the likelihood *568 that the agent caused a specific individual disease."). From epidemiological studies

demonstrating an association, an epidemiologist may or may not infer that a causal relationship exists. However, the epidemiological studies themselves are not designed to demonstrate whether a particular agent *did* cause the disease, and the trial court erred in concluding that the studies were unreliable because they failed to establish causal relationship.^[12]

Nonetheless, **CSX** argues that the epidemiological studies upon which appellants' experts rely are infirm because they contain methodological flaws. It is the railroad's position that even if the experts' opinions themselves do not have to be *Frye* tested, here the underlying methodology upon which the opinions rely, the epidemiological studies, fail the *Frye* test.

Before turning to a discussion of the critical analysis employed by **CSX**, we must emphasize at this juncture that the issue in *Frye* and in the instant cases involves the *admissibility* of expert testimony, not the *sufficiency* of that testimony. An inquiry regarding the "sufficiency" of the evidence concerns whether the party has produced sufficient evidence to convince a reasonable juror that the opinion of the party's expert is correct. *In re Paoli R.R. Yard PCB Litig.*, 35 F.3d at 744. "Admissibility," in contrast, "entails a *threshold* inquiry over whether a certain piece of evidence ought to be admitted at trial." *In re Joint E. & S. Dist. Asbestos Litig.*, 52 F.3d at 1132 (emphasis in original).

At this admissibility stage of the proceedings, under *Frye* the court is asked to decide whether the basis of the evidence upon which plaintiffs' experts rely has a sufficient indicia of reliability. "Reliability is fundamental to issues involved in the admission of evidence." *Hadden*, 690 So.2d at 578. We agree with the appellants that under *Frye* they have demonstrated the reliability of the scientific evidence upon which their experts rely. While, as Dr. Baker acknowledged in his proffered testimony, there continues to be scientific debate about the safe levels of exposure with respect to certain toxins and the degree of reversibility of the effect of exposure to the toxins, we find the epidemiological science and methodology underlying his testimony to be established, reliable, and well-founded.

CSX asserts that, in deciding the question of admissibility here, as a part of our *de novo* review we must engage in a highly detailed level of critical analysis of each epidemiological study. While an analysis of each study for relative risk, confidence interval, biases, confounders, criteria of causality and other numerous factors may be appropriate in considering the sufficiency of the evidence, that is not appropriate or necessary under the circumstances here or at this stage of the litigation. Further, such a detailed analysis would require this court not *569 only to have an appreciation for the methodological errors and inadequacies in the studies, an ability to assess the validity of a reanalysis of those studies, and an understanding of the biological underpinnings associated with the disease in question, but also to possess a firm grounding in the concepts of relative risk, statistical significance and confidence intervals, and their relationship to the preponderance of the evidence standard. Green, 86 Nw. U.L.Rev. at 681. While certainly courts must become educated on these subjects when necessary to adjudicate issues regarding the sufficiency of the evidence in the toxic torts arena, the record in these cases is lacking the necessary evidence upon which to make these judgments at this stage of the proceeding. See, e.g., *DeLuca*, 911 F.2d at 955 (declining to rule as a matter of law that any expert opinion rooted in a statistical analysis where the results of the underlying studies are not significant at a .05 level would not be allowed where the record contained virtually no relevant help from the parties or from qualified experts); *In re Joint E. & S. Dist. Asbestos Litig.*, 52 F.3d at 1134 (an argument that an epidemiological study must show a relative risk greater than 2.0 is a sufficiency argument not an admissibility argument).^[13]

Our conclusion is strongly influenced by the fact that the epidemiological studies here were conducted independently of this litigation and were peer-reviewed and accepted by journals that are widely acknowledged in the scientific and medical communities. See generally *Modern Scientific Evidence* at § 1-3.3.3 (noting the importance of peer review and publication in highly regarded journals for the purpose of establishing scientific validity under *Daubert*). Although there is a debate as to whether publication in peer-reviewed journals or other professional literature is necessary to give a study an indicia of reliability, when there exists a mature epidemiological record with numerous peer-reviewed, published studies supporting the expert's analysis, an aura of reliability and validity is accorded those studies. See Green, 86 Nw. U.L.Rev. at 694; *Richardson v. Richardson—Merrell, Inc.*, 649 F.Supp. 799, 802-03 (D.D.C.1986), *aff'd*, 857 F.2d 823 (D.C.Cir.1988), *cert. denied*, 493 U.S. 882, 110 S.Ct. 218, 107 L.Ed.2d 171 (1989). While the existence of numerous peer-reviewed, published, epidemiological studies does not guarantee that the studies are without flaws,

570 such publication here alleviates the necessity of thorough judicial scrutiny of each study at the admissibility stage "to sort out the disputes over methodologic errors in studies." Green, 86 Nw. U.L.Rev. at 694.^[14] At least *570 until a more refined screening mechanism can be devised, we are satisfied that under *Frye* peer review and publication lends sufficient reliability and validity to these studies to allow an expert's testimony based upon these studies to be admissible.^[15]

In our ruling here we are not advocating the abdication of the judicial "gate-keeping" role, contemplated by *Frye*, to the editors of scientific and medical journals. In part, our ruling is a recognition that at this stage of these proceedings a sufficient record is not in place which would allow judicial scrutiny of these studies, spanning several scientific and medical disciplines, to determine the existence and seriousness of any methodological errors. While the experts in these cases testified at length, they testified only in a very general way about the qualities of the studies upon which they relied. Although the studies themselves are in the record, there is insufficient expert testimony on the quality of those studies to guide the court in making any legal conclusion about the probity of the studies. Researchers have methods for assessing the characteristics of persons included in the study and the risk of disease which can be used to rule out known sources of biases and error. On the basis of this record, this court cannot say that the researchers involved in these studies failed to employ such methods.

In addition, any such errors in these studies would principally affect the weight to be accorded the opinions based thereon. Our focus at this stage, however, is a more narrow one—whether to exclude expert testimony based on mere speculation or unreliable science. *Joiner v. General Elec. Co.*, 78 F.3d at 532.^[16]

Finally, we decline to adopt the railroad's suggestion that we reject "statistically insignificant" studies. The use of "statistical significance" to reject an epidemiological study has been roundly criticized by the experts in the field. See, e.g., Green, 86 Nw. U.L.Rev. at 681-93. Professor Green, for example, concludes that rejecting studies that are not statistically significant would be cursory and foolish. We find his explanation instructive:

The *Brock* [*Brock v. Merrell Dow Pharm., Inc.*, 874 F.2d 307 (5th Cir.1989), cert. denied, 494 U.S. 1046, 110 S.Ct. 1511, 108 L.Ed.2d 646 (1990)] decision, in ascribing wondrous powers to the concept of statistical significance, contributes to doubts that these matters are ones that reasonably can be mastered by generalist judges. Statistical significance addresses only random error due to the sampling inherent in any epidemiologic study. It cannot and does not speak to systematic error, which requires an informed review of the methodology employed in conducting the study. Moreover, statistical significance is merely an instrument for assisting in evaluating a study, not a truth serum that can be simplistically prescribed.

Id. at 681-82.

571 In sum, for the above reasons we decline to accept the railroad's invitation to examine these studies in detail ourselves and conclude without the basis of record evidence that they are deficient for the variety of reasons advanced by the railroad. **CSX's** claims of *571 bias, lack of biological plausibility, and alleged other defects in these studies go to the weight, rather than the admissibility, of the studies. See *Ellis v. International Playtex, Inc.*, 745 F.2d 292, 303 (4th Cir.1984). If there are weaknesses or technical deficiencies in the published epidemiological studies supporting the plaintiffs' experts' opinions as the railroad claims, those perceived deficiencies are appropriate matters upon which to examine and cross examine the experts at trial and, then, for consideration by the fact finder. *In re Joint E. & S. Dist. Asbestos Litig.*, 52 F.3d at 1132. In the instant cases, however, the claimed deficiencies are not a valid reason for excluding the experts' opinions.

As argued by the appellants, the trial in the instant cases will be primarily a so-called "battle of the experts." The fact that the experts have all derived their opinions from the same generally-accepted methodology, the epidemiological studies contained in the record, but simply disagree upon how to interpret the scientifically (and legally) reliable data, is not a valid reason for excluding the plaintiffs' experts' opinions altogether. As the court said in *In re Joint E. & S. Dist. Asbestos Litig.*, 52 F.3d at 1135:

For the district court to seize on the putative flaws of studies favorable to plaintiff, and then to privilege certain studies favorable to the defendant, was impermissibly to place a thumb on defendant's side of the scale and to encroach on the jury's prerogative to weigh the relative merits and credibilities of competing studies ... Thus, to the extent that none of the studies is flawless or dispositive, their relative merits seems to us to be a classic question for the jury. Trial courts should not arrogate the jury's role in "evaluating the evidence and the credibility of expert witnesses" by "simply cho[osing] sides in [the] battle of the experts." Christophersen v. Allied-Signal Corp., 902 F.2d 362, 366 (5th Cir. 1990).

Finally, we must respectfully disagree with the trial court's rejection of Dr. Kelly's testimony on specific causation. Dr. Kelly employed the differential diagnosis method which is scientifically acceptable. In re Paoli R.R. Yard PCB Litig., 35 F.3d at 758; Hines v. Consolidated Rail Corp., 926 F.2d at 274. Using this differential diagnosis, Dr. Kelly attempted to eliminate the other possible causes of **Berry's** symptoms. Unlike the situation in In re "Agent Orange" Prod. Liab. Litig., 611 F.Supp. 1223, and other cases, Dr. Kelly had physical contact with **Berry** and personally examined him as well as supervised his treatment by other professionals. Dr. Kelly's opinion was not only based upon **Berry's** statements of his symptoms, but was based upon **Berry's** personal history, medical records, physical examinations and medical tests. In short, Dr. Kelly's opinion was based upon sufficient epidemiological data, facts and personal observation, and was therefore reliable.

REVERSED and REMANDED for further proceedings consistent with this opinion.

JOANOS and PADOVANO, JJ., concur.

APPENDIX A

Edward L. Baker, M.D., et al., *Neurobehavioral Effects of Solvents in Construction Painters*, 30 J. Occup. Med. 116 (1988)

Barbara Bazylewicz-Walczak, et al., *The Psychological Effects of Chronic Exposure to White Spirit in Rubber Industry Workers*, 3 Polish J. Occup. Med. 117 (1990)

Stig-Arne Elofsson, Ph.D., et al., *Exposure to Organic Solvents*, 6 Scand. J. Work Envtl. Health 239 (1980)

Evelin Escalona, M.D., et al., *Neurobehavioral Evaluation of Venezuelan Workers Exposed to Organic Solvent Mixtures*, 27 Am. J. Indus. Med. 15 (1995)

Anne T. Fidler, et al., *Neurobehavioral Effects of Occupational Exposure to Organic Solvents Among Construction Painters*, 44 Brit. J. Indus. Med. 292 (1987)

Helena Hanninen, et al., *Exposure to Organic Solvents and Neuropsychological Dysfunction: A Study on Monozygotic Twins*, 48 Brit. J. Indus. Med. 18 (1991)

572 Lisa A. Morrow, Ph.D., et al., *Alterations in Cognitive and Psychological Functioning *572 After Organic Solvent Exposure*, 32 J. Occup. Med. 444 (1990)

Lisa A. Morrow, Ph.D., et al., *A Distinct Pattern of Personality Disturbance Following Exposure to Mixtures of Organic Solvents*, 31 J. Occup. Med. 743 (1989)

Andreas Seeber, *Neurobehavioral Toxicity of Long-Term Exposure to Tetrachloroethylene*, 2 Neurotoxicology and Teratology 579 (1989)

A. Spurgeon, Ph.D., et al., *Neurobehavioral Effects of Long-Term Occupational Exposure to Organic Solvents: Two Comparable Studies*, 22 Am. J. Indus. Med. 325 (1992)

Kurt Rasmussen, M.D., et al., *Solvent-Induced Chronic Toxic Encephalopathy*, 23 Am. J. Indus. Med. 779 (1993)

[1] There remains pending below a suit on behalf of Roy Lee **Berry**, Jr., for injuries due to alleged exposure to excessive levels of

asbestos.

[2] Toxic encephalopathy occurs when there has been an alteration to the brain and central nervous system function due to exposure to various toxins. See generally Neil L. Rosenberg, M.D., *Occupational and Environmental Neurology*, 116-17 (1995)(herein *Occupational and Environmental Neurology*). As explained in William N. Rom, M.D. (ed.) *Environmental and Occupational Medicine* at 849 (1992):

The nonspecific effects of long-term exposure to solvents range from a general negative affective state to a subtle reduction in functional reserve capacity to perform well when fatigued or in a distracting environment, to mild slowing of psycho-motor performance, to memory disturbance, and finally to severe intellectual deficits. The most severe condition, which has been called psycho-organic syndrome, presenile dementia, and severe chronic toxic encephalopathy, is also the most controversial. Although the existence of chronic solvent encephalopathy has been questioned, experts now generally agree that it occurs but not on its prevalence.

(Footnotes deleted).

[3] Some, but by no means all, of the studies relied upon by appellants' experts are set forth in "Appendix A."

[4] In their recent treatise, Professors Faigman, Kaye, Saks and Sanders have explained the differences between *Frye* and *Daubert* thusly:

In fact, if *Daubert* is a significant break from the past, the departure lies in the changed focus of the admissibility determination. *Frye* asks judges to decide the admissibility of scientific expert testimony by deferring to the opinions of scientists in the "pertinent field." Thus, under *Frye*, judges need not have any facility with scientific methods to make the admissibility decision. They must merely have some basis for knowing what scientists believe. Under *Daubert*, the trial court itself is initially responsible for determining the admissibility of scientific expert testimony by determining that the science supporting that opinion is valid. *Modern Scientific Evidence* at § 1-3.0. These authors have further characterized *Frye* as "easy to apply and requir[ing] little scientific sophistication on the part of judges." *Id.* at § 1-2.3. "Whereas *Frye* require[s] judges to survey the pertinent field to assess the validity of the proffered scientific evidence, *Daubert* calls upon judges to assess the merit of the scientific research supporting an expert's opinion." *Id.* at Preface p. viii.

[5] Recently in *General Elec. Co. v. Joiner*, U.S. , 118 S.Ct. 512, 139 L.Ed.2d 508 (1997), the United States Supreme Court has held that an abuse of discretion standard of review applies to the review of a trial court's determination of admissibility under *Daubert*.

[6] One generally accepted set of standards for evaluating epidemiological studies is known as the Koch Postulates. Those standards are composed of the following seven factors:

1. strength of association;
2. temporal relationship;
3. consistency of the association in other research;
4. biological plausibility;
5. consideration of alternative explanations;
6. specificity of the association; and
7. dose-response relationship.

Federal Judicial Center, *Reference Manual on Scientific Evidence* 161 (1994)(herein the *Reference Manual*); see also Bert Black & David E. Lilienfeld, *Epidemiological Proof in Toxic Tort Litigation*, 52 Fordham L.Rev. 732, at 762-63 (1984).

[7] The "relative risk" concept is sometimes referred to as the "odds ratio" depending upon the type of study involved. However, for ease of reference, we will refer to relative risk only. *Reference Manual* at 149.

[8] As stated by the court in *Daubert v. Merrell Dow Pharm., Inc.*, 43 F.3d 1311, 1317 (9th Cir.1995):

One very significant fact to be considered is whether the experts are proposing to testify about matters growing naturally and directly out of research they have conducted independent of the litigation, or whether they have developed their opinions expressly for purposes of testifying.... [I]n determining whether proposed expert testimony amounts to good science, we may not ignore the fact that a scientist's normal workplace is the lab or the field, not the courtroom or the lawyer's office. That an expert testifies based on research he has conducted independent of the litigation provides important, objective proof that the research comports with the

dictates of good science.

[9] "Differential diagnosis" is a term used "to describe a process whereby medical doctors experienced in diagnostic techniques provide testimony countering other possible causes ... of the injuries at issue." Hines v. Consolidated Rail Corp., 926 F.2d 262, 270 n. 6 (3d Cir.1991).

[10] Hypoxia is a "[d]ecrease below normal levels of oxygen in inspired gases, arterial blood, or tissue, short of anoxia;" anoxia is an "[a]bsence or almost complete absence of oxygen." *Stedman's Medical Dictionary*, at 90 and 756 (25th ed.1989).

[11] While the court had already ruled in Ramirez, 651 So.2d at 1168, that general acceptance under *Frye* must be established by a preponderance of the evidence, in *Brim* the court added to the analysis by defining "general acceptance" as meaning acceptance by a clear majority of the members of the relevant scientific community, with consideration by the trial court of both the quality and quantity of those opinions. Brim, 695 So.2d at 272.

[12] Further, the fact that a epidemiological study calls for further research does not indicate uncertainty on the part of the researchers. As explained below by expert witness David Hartman, Ph.D., who submitted an affidavit in the Chrisco case:

Any research design assessing clinical data in the real world will always be considered incomplete by critical reviewers. By its very nature, the medical researcher cannot control all possible factors in the human population under study. Therefore, one must distinguish between a truly erroneous study, and the study which is simply an expression of a particular population ... [and] is correctly constructed and analyzed....

Almost all genres of research articles in the medical and behavioral sciences conclude their discussion with qualifying statements such as "there is still much to be learned." This is not, as might be assumed, an expression of ignorance, but rather an expression that all scientific fields are open-ended and can progress from their present state....

Medical and behavioral statistics is a methodology that seeks to measure degrees of probability, not causality. Uncertainty is never completely abolished in any form of behavioral or medical science statistical manipulation. Therefore, conclusions must be defined in terms of "suggestions" or "associations" rather than causes. This is not due to some inaccuracy or vagueness of the technique or conclusion, but rather is intrinsic to the properties of statistics.

Mr. Hartman's opinion is consistent with other authorities on the subject. See, e.g., *Reference Manual* at 157 ("Most researchers are conservative when it comes to assessing causal relationships, often calling for stronger evidence and more research before a conclusion of causation is drawn.").

[13] Though there are certainly a number of cases that suggest a relative risk greater than 2.0 can permit an inference that an individual's disease was more likely than not caused by exposure to the toxic agent, there are also cases which have recognized that a plaintiff may satisfy his or her burden of production even if a relative risk less than 2.0 emerges from the epidemiological evidence. *Reference Manual* at 170. See, e.g., Grassis v. Johns-Manville Corp., 248 N.J.Super. 446, 591 A.2d 671, 675 (App.Div.1991):

The physician or other qualified expert may view the epidemiological studies and factor out other known risk factors such as family history, diet, alcohol consumption, smoking ... or other factors which might enhance the remaining risks, even though the risk in the study fell short of the 2.0 correlation.

[14] In an action against CSX factually similar to the instant cases, the Tennessee Supreme Court recently upheld the admission into evidence of expert testimony based upon epidemiological studies showing an association between exposure to certain organic solvents and toxic encephalopathy. McDaniel v. CSX Transp., Inc., 955 S.W.2d 257 (Tenn.1997). We believe that the *McDaniel* court correctly explained the role of the trial court in cases such as this:

Although the trial court must analyze the science and not merely the qualifications, demeanor or conclusions of experts, the court need not weigh or choose between two legitimate but conflicting scientific views. The court instead must assure itself that the opinions are based on relevant scientific methods, processes, and data, and not upon an expert's mere speculation. The trial court should keep in mind that the preliminary question ... is one of admissibility of the evidence. Once the evidence is admitted, it will thereafter be tested with the crucible of vigorous cross-examination and countervailing proof. After that occurs, a defendant may, of course, challenge the sufficiency of the evidence by moving for a directed verdict at the appropriate times. Yet it is important to emphasize that the weight to be given to stated scientific theories, and the resolution of legitimate but competing scientific views, are matters appropriately entrusted to the trier of fact.

Id. at 265 (citations omitted).

[15] A review of case law in the toxic torts area demonstrates that the intensity of the "admissibility" inquiry evolved as a result of

Agent Orange and bendictin cases. See Green, 86 Nw. U.L.Rev. 643. But unlike the present situation, the initial published studies involving both of those allegedly toxic agents were *negative* and the plaintiffs were trying to introduce expert testimony contrary to the published epidemiological studies.

[16] Though certain of the federal decisions cited or discussed in this section of the opinion employ a *Daubert* analysis, rather than a *Frye* analysis, these opinions are nonetheless focusing on the reliability of the expert's methodology. Florida's *Frye* test is ultimately concerned with the reliability of the scientific principles or methodology upon which the expert bases his opinion. See generally, C. Ehrhardt, *Florida Evidence* §§ 702.3, 702.4 (1997). It is yet a matter of debate whether the *Daubert* test, in requiring that the reasoning or methodology underlying the testimony be scientifically valid, will be more liberal and allow more expert testimony than the *Frye* requirement that there be general acceptance of the underlying methodology. *Modern Scientific Evidence* at § 1-3.3.4. But we are satisfied that for the purposes of the analysis here, under the *Frye* test of general acceptance, that peer-reviewed epidemiological studies conducted independently of the instant litigation are the scientifically accepted means of analyzing human response to exposures to certain substances.

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193 P.3d 1030 (2008)

222 Or. App. 431

Thomas KENNEDY, Plaintiff-Appellant,

v.

EDEN ADVANCED PEST TECHNOLOGIES, a Washington corporation, Glen Howell, and
Greg Prater, Defendants-Respondents.CV04120346, A132638.

Court of Appeals of Oregon.

Argued and Submitted April 4, 2008.

Decided October 1, 2008.

1031 *1031 Ken Dobson argued the cause for appellant. With him on the briefs was The Dobson Law Firm LLC.

Thomas W. Brown, Portland, argued the cause for respondents. With him on the brief were Wendy M. Margolis, Portland, and Cosgrave Vergeer Kester LLP.

Before EDMONDS, Presiding Judge, and WOLLHEIM, Judge, and SERCOMBE, Judge.

EDMONDS, P.J.

Following defendants' application of pesticides to plaintiff's house and yard, plaintiff brought this action, alleging claims for fraud, violation of the Unlawful Trade Practices Act (UTPA), negligence, intentional infliction of emotional distress, and trespass. The jury found for defendants on the fraud and UTPA claims and for plaintiff on the negligence and trespass claims.^[1] The trial court entered judgment for plaintiff in the amount of nearly \$120,000. Plaintiff appeals, raising three assignments of error. Because we agree that plaintiff's first assignment of error requires reversal, we do not address his other claims.

1032 *1032 In the early 1990s, plaintiff began having health problems that he eventually attributed to the mercury amalgam in his dental fillings, which he had removed. At that time, according to his testimony, he was diagnosed with chemical sensitivity.^[2] As a result, he took various precautions to modify his house so that it would not exacerbate his health problems. For example, plaintiff installed wooden floors, a water filter, and air filters. He used organic bedclothes, and he ate almost exclusively organic foods. Plaintiff also testified that his condition made it difficult to travel and to engage in certain social activities.

In May 2004, plaintiff saw carpenter ants in his yard. In determining what to do about the ants in light of his sensitivity to chemicals, plaintiff consulted a book that provided information for healthy indoor living. Plaintiff read in the book that a chrysanthemum flower product called Tri-Die could be used to combat ant problems. Plaintiff telephoned a number of pest control companies listed in the phone book that he thought might have nontoxic products, asking each about Tri-Die. Eventually, he called defendant **Eden Advanced Pest Technologies** and asked if they used Tri-Die. As a result of the telephone call, in mid-June, defendant Howell, an **Eden** employee, came out to plaintiff's house to discuss treatment options.

Plaintiff asked Howell about Tri-Die, and Howell responded that defendants did not use Tri-Die, but that they had another product that was, according to plaintiff's testimony, "a non-toxic chrysanthemum oil product that could be used on carpenter ants." Howell told plaintiff that the product he would use, Termidor, was safe for people with chemical sensitivities. Plaintiff and Howell discussed at some length exactly where the Termidor would be placed and how it would be applied. According to plaintiff, Howell stated that he would be present for the Termidor application to make sure it was done exactly as he and plaintiff had discussed. They scheduled the application of the Termidor for June 23.

Plaintiff left the house early on the morning of June 23 for a flight to Phoenix, Arizona, where he spent the day. He testified that, as soon as he walked into the house on his return that evening, he knew he "was having a reaction." He experienced a bad taste in his mouth, he was nauseated, and he was jittery. Throughout the night, plaintiff continued to experience those and a number of additional symptoms. Plaintiff awakened several times during the night and, during one of those periods of sleeplessness, he found a document near his front door that had been left by **Eden's** employee. The document indicated that, in addition to Termidor, a product called Cy-Kick had been applied to plaintiff's house. In light of his symptoms and because he did not know what Cy-Kick was, plaintiff telephoned **Eden** in the morning and then defendant Howell directly. In response to plaintiff's inquiry, Howell investigated and reported to plaintiff that the person who had applied the pesticides had run out of Termidor and had substituted Cy-Kick for the remainder of the application. Howell also told plaintiff that, although he, Howell, had met the person applying the pesticides at the house, he had been unable to stay for the application because of other obligations.

Plaintiff testified that, in the following weeks and months, he continued to experience severe symptoms. **Eden**, for its part, made attempts to remedy the situation by providing an ozone generator (with the goal of neutralizing the pesticide in the house) and applying Neutrasol, a neutralizing agent. According to plaintiff, neither attempt to remedy the problem appeared to help his physical condition, and he eventually incurred thousands of dollars in expenses for the removal of soil, substitute housing, and medical treatment.

As part of his efforts to obtain a diagnosis and treatment for his condition, plaintiff went to Texas in November 2004 to see Dr. William Rea. Rea, who founded the Environmental Health Center in Dallas, diagnosed plaintiff with chemical sensitivity, toxic encephalopathy, *1033 toxic effects of pesticides, allergic gastroenteritis, chronic fatigue, malabsorption, hormone imbalance, muscle pain, hypogammaglobulinemia, acute rhinosinusitis, and abdominal pain. Rea concluded that plaintiff had been suffering from those conditions before June 2004 and that his exposure to defendants' pesticides in June 2004 exacerbated those conditions. Rea prescribed dietary restrictions, injection therapy, nutrient therapy, heat therapy, massage and exercise therapy, and immune therapy.

Plaintiff ultimately filed the complaint in this case, alleging that defendants' actions had caused him \$750,000 in damages. His first claim was for fraud, based on the theory that Howell had misrepresented that Termidor was nontoxic and that he personally would be present during the pesticide application. His second claim, brought under the UTPA, ORS 646.605 to 646.656, was that Howell and **Eden** had made or conspired to make false or misleading representations concerning the "characteristics, ingredients, and qualities of Termidor and the proposed pesticide application." Plaintiff's third claim was a negligence claim, based on the theory that defendants had made misrepresentations about Termidor, had failed to disclose their planned use of Cy-Kick, had misrepresented that the employee applying the pesticides would be properly supervised, and had negligently performed the actual application. Plaintiff's fourth claim was against **Eden** and was based on a theory of trespass. Finally, plaintiff included claims for intentional infliction of emotional distress and for declaratory relief.

The jury returned a verdict finding that Howell made false representations to plaintiff and that defendants violated the UTPA, but that plaintiff suffered no damages as a result of defendants' conduct. The jury also found that defendants were negligent, but that plaintiff was also 40 percent negligent. Finally, the jury found that defendants Prater and **Eden** had trespassed on plaintiff's property. Based on the jury's verdicts, the trial court entered judgment in favor of plaintiff on the negligence and trespass claims, and dismissed the UTPA and fraud claims. Plaintiff appeals.

As noted, plaintiff raises three assignments of error on appeal. First, he argues, the trial court erred in excluding the testimony of Rea, plaintiff's treating physician and a purported expert in the area of chemical sensitivity. In his second assignment of error, plaintiff asserts that the trial court erred in excluding other expert testimony regarding chemical sensitivity. Finally, in his third assignment of error, plaintiff contends that the trial court erred in denying his motion to amend his complaint to plead entitlement to punitive damages. For the reasons explained below, we agree that the trial court erred in excluding Rea's testimony.

Pretrial, defendants moved to exclude Rea's testimony and requested a hearing under OEC 104(1), which provides:

"Preliminary questions concerning the qualification of a person to be a witness, the existence of a

privilege or the admissibility of evidence shall be determined by the court, subject to the provisions of subsection (2) of this section. In making its determination the court is not bound by the rules of evidence except those with respect to privileges."

Specifically, defendants moved to exclude "(1) all testimony of plaintiff's proposed expert Dr. William J. Rea, including testimony as to his diagnoses, opinions of causation, and recommended treatment for plaintiff; and (2) the testimony of any other witness that relies on Dr. Rea's work or opinions."

Following a hearing at which both plaintiffs and defendants' experts (but not Rea) testified, the trial court ruled that Rea would not be allowed to testify:

"The burden of proof is on the plaintiff to prove by a preponderance of the evidence that the proffered testimony is scientifically valid. And while there's some evidence to suggest that it is a legitimate diagnosis, I cannot find by a preponderance of the evidence that it is a—legitimate diagnosis.

1034 "The greater weight of the evidence is to the contrary, that it is not. So I will find that the proffered testimony does not meet *1034 the *Daubert* standard,^[3] and it will not be admissible, * * * nor will any derivative evidence that relies on it. So I will adopt the findings that are stated in Defendant's memorandum on that issue. That will be the order of the Court."

In its written order, the trial court concluded that

"plaintiff has failed to establish by a preponderance of the evidence that the proffered 'scientific' evidence concerning the diagnosis, cause, and/or treatment of chemical sensitivity and related chemical injuries satisfies the standard for scientific evidence as set forth in State v. O'Key, 321 Or. 285, 899 P.2d 663 (1995)], and its progeny."

On appeal, plaintiff argues that Rea's testimony was admissible as scientific evidence under the tests set out in the seminal cases of State v. Brown, 297 Or. 404, 687 P.2d 751 (1984), State v. O'Key, 321 Or. 285, 899 P.2d 663 (1995), and Jennings v. Baxter Healthcare Corp., 331 Or. 285, 14 P.3d 596 (2000). Defendants respond:

"The trial court did not err in excluding the testimony of Dr. Rea regarding the diagnosis, cause, and/or treatment of 'chemical sensitivity' because plaintiff failed to establish by a preponderance of the evidence that the condition, as advocated by Dr. Rea and other practitioners of 'clinical ecology,' satisfies Oregon's standard for admissible scientific evidence. Reputable medical organizations across a wide range of disciplines repeatedly and consistently have rejected the existence of 'chemical sensitivity,' virtually every federal court that has considered the admissibility of expert testimony on the subject has excluded it as lacking scientific validity, and the underlying methodology has not progressed since those cases were decided, much less to the point of scientific knowledge capable of assisting a jury."

We review the exclusion of scientific evidence for errors of law. Jennings, 331 Or. at 301, 14 P.3d 596.

"Scientific evidence" is "evidence that draws its convincing force from some principle of science, mathematics and the like." Brown, 297 Or. at 407, 687 P.2d 751. Here, the parties do not dispute—and we agree—that Rea's diagnosis and related testimony constitute scientific evidence. See State v. Sanchez-Cruz, 177 Or.App. 332, 341, 33 P.3d 1037 (2001), *rev. den.*, 333 Or. 463, 42 P.3d 1245 (2002) (stating that "a medical diagnosis is scientific evidence"). Accordingly, the issue that we must address is whether the trial court erred, as a matter of law, in excluding Rea's testimony. For the reasons explained below, we conclude that it did.

Scientific evidence is treated differently from other types of evidence. That different treatment is based on the premise that "[e]vidence perceived by lay jurors to be scientific in nature possesses an unusually high degree of persuasive power." O'Key, 321 Or. at 291, 899 P.2d 663 (omitted). In light of that premise, appellate courts have described the role of the trial court as that of a "gatekeeper," whose job

"is to ensure that the persuasive appeal is legitimate. The value of proffered expert scientific testimony critically depends on the scientific validity of the general propositions utilized by the expert. Propositions that a court finds possess significantly increased potential to influence the trier of fact as scientific assertions, therefore, should be supported by the appropriate scientific validation. This approach `ensure[s] that expert testimony does not enjoy the persuasive appeal of science without subjecting its propositions to the verification processes of science."

Id. at 291-92, 899 P.2d 663 (quoting John William Strong, *Language and Logic in Expert Testimony: Limiting Expert Testimony by Restrictions of Function, Reliability, and Form*, 71 Or. L. Rev. 349, 361 (1992)) (citations omitted).

1035 In *O'Key*, adopting and relying in part on the analysis applied by the United States Supreme Court in *Daubert v. Merrell Dow Pharmaceuticals*, 509 U.S. 579, 113 *1035 S.Ct. 2786, 125 L.Ed.2d 469 (1993), the Oregon Supreme Court reiterated its earlier statement in *Brown* that the admissibility of scientific evidence is determined by applying OEC 702 (addressing expert testimony) together with OEC 401 and 403 (addressing relevance and the balancing of probative value against the potential for unfair prejudice, respectively).^[4] 321 Or. at 297-99, 899 P.2d 663. "In applying OEC 401, 702, and 403, the court must identify and evaluate the probative value of the proffered scientific evidence, consider how that evidence might impair rather than help the trier of fact, and decide whether truthfinding is better served by admission or exclusion." *Id.* at 299, 899 P.2d 663 (omitted).

To help the court perform that function, the Supreme Court in *Brown* identified seven factors that "are to be considered as guidelines":

- "(1) The technique's general acceptance in the field;
- "(2) The expert's qualifications and stature;
- "(3) The use which has been made of the technique;
- "(4) The potential rate of error;
- "(5) The existence of specialized literature;
- "(6) The novelty of the invention; and
- "(7) The extent to which the technique relies on the subjective interpretation of the expert."

297 Or. at 417, 687 P.2d 751.^[5] But, the court cautioned,

"[t]he existence or nonexistence of these factors may all enter into the court's final decision on admissibility of the novel scientific evidence, but need not necessarily do so. What is important is not lockstep affirmative findings as to each factor, but analysis of each factor by the court in reaching its decision on the probative value of the evidence * * *."

Id. at 417-18, 687 P.2d 751 (footnotes omitted).

We turn to the evidence adduced at the pretrial hearing on defendants' motion to exclude Rea's testimony. The record reveals the following facts.^[6] Rea received his medical degree from Ohio State University in 1962. Following additional training, Rea became board certified in general surgery and cardiovascular surgery. In addition, Rea testified that he is "board certified" in environmental medicine, a statement that will be discussed in more detail below. Rea testified at his deposition that he has authored "four definitive textbooks" on chemical sensitivity, as well as a number of other books and book chapters, and "about 140 peer reviewed or scientific articles on vascular disease in the environment." Rea has practiced environmental medicine for about 40 years, treating over 30,000 patients. He is a Fellow of— among others—the American College of Surgeons, the American Academy of Environmental Medicine, the American College of Allergists, and the American College of Preventative Medicine. He belongs to a number of medical associations, has held a number of teaching posts, and has received a number of honors.

1036 *1036 As noted above, Rea diagnosed plaintiff as suffering from chemical sensitivity and related conditions. Rea testified that the "foundation" of his diagnoses was plaintiff's medical history, including his history of exposure to mercury and the more recent exposure to pesticides. Rea also testified that his physical examination of plaintiff supported his diagnoses. Rea examined plaintiff's eyes, ears, nose, throat, heart, lungs, skeletal muscles, and blood vessels. He also determined, using a "tandem Romberg" test and a "stress Romberg" test, that plaintiff could not walk a straight line and that he could not stand on his toes. Rea also ordered a SPECT scan in diagnosing plaintiff's condition.^[7] Rea testified that a SPECT scan is used to "rule out things like schizophrenia and depression, things like that." Rea also sent plaintiff to Dr. Didriksen, a psychologist, for evaluation. Rea testified that he performed a differential diagnosis in reaching his conclusion about plaintiff's condition.^[8]

Rea ordered or performed a number of laboratory tests. Those tests included a plasma cholinesterase test that suggested that plaintiff had been exposed to an insecticide. Rea also ordered a "T & B lymphocyte" test, the result of which, in his view, supported his conclusion that plaintiff had suffered a chemical exposure. In addition, a "CMI, or cell mediated immunity" test was performed, which also revealed an abnormal result, suggesting that plaintiff had been exposed to toxic chemicals. Rea also performed "skin tests" by injecting various substances into plaintiff's skin and measuring the reaction to those substances; Rea concluded that those tests showed "multiple abnormalities." He also ordered a stool culture, which showed abnormal growth of candida, a fungus. Rea stated that such an abnormal growth is seen "frequently in chemical injury." In addition, Rea performed two autonomic nervous system tests, the heart rate variability test and the pupillography test; he concluded that the results of both tests were abnormal. Finally, Rea performed a thermography test, which revealed "multiple organ dysfunction involving inflammation, toxicity of various organs."

Rea testified that each of the techniques and tests he employed in diagnosing plaintiff's condition was an accepted diagnostic tool. As noted above, based on plaintiff's history, his physical examination, and the laboratory tests, Rea stated that he believed, to a reasonable degree of medical certainty, that plaintiff's exposure to pesticides in June 2004 exacerbated his preexisting conditions.

In addition to Rea's deposition testimony (which defendants had submitted as an exhibit), plaintiff called Dr. Lipsey, an expert in toxicology who earned his doctorate in toxicology in 1972. Lipsey testified that he was familiar with the condition known as chemical sensitivity and that he had spoken on the subject to the American Academy of Environmental Medicine (AAEM), an organization that was composed of medical doctors, nurses, and others. Lipsey stated that many outside of the AAEM recognize chemical sensitivity as a diagnosable condition, including the Canadian government, which recognizes chemical sensitivity as a disability. Lipsey also testified that Rea is "highly respected in the American Academy of Environmental Medicine."

At the OEC 104 hearing, defendants challenged Rea's qualifications and methods through their expert, Dr. Burton, a physician specializing in occupational and environmental toxicology. Burton disagreed with virtually every aspect of Rea's deposition testimony, testifying that the tests Rea performed and the research he relied on either did not support his diagnoses or were inappropriate in determining the existence of chemical sensitivity. For example, Burton stated, "If
1037 you're asking me can dental fillings cause mercury poisoning, the answer, of course, is *1037 no." Burton testified that the heart rate variability test and pupillography are "novel tests * * * published in obscure journals for which we don't know anything about peer review or other aspects of the testing procedure." Burton testified that many of the journal articles on which Rea relied in fact contradicted his conclusions. Burton stated that the SPECT scan "has no utility. It's not a test that a medical toxicologist would ever use to diagnose a toxic illness." Pupillography, Burton testified, is a test that "is no better than reading a palm." According to Burton, "a stool culture has nothing to do with toxicology."

Underlying Burton's testimony was the belief that there is no such condition as "chemical sensitivity." As Burton explained,

"The—the concept of chemical sensitivity or multiple chemical sensitivity, which has gone through a few name changes, was—was first proposed by—by a physician who called himself a clinical ecologist back in the 1940s. * * * He—he formed a belief and found followers that something in the environment—he

wouldn't say what it was—but something caused people to develop a variety of symptoms. And the symptoms could be just about anything you could imagine.

"And Dr. Rea became one of his disciples and published extensively in a journal called Clinical Ecology, and he became the mouthpiece, so to speak, for the clinical ecology movement. But the—the difficulty with—with this concept is that it's never had any scientific underpinnings. One cannot demonstrate exposure to any particular substance of a—of any duration or intensity that can cause human disease, nor can the condition be defined in such a way that anybody can properly diagnose it.

* * * * *

"And so as—as of today, we continue to see a number of physicians who have that kind of practice that use diagnostic tests that are not validated. They continue to make the diagnosis of multiple chemical sensitiv[ity], or MCS, or chemical sensitivity or sometimes it's been renamed to idiopathic environmental intolerance. None of these are legitimate diagnosable medical conditions for which criteria exist."

Burton testified that, after the practice of clinical ecology "was reviewed and multiple publications came out repudiating the practice and the diagnostic techniques," its adherents started calling themselves practitioners of environmental medicine. According to Burton, "[n]o medical toxicologist subscribes to this sort of nonsense."

Burton also challenged Rea's credentials. He testified that, in contrast to the subspecialty of preventative medicine, the American Board of Medical Specialties does not recognize "environmental medicine" as a specialty; an exhibit submitted by defendants supports that statement. Burton testified that Rea "certainly doesn't have the background, training, expertise, [or] board certification that would be required of a medical toxicologist to diagnose—to evaluate or diagnose toxic illness." According to Burton, Rea is "practicing something that is not mainstream medicine, for sure. That, I can tell you."

In response to defense counsel's questions about each of the seven *Brown/O'Key* factors, Burton testified that Rea's diagnosis and proposed testimony failed to meet each of the factors. He denied that the "theory or techniques applied by Dr. Rea [have] been tested and shown to have scientific validity." As noted, he essentially scoffed at the question whether Rea's "qualifications and stature" were adequate. Burton testified that, although Rea's "approach * * * has been subject to generally recognized peer review and publication," that review had universally rejected Rea's views on chemical sensitivity. Defense counsel asked, "What is the general degree of acceptance of Dr. Rea's approach * * * within the medical-recognized medical community?" Burton responded, "Oh, not at all in the recognized medical community." Burton, in response to a question about potential error rates, responded, "Well, I—I would regard the error rate as a hundred percent, because it hasn't been substantiated as—as—as a scientific method." When counsel asked whether Rea's approach involves subjective interpretation, Burton responded, "Well, it's all his subjective interpretation."

1038 Counsel concluded by pointing out that a *1038 number of other courts had rejected Rea's testimony, a point that we return to later.

On cross-examination, Burton took the position that no physician had diagnosed plaintiff with chemical sensitivity, because there is no such condition: "They may have thought they did, but they did not."⁹¹ Burton also admitted that he "did not spend a great deal of time reviewing the literature cited by Dr. Rea because it—it's not really worthy of much review." Finally, Burton conceded that a SPECT scan is an appropriate technique by which to diagnose brain injuries.

In support of their motion to exclude Rea's testimony, defendants submitted several documentary exhibits, including portions of witnesses' depositions and other documents. Among other documents, they submitted a 2002 "Statement on Dental Amalgam" by the American Dental Association. According to that statement, which addressed the safety of the material plaintiff believes to have caused his initial chemical sensitivity, "[d]ental amalgam has been studied and reviewed extensively, and has established a record of safety and effectiveness. * * * [N]o valid scientific evidence has ever shown that amalgams cause harm to patients." (Internal quotation marks and citations omitted.)

Defendants also submitted a 1992 report by the American Medical Association (AMA) Council on Scientific Affairs that discussed both the discipline of clinical ecology and multiple chemical sensitivity. That report stated:

"No evidence based on well-controlled clinical trials is available that supports a cause-and-effect relationship between exposure to very low levels of substances and the myriad symptoms purported by clinical ecologists to result from such exposure. Several articles and books are available that seek to provide a scientific basis for such an association. Such publications, while thought provoking and interesting, fail to provide proof based on well-controlled clinical studies."

(Footnotes omitted.) Also, defendants submitted a 1999 position statement on idiopathic environmental intolerances (IEI) by the American Academy of Allergy, Asthma and Immunology (AAAAI). The AAAAI equated idiopathic environmental intolerances with multiple chemical sensitivity and noted that

"[t]he diagnosis of IEI is typically made on the basis of the patient's history, without any defining criteria. There are no diagnostic symptoms, and there are no diagnostic objective physical signs. Many different tests and procedures have been proposed, but no single test or combination of tests has been validated as diagnostic."

"Studies to date," the AAAAI report stated, "have failed to confirm that any immunologic tests are diagnostic for chemically induced symptomology. The diagnostic validity of the other procedures has yet to be tested." (Footnotes omitted.) The American College of Occupational and Environmental Medicine (ACOEM) issued a 1999 position paper expressing similar sentiments. Among other things, the ACOEM concluded, "ACOEM concurs with many prominent medical organizations that evidence does not yet exist to define MCS as a distinct entity."^[10]

In light of the record before the trial court, we return to the gatekeeping function of trial courts in determining whether to allow a jury to consider proffered scientific evidence. We are mindful that each case presenting such an issue must necessarily be decided on its own facts in light of the guiding principle that scientific evidence should be excluded only when it is so unhelpful or so potentially confusing or prejudicial that any probative value is substantially outweighed. Our approach to that issue is informed by the Oregon Supreme Court's admonishment that a difference of opinion in a scientific community alone is insufficient to exclude evidence from the jury's consideration:

1039 *1039 "[C]ontroversy within the scientific community is not necessarily a ground for exclusion of scientific evidence. In deciding whether to admit scientific evidence, a court need not resolve disputes between reputable experts; the evidence may be admissible even though a dispute exists. * * * [T]he witness who testifies to an expert opinion is subject to cross-examination concerning how he or she arrived at that opinion, and the cross-examiner is to be given 'great latitude' in eliciting testimony to vitiate the opinion."

State v. Lyons, 324 Or. 256, 278-79, 924 P.2d 802 (1996) (quoting Bales v. SAIF, 294 Or. 224, 235 n. 4, 656 P.2d 300 (1982)). Focusing on the applicable evidence code sections—as the Supreme Court has instructed—we conclude that Rea's testimony is relevant to plaintiffs' claims of injury, that it would have assisted the jury in determining a fact in issue (whether, and to what extent, plaintiffs' injuries were caused by defendants' conduct), and that, had it been admitted, it was unlikely to have caused confusion or have misled the jury.

On appeal, defendants address each of the seven *Brown/O'Key* factors, arguing that each of the factors supports the trial court's decision to exclude Rea's testimony. But defendants' analysis fails to give adequate attention to plaintiff's evidence, both in the form of Rea's deposition testimony and the testimony of Lipsey. When that evidence is considered, the most that can be said is that there is a controversy in the medical community about whether chemical sensitivity or MCS is a valid diagnosis.^[11]

We briefly discuss the *Brown/O'Key* factors to explain why we have reached the above conclusion. The first question is whether Rea's diagnostic methodology is generally accepted "in the field." In a broad sense, Rea's diagnostic techniques—that is, the taking of a patient's history, the examination of the patient, and the performance or ordering of tests of the patient's functions—are the very foundation of medical diagnosis.^[12] To be sure, defendants' expert

disagreed with Rea's choice of tests and their applicability to diagnosing chemical sensitivity (a diagnosis that defendants' expert denied exists), but Rea testified that the tests he uses are generally accepted as diagnostic tools. Thus, defendants' evidence demonstrates only that other experts on toxicology disagree with the use of those tests to diagnose chemical sensitivity.

In a related argument, defendants point out that Rea could not explain the physical mechanism by which patients become chemically sensitive. Although that fact is relevant to the inquiry, we note the Supreme Court's statement in Jennings, 331 Or. at 309, 14 P.3d 596, that "[t]here are many generally accepted hypotheses in science for which the mechanism of cause and effect is not understood fully. [The expert's] inability to explain the mechanism of plaintiff's condition goes to weight, not to admissibility."¹³¹ In this case, Rea appears to have based his diagnosis in part on his clinical experience of treating numerous patients over many years with symptoms similar to plaintiff's, not unlike what occurred in Jennings.

1040 Rea's qualification to make such a diagnosis similarly was contested by defendants. Nonetheless—and despite Burton's statement that Rea does not have the background, *1040 training, or expertise to diagnose or evaluate toxic illness—plaintiff's evidence established that Rea is a medical doctor who has practiced for a long period of time, belongs to relevant professional organizations, and has examined over 30,000 patients. Although the American Board of Medical Specialties does not recognize "environmental medicine" as a specialty, the American Academy of Environmental Medicine does. Again, the implication from those facts is that there exists a legitimate debate within the scientific community between two groups of scientists. For example, Rea testified that his technique for determining the existence of chemical sensitivity in a patient is commonly used in the medical community to which he belongs. In contrast, Burton suggested that only "fringe" medical practitioners would diagnose for toxic illness in the manner that Rea does. In our view, the trial court, in performing its gatekeeping function, need not keep from the jury evidence that demonstrates only such a conflict among professionals.

Moreover, we observe that the evidence is in conflict about the "potential rate of error" of Rea's diagnostic technique. Burton testified that the error rate is 100 percent, a statement that follows ineluctably from his view that chemical sensitivity does not exist. But a jury might not have been persuaded of that premise in light of Rea's qualifications and clinical experience, particularly when considered together with Lipsey's testimony and the other evidence presented by defendants. See Sanchez-Cruz, 177 Or. App. at 342, 33 P.3d 1037 ("Defendant * * * principally objects to the potential rate of error for this diagnosis and to the extent to which it relies upon an expert's subjective interpretation. Both objections, however, may be said of many recognized medical diagnoses."). Again, those kinds of conflicts between qualified experts go to the weight to be given to plaintiff's evidence and not its admissibility.

There can be no doubt that specialized literature exists on the subject of chemical sensitivity. To be sure, some of the literature—such as the documentary evidence submitted by defendants—argues against chemical sensitivity as a valid diagnosis. However, some of that literature is dated and the evidence demonstrates that the scientific community is engaged in an ongoing investigation and debate about MCS. That some of the literature rejects conclusions reached regarding chemical sensitivity does not make the methodology used in arriving at those conclusions any less scientific. See State v. Sampson, 167 Or.App. 489, 508, 6 P.3d 543, rev. den., 331 Or. 361, 19 P.3d 354 (2000) ("The difficulty with defendant's argument is that it attacks the credibility of the literature bolstering the reliability of the DRE protocol, not its existence."). Indeed, even defendants' expert agreed that chemical sensitivity is not a new or previously unheard of diagnosis, having been first proposed in 1940.

Moreover, evidence adduced at the hearing indicated that many legitimate entities view MCS as a legitimate diagnosis. For example, the Canadian government recognizes chemical sensitivity as a disability. And the "ICD-9" (International Classification of Diseases, Ninth Revision), which is maintained by the National Center for Health Statistics, includes chemical sensitivity as a diagnosis. Testimony at the OEC 104 hearing also demonstrated that the State of Washington maintains a registry for those with chemical sensitivities, and that the United States Housing Authority recognizes the diagnosis. See also SAIF Corp. v. Scott, 111 Or.App. 99, 102-03, 824 P.2d 1188, rev. den., 313 Or. 300, 832 P.2d 456 (1992) (concluding that substantial evidence supported the board's determination that the claimant's employment was the major contributing cause of his multiple chemical sensitivities). Also, the United States Social Security

Administration recognizes MCS as a medically determinable impairment for Social Security disability income purposes. Creamer v. Callahan, 981 F.Supp. 703, 705 (D.Mass.1997).

1041 The evidence that there are competing schools of scientific thought about whether MCS is a legitimate diagnosis and whether plaintiffs injuries were caused by his exposure to defendants' pesticides demonstrates why the trial court erred in exercising its gatekeeping function. As the Supreme Court explained in Marcum v. Adventist Health System/West, 345 Or. 237, 247-50, 193 P.3d 1 (2008).

"Even if the expert is not able to eliminate *all* alternative causes, the testimony nevertheless may be reliable and admissible if sufficient potential causes are eliminated for the expert to identify one particular cause as the likely cause of the condition. * * * [W]hen 'ruling in' potential causes of a condition or injury for purposes of differential diagnosis, a trial court should insist that the causation theory be 'biologically plausible,' that is, that the exposure *could* have caused plaintiff's injury. For that reason, a particular possible cause should not necessarily be excluded on the grounds that the expert cannot describe the precise mechanism of causation or point to statistical studies of cause and effect."

(Emphasis in original; citations omitted.) Here, according to plaintiff's evidence, MCS is a biologically plausible diagnosis—that is, plaintiff's diagnosis is based on a scientific methodology (an interpretation of plaintiff's history and the scientific tests that were performed) from which plaintiff's expert, who is qualified to draw such conclusions, concluded that the exposure could have caused plaintiff's injuries. Although defendants' experts reject the methodology and the conclusions reached by plaintiff's expert, the competing views between the two schools of scientific thought did not authorize the trial court in its gatekeeping function to exclude plaintiff's evidence. That is so because each school of thought reaches a conclusion that is "biologically plausible," as that phrase was used by the Supreme Court in Marcum.

We conclude by addressing defendants' assertion that "virtually all courts that have considered the issue have refused to allow expert testimony—including Drs. Rea and [his associate] Johnson—on the diagnosis of chemical sensitivity." Defendants' survey of the law in other jurisdictions is correct. The court in McNeel v. Union Pacific Railroad Company, 276 Neb. 143, 753 N.W.2d 321 (2008), recently described the state of the law in most jurisdictions:

"A number of courts have determined that toxic encephalopathy, also known as multiple chemical sensitivity or idiopathic environmental intolerance, is a controversial diagnosis unsupported by sound scientific reasoning or methodology. Some courts have specifically rejected or discredited the opinions of Rea and Didriksen on this subject."

Id. at 153-54, 753 N.W.2d at 331 (Footnotes omitted);^[14] see also Coffey v. County of Hennepin, 23 F Supp 2d 1081, 1086 (D.Minn.1998) ("[F]ederal courts do not consider environmental illness or MCS a scientifically valid diagnosis.").

1042 Under Oregon law, however, the proper inquiry is not whether MCS or chemical sensitivity is a "valid" diagnosis or is recognized by other jurisdictions; rather, we must, on the record in this case, "decide whether truthfinding is better served by admission or exclusion." O'Key, 321 Or. at 299, 899 P.2d 663.^[15] Regardless of what other courts have held, we have an obligation to independently construe the relevant provisions of the Oregon Evidence Code. Even though OEC 702 has as its origin the federal evidence code, the commentary to OEC 702 emphasizes that "[w]hether the situation is a proper one for the use of expert testimony is to be determined on the basis of assisting the trier of fact." Legislative Commentary to OEC 702, reprinted in Laird C. Kirkpatrick, *Oregon Evidence* § 702.02 (5th ed. 2007). Here, given the Oregon legislature's strong policy to aid the trier of fact to understand the evidence presented at trial in the context of *1042 the parties' theory of the case, we believe that the legislature intended controversial evidence like Rea's testimony to be presented to the jury.

We conclude on this record that plaintiff has carried his burden of showing that Rea's testimony is relevant, that it will assist the trier of fact to understand why plaintiff reacted as he did to the pesticides that defendants applied, and that it is not unfairly prejudicial, misleading, or confusing. When qualified experts disagree about the validity of medical diagnoses or other scientific evidence, judges are in no better position to resolve that dispute than are juries. Rather, the usual techniques for truthfinding—cross-examination, presentation of contrary evidence, and instruction on the

burden of proof—should be applied. In Oregon, we trust juries to be able to find the truth in the classic "battle of the experts." See Stoeger v. Burlington Northern Railroad Co., 323 Or. 569, 577, 919 P.2d 39 (1996) ("[I]t is the role of a jury—not a judge acting pretrial—to determine where the truth lies."). The circumstances of this case present such an issue.^[16]

Reversed and remanded.

[1] The record does not reveal the disposition of the intentional infliction of emotional distress claim, but it appears that it was dismissed.

[2] For purposes of this opinion, we treat the term "chemical sensitivity" as synonymous with "multiple chemical sensitivity" or "MCS."

[3] Daubert v. Merrell Dow Pharmaceuticals, 509 U.S. 579, 113 S.Ct. 2786, 125 L.Ed.2d 469 (1993).

[4] OEC 702 provides:

"If scientific, technical or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training or education may testify thereto in the form of an opinion or otherwise."

OEC 401 provides:

"'Relevant evidence' means evidence having any tendency to make the existence of any fact that is of consequence to the determination of the action more probable or less probable than it would be without the evidence."

OEC 403 provides:

"Although relevant, evidence may be excluded if its probative value is substantially outweighed by the danger of unfair prejudice, confusion of the issues, or misleading the jury, or by considerations of undue delay or needless presentation of cumulative evidence."

[5] In Marcum v. Adventist System/West, 345 Or. 237, 244 n. 7, 193 P.3d 1 (2008), the Supreme Court noted that, in *Brown*, it had "joined 11 additional considerations" to the seven listed factors.

[6] As noted, Rea did not testify at the OEC 104 hearing. Portions of Rea's deposition testimony, his curriculum vitae, and a number of other documents were submitted by the parties for the court to consider in connection with defendants' motion to exclude Rea's testimony.

[7] "SPECT" stands for "Single Photon Emission Computed Tomography." It is a type of brain scan that is used primarily to view how blood flows through arteries and veins in the brain.

[8] Differential diagnosis is "the determination of which of two or more diseases with similar symptoms is the one from which the patient is suffering, by a systematic comparison and contrasting of clinical findings." *Stedman's Medical Dictionary* 492 (27th ed. 2000). For a discussion of the use of differential diagnoses generally, see Marcum, 345 Or. at 246-50, 193 P.3d 1.

[9] Dr. Green, a medical doctor, also diagnosed plaintiff with chemical sensitivity.

[10] See generally Bernard D. Goldstein and Mary Sue Henifin, *Reference Guide on Toxicology*, in *Reference Manual on Scientific Evidence* 416 n. 43 (Federal Judicial Center, 2d ed. 2000) (explaining lack of acceptance of MCS and clinical ecology).

[11] Indeed, the trial court appeared to recognize that "there's some evidence to suggest that [MCS] is a legitimate diagnosis[.]"

[12] "The patient history is one of the primary and most useful tools in the practice of clinical medicine. * * * Even in this era of sophisticated medical testing protocols, it is estimated that 70% of significant patient problems can be identified, although not necessarily confirmed, by a thorough patient history." Mary Sue Henifin et al., *Reference Guide on Medical Testimony*, in *Reference Manual on Scientific Evidence* 452-53 (Federal Judicial Center, 2d ed. 2000).

[13] This court made the same point in its opinion in *Jennings*:

"[P]laintiff does not have to meet every *Brown* factor, nor does [the expert] have to understand the mechanism of how the silicone causes the conditions or symptoms as predicate to the admissibility of his conclusion. There are many generally accepted hypotheses in science where the mechanism of cause and effect is not understood."

Jennings v. Baxter Healthcare Corp., 152 Or.App. 421, 430, 954 P.2d 829 (1998).

[14] In the omitted footnotes, the *McNeel* court cited the following cases: *Summers v. Missouri Pacific R.R. System*, 132 F.3d 599 (10th Cir. 1997); *Bradley v. Brown*, 42 F.3d 434 (7th Cir. 1994); *Brown v. Shalala*, 15 F.3d 97 (8th Cir. 1994); *Coffey v. County of Hennepin*, 23 F Supp 2d 1081 (D.Minn.1998); *Frank v. State of New York*, 972 F.Supp. 130 (N.D.N.Y.1997); *Sanderson v. IFF*, 950 F.Supp. 981 (C.D.Cal.1996); *Myhre v. Workers Compensation Bureau*, 653 N.W.2d 705 (N.D.2002); *Jones v. Ruskin Mfg.*, 834 So.2d 1126 (La.App.2002).

[15] On appeal, plaintiff argues that the trial court improperly ruled on Rea's ultimate opinion, rather than on his methodology. Although the trial court's ruling is unclear in that respect, we agree that, to the extent that the trial court focused on the "legitimacy" of Rea's diagnosis and not on his methodology, that focus was incorrect.

[16] In *Jennings*, the Supreme Court explained that, "[i]n the past, this court has stated that a published decision affirming the admissibility of certain forms of scientific evidence will mean that the proponent of the evidence need not lay a scientific foundation for it again." 331 Or. at 310, 14 P.3d 596. The court nonetheless chose not to apply that general rule in *Jennings*. In this case, although we conclude that, on this record, the trial court erred in excluding Rea's testimony, we do not hold that testimony about chemical sensitivity will, as a matter of law, always be admissible.

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171 S.W.3d 45 (2005)

Brian LANTER, Appellant,

v.

KENTUCKY STATE POLICE; Hon. J. Kevin King, Administrative Law Judge; and Workers' Compensation Board, Appellees.

No. 2004-SC-0872-WC.

Supreme Court of Kentucky.

August 25, 2005.

As Corrected August 29, 2005.

46 *46 Gregory N. Schabell, Busald, Funk & Zevely, PSC, Florence, KY, Counsel for Appellant.

Kenneth Lance Lucas, Edgewood, KY, Counsel for Appellee.

Chapter 13 of the *AMA Guides to the Evaluation of Permanent Impairment (Guides)* addresses disorders of the central and peripheral nervous system; Chapter 14 addresses mental and behavioral disorders. The claimant alleged that work-related head trauma caused impairments under both chapters that, together, rendered him totally disabled. Nonetheless, an Administrative Law Judge (ALJ) awarded income benefits for only partial disability and determined that
47 an impairment that was assigned under Chapter 13 most nearly measured the claimant's ability *47 to perform activities of daily living with the need for some direction. Rejecting the claimant's assertion that uncontroverted evidence of a psychiatric impairment compelled a Chapter 14 impairment to be included in his disability rating, the Workers' Compensation Board (Board) and the Court of Appeals affirmed. We affirm.

On April 5, 2002, the claimant was struck in the head while participating in a training class in defensive tactics at the Kentucky State Police Academy. He later testified that he had six years of martial arts training that involved physical contact and that he had used that training previously to defend himself from an assault. He stated that he had been mentally prepared for the training exercise and had not been afraid. As he recalled the incident, he was struck in the head and became dazed. He was then hit several more times and became unconscious. Upon regaining consciousness, he was kicked while struggling to his feet. When he attempted to leave the room, he had his head slammed into the wall. He was told to return to class after the incident but refused, became dizzy, and fell down again. He was then interviewed in the captain's office, resigned from the academy, and drove home, almost wrecking several times.

Ten days later, after experiencing neck pain, memory loss, and clumsiness, as well as difficulty walking, speaking and driving, the claimant first sought treatment from his family physician, Dr. Shearer. In addition to a neck injury that is no longer at issue, his application for workers' compensation benefits alleged a severe brain contusion and concussion as well as post-traumatic stress disorder, severe generalized anxiety disorder, and psychosis due to the head injury. At issue presently is whether the medical evidence compelled a finding that harmful changes resulting from the head trauma warranted a disability rating based upon impairments under both Chapter 13 and 14 of the *Guides*.

A December, 2002, report from Dr. Shearer stated that he began treating the claimant on April 15, 2002, for neck pain and for memory loss and other cognitive complaints after he was struck in the head several times by an instructor. Dr. Shearer diagnosed cognitive brain dysfunction and cervical stenosis. Using the Fifth Edition of the *Guides*, he assigned a 30% impairment based on Chapter 13, Table 13-3 (Impairment Due to Episodic Loss of Consciousness or Awareness).

A November, 2002, report from Dr. D'Souza, the claimant's treating psychiatrist, noted that the claimant was frightened, confused, and experienced severe headaches after the head trauma and period of unconsciousness. Since then, he

had also been experiencing nightmares, difficulty sleeping, and severe depressive symptoms as well as anxiety, panic attacks, paranoid thoughts, and active flashbacks. He was currently engaged in extensive psychotherapy and receiving pharmacotherapy. Dr. D'Souza diagnosed post-traumatic stress disorder, major depressive episodes with psychotic features, post-concussion syndrome, and psychosis due to head trauma. He attributed the conditions to a focal brain lesion that was caused by the head injury. In his opinion, the claimant did not retain the physical capacity to return to the type of work performed at the time of the injury. Such work would exacerbate his symptoms and make him more disabled. He should avoid stressful situations in any kind of work.

48 Dr. Pagani, who is board-certified in neurology and emergency medicine, treated the claimant several times between April 18 and October 17, 2002. His December, 2002, report noted the history of *48 injury followed by symptoms that included headache, confusion, disorientation, loss of memory, hypersomnia, and psychomotor retardation. He noted that the medications Dr. D'Souza prescribed had helped. After performing various diagnostic tests, including a brain MRI, EEG, and brain SPECT, Dr. Pagani diagnosed a cerebral contusion with post-concussive syndrome. He attributed the claimant's present condition to the head trauma and assigned a 14% impairment to the central nervous system, using Table 13-6 (Impairment Related to Mental Status) from Chapter 13 of the *Guides*. He stated that the claimant did not have an active impairment before the injury or a pre-existing dormant condition that was aroused by the injury. In his opinion, the claimant lacked the physical capacity to return to the type of work he performed at the time of the injury. Furthermore, he should avoid stressful situations and independent or unsupervised work.

The employer submitted a report based on a June 11-12, 2003, neuropsychiatric evaluation by Dr. Granacher, who is board-certified in both neurology and psychiatry. Dr. Granacher obtained a detailed history and performed both physical and mental status examinations. He ordered extensive neuropsychological, intellectual, achievement, and personality testing. He also ordered a SPECT scan, which revealed functional defects in the right parietal and left occipital lobes of the claimant's brain.

Noting that Dr. D'Souza thought the claimant was psychotic but that the claimant denied ever hearing voices, seeing things, or being delusional, Dr. Granacher stated that he could not determine the basis for the diagnosis. He noted that Dr. D'Souza had prescribed Seroquel and Trileptal for a while but that the claimant had not been on them for some time and was taking no "psychiatric or brain medications" presently. Summarizing the mental status examination, he noted that the claimant was pleasant and cooperative; that he independently completed a complex 23-page medical questionnaire; that he was oriented to person, place, and time; and that he was a capable historian. His affective range was moderately constricted, but he made good eye contact, had no delusions or hallucinations, and had no loose associations or circumstantial thinking. He denied suicidal ideas or plans and never appeared tearful or anxious.

Dr. Granacher noted that there was no sign of "faking bad" on the cognitive portions of the testing and concluded that it was valid. He stated, however, that when taking the MMPI-2, which measures psychological adjustment, the claimant may have attempted "to create a highly virtuous self-portrait, in conjunction with elevated clinical scales that indicate a claim of serious physical and emotional disability." Therefore, Dr. Granacher thought that the claimant's MMPI-2 profile "may not accurately represent existing psychopathology." Later in the report, he explained that the test was administered "to provide hypotheses" regarding the claimant's psychological functioning but that its validity in individuals with traumatic brain injury had not been verified. Therefore, the standard interpretations may not apply to such individuals, and "[t]he interpretations presented in this report need to be verified by other sources of clinical information."

49 Dr. Granacher determined that the claimant's cognitive functioning was average before the injury but that it had declined in several areas due to the head trauma and that the brain lesions that were noted on the SPECT scan appeared to be permanent. Using the DSM-IV-TR classification system for mental disorders, he diagnosed a cognitive disorder due to *49 head trauma (Axis I), no personality or developmental disorder (Axis II), a cognitive disorder (Axis III), no psychosocial stressors (Axis IV), and a current GAF of 65 (Axis V). He concluded that the claimant had a 14% neuropsychiatric impairment due to head trauma, relying on Tables 13-5 (Clinical Dementia Rating) and 13-6 (Impairment Related to Mental Status) from page 320 of the Fifth Edition of the *Guides*.

Michael Borack, a Doctor of Psychology and practicing clinical psychologist, evaluated the claimant on May 6, 2003. His

July 3, 2003, report indicated that he reviewed the other medical reports and diagnostic test results, including the neuropsychological, academic/achievement, intellectual capacity, personality, and brain imaging tests. He disagreed with Dr. Granacher's conclusion regarding the validity of the MMPI-2 personality assessment. Dr. Borack acknowledged that there were no norms specific to individuals who have sustained a head injury. Nonetheless, he thought that the claimant's effort to "fake good" and, thereby, to minimize any psychological disturbances suggested that the clinical scale findings were highly meaningful. They revealed "significant sadness and depressed mood, suspiciousness and hostile sensitivity, anxiety and agitation, interpersonal alienation, and difficulties in logic and concentration." Dr. Borack diagnosed posttraumatic stress disorder and dementia due to head trauma with a clinically significant behavioral disturbance. Taking into account the degree of impairment in the claimant's ability to perform activities of daily living and in his social functioning, concentration, and adaptation, Dr. Borack concluded that he came within the criteria for a Class 3 (moderate) impairment of 47.5%.

When deposed in May, 2003, the claimant stated that he was living with his parents and attending college. He explained that he decided to become a fitness trainer after his injury and began taking three classes but later dropped two of them due to post-traumatic stress, panic attacks, and seizures. He stated that he had not attempted to find work and had not been released to do so by his doctor. He stated that he continued to experience memory loss, clumsiness, difficulty walking, difficulty speaking, and forgetfulness. In July, 2003, at the hearing, he testified that he was on summer break but was scheduled to return to school in the fall. He stated that he had experienced difficulty with the physical activities in his previous classes and sometimes passed out. He had problems with long term and short term memory, became physically and mentally exhausted, and had difficulty understanding the material. He testified that he no longer took medication for the effects of his injury and noticed no change in his condition. He had not seen Drs. Pagani or D'Souza for a few months and had no scheduled medical appointments. On a typical day, he did physical therapy and researched his brain injury on the internet.

After summarizing the lay and medical evidence, the ALJ stated as follows:

From a psychological perspective, four physicians have rendered opinions regarding Lanter's impairment. Dr. Shearer assigned Lanter a 30% impairment, Dr. Granacher and Dr. Pagani assigned Lanter a 14% impairment, and Dr. Borack assigned Lanter a 47.5% impairment.

50 Having reviewed the evidence and the appropriate portions of the *AMA Guides*, the [ALJ] notes that Dr. Shearer's impairment would require Lanter to suffer from severe episodic loss of consciousness *50 or awareness to the point that Lanter's activities would need to be supervised, protected, or restricted. While it is clear that Lanter does have some occasional loss of awareness, it is not to the extent necessary to support Dr. Shearer's impairment rating. Dr. Borack's impairment is based on mental and behavioral disorders. To qualify for the high-end of a Class 3 impairment, Lanter must have impairment levels compatible with some but not all useful functioning rising nearly to the level of significant difficulties with useful functioning. Furthermore, the *Guides* state on page 364 that, "a moderate impairment does not imply a 50% limitation in useful functioning, and an estimate of moderate impairment in all four categories does not imply a 50% impairment of the whole person." On the other hand, the impairment ratings of Dr. Pagani and Dr. Granacher more nearly indicate Lanter's ability to perform activities of daily living and the need for some direction. Therefore, the [ALJ] finds that Lanter has a 14% impairment from a psychological standpoint.

Taking into account the claimant's difficulty performing classwork due to his mental and physical restrictions but also his age (25), education (two years of college), history of sedentary to medium work, and his ability to drive, to research his condition on the internet, and to perform the majority of his activities of daily living, the ALJ determined that he was capable of some type of work.

The claimant maintains that his head injury caused both brain damage and a psychological condition. Pointing to the ALJ's references to a psychological injury while relying on a neurological impairment, he maintains that the ALJ "overlapped and misinterpreted" Chapters 13 and 14 of the *Guides*, considered only the first condition, and disregarded

the second. He asserts that only Drs. Borack and D'Souza testified regarding a psychological condition and that only Dr. Borack analyzed the impairment the condition caused. Therefore, the ALJ was required to accept Dr. Borack's uncontradicted testimony that the condition caused a 47.5% impairment. We disagree.

Chapter 13 of the *Guides* provides criteria for evaluating brain dysfunction, emphasizing the deficits or impairments that may be identified during a neurologic evaluation. *Id.* at 305. It acknowledges, however, that "[b]ecause neurologic impairments are intimately related to mental and emotional processes and their functioning, the examiner should also understand Chapters 14, Mental and Behavioral Disorders, and 18, Pain" and that "[a]dditional impairments based on those chapters *may* need to be considered." (emphasis added). *Id.* at 306; *see also Id.* at 321-22. Section 13.3f (Emotional and Behavioral Impairments) of Chapter 13 contains Table 13-8, which sets forth the criteria for rating such impairment.^[1] Furthermore, Section 13.3f states that "[e]motional, mood, and behavioral disturbances illustrate the relationship between neurology and psychiatry. *Emotional disturbances originating in verifiable neurologic impairments (e.g., stroke, head injury) are assessed using the criteria in this chapter.*" (emphasis added). *Id.* at 325. Some of the psychiatric features *51 listed as examples include irritability, outbursts of rage or panic, aggression, withdrawal, depression, mania, and emotional fluctuations. Section 13.3f also states that "[n]eurologic impairments producing psychiatric conditions are assessed using the neurologic examination, with an expanded neuropsychiatric history and the necessary ancillary tests." *Id.*

The introduction to Chapter 14 of the *Guides*, states, in part, as follows:

This chapter discusses impairments due to mental disorders and considers behavioral impairment of function that may complicate any condition. As did Chapter 13 (The Central and Peripheral Nervous System), this chapter assesses the brain; however, here the emphasis is on evaluating brain function and its effect on behavior for mental disorders. Unlike the other chapters in the *Guides*, this chapter focuses more on the *process* of performing mental and behavioral impairment assessment. Numerical impairment ratings are not included; however, instructions are given for how to assess an individual's abilities to perform activities of daily living. (emphasis original).

Id. at 357-58. The introduction also notes that the Fifth Edition stresses the importance of the DSM-IV criteria for determining a mental impairment and includes more case examples to exemplify the relationship between diagnosis, symptoms, and impact on the ability to perform activities of daily living. Current research finds little relationship between psychiatric signs and symptoms and the ability to perform competitive work. *Id.* at 361-62. Evaluating impairment is based on the extent of function in four main categories: 1.) ability to perform activities of daily living; 2.) social functioning; 3.) concentration, persistence, and pace, which relate to the ability to sustain focused attention long enough to permit the timely completion of necessary tasks; and 4.) ability to adapt to stressful circumstances without deterioration or decompensation. Chapter 14 describes a Class 2 impairment as being mild, which "implies that any discerned impairment is compatible with most useful social functioning." *Id.* at 363. It describes a Class 3 impairment as being moderate, which "means that the identified impairments are compatible with some, but not all useful functioning." *Id.* Chapter 14 does not assign percentages to impairments, but as the ALJ noted when analyzing the evidence, it does state that "a moderate impairment does not imply a 50% limitation in useful functioning, and an estimate of moderate impairment in all four categories does not imply a 50% impairment of the whole person." *Id.* at 364.

Workers' compensation law is fundamentally for the benefit of the injured worker. *See Messer v. Drees*, 382 S.W.2d 209 (Ky.1964). Nonetheless, an injured worker has the burden to prove every element of a claim for benefits, one of which is the amount of AMA impairment that it caused. *See* KRS 342.0011(11); KRS 342.730(1)(b); *Roark v. Alva Coal Corporation*, 371 S.W.2d 856 (Ky.1963); *Wolf Creek Collieries v. Crum*, 673 S.W.2d 735 (Ky.App.1984); *Snawder v. Stice*, 576 S.W.2d 276 (Ky.App.1979). KRS 342.285 designates the ALJ as the finder of fact; therefore, the courts have determined that the ALJ, rather than the Board or a reviewing court, has the sole discretion to determine the quality, character, and substance of evidence. *See Paramount Foods, Inc. v. Burkhardt*, 695 S.W.2d 418 (Ky.1985). When the party with the burden of proof does not succeed before the ALJ, that party's burden on appeal is to show that the favorable evidence was so compelling that the decision to the contrary was unreasonable. *Special Fund v. Francis*, 708

S.W.2d 641, 643 (Ky.1986).

- 52 *52 Depending on the evidence, a claim of psychological harm from a traumatic brain injury could be raised under either of two theories: 1.) that the emotional effects of having sustained such an injury resulted in behavioral symptoms; or 2.) that the brain damage caused by the injury resulted in both neurological and behavioral symptoms. No medical expert attributed the claimant's behavioral symptoms to the emotional effects of the training incident or of living with the harm that it caused. At issue, therefore, is whether the evidence compelled the ALJ to award benefits for the effects of the claimant's brain damage based not only on his impairment under Chapter 13 but also on an impairment under Chapter 14.

The proper interpretation of the *Guides* and the proper assessment of impairment are medical questions. See Kentucky River Enterprises, Inc. v. Elkins, Ky., 107 S.W.3d 206, 210 (Ky.2003). In the present case, no physician testified regarding the proper application of the *Guides* when evaluating impairment from a traumatic brain injury that causes both neurological and behavioral symptoms. Faced with impairment ratings that were assigned under Chapters 13 and 14 and the task of selecting an impairment rating that was a reasonable estimation of the claimant's condition, the ALJ appropriately consulted the *Guides* when considering the medical evidence and deciding upon which experts to rely. Chapter 13 clearly indicates that an additional impairment may be warranted in certain instances based on behavioral factors that originate in the brain due to organic damage from a head injury, but it does not indicate that behavioral symptoms always warrant an additional impairment. Furthermore, it appears to indicate that any additional impairment for emotional or behavioral disorders is to be determined under the criteria found in Section 13.3f of Chapter 13 rather than under Chapter 14. *Id.* at 325.

We find nothing in the ALJ's reference to the impairment "from a psychological standpoint" or "psychological perspective" together with a discussion of impairments that were assigned under Chapters 13 and 14 of the *Guides* that evinces a misunderstanding of the medical evidence or a confusion regarding Chapters 13 and 14. In summarizing the evidence, the ALJ specifically noted that the claimant was no longer taking any medication for the neurological or behavioral effects of his injury and had no scheduled medical appointments. It is apparent from the analysis that followed that the ALJ found the impairments assigned by Drs. Shearer and Borack to be excessive in light of the claimant's restrictions and found the impairments assigned by Drs. Pagani and Granacher to "more nearly indicate [the claimant's] ability to perform activities of daily living and the need for some direction." The decision was reasonable under the evidence that was available and was properly affirmed on appeal. Special Fund v. Francis, supra.

LAMBERT, C.J., and COOPER, JOHNSTONE, ROACH, SCOTT, and WINTERSHEIMER, JJ., concur.

GRAVES, J., dissents and states that when the ALJ "noted in particular Lanter's young age", he gave undue weight to youth and erroneously assumed Lanter would outgrow his disability.

[1] The criteria are as follows: Class 1 (0-14%), Mild limitation of activities of daily living and daily social and interpersonal functioning; Class 2 (15-29%), Moderate limitation of some activities of daily living and some daily social and interpersonal functioning; Class 3 (30-69%), Severe limitation in performing most activities of daily living, impeding useful action in most daily social and interpersonal functioning; and Class 4 (70-90%), Severe limitation of all daily activities, requiring total dependence on another person.

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UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF INDIANA
SOUTH BEND DIVISION

DALE RUPPEL,)	
SHELLEY RUPPEL,)	
Plaintiffs,)	
v.)	No: 3:08 CV 591
DRAGAN KUCANIN,)	
FEDEX GROUND PACKAGE SYSTEM, INC.,)	
Defendants.)	

OPINION AND ORDER

Defendant Dragan Kucanin ("Kucanin") a driver for defendant FedEx Ground Package System, Inc. ("FedEx") drove his semi-tractor trailer rig into a semi-tractor trailer rig driven by plaintiff Dale Ruppel ("Ruppel") when Ruppel was stopped in a construction zone. The accident between Ruppel and Kucanin occurred on Interstate 80/94 East in Calumet Township, Lake County, Indiana, on January 8, 2008. Both vehicles were damaged in the collision. (Pls.' Exh. 2, DE # 57-2.) Ruppel and his wife Shelley Ruppel (collectively "the Ruppels") sued FedEx and Kucanin for damages that he allegedly sustained as a result of the accident. (DE # 1.) Defendants have admitted that Kucanin was negligent in operating his semi-tractor trailer rig causing the crash with Ruppel's semi-tractor trailer rig. (Responses to Plaintiffs' Requests to Admit to Dragan Kucanin and FedEx Ground Package system, Inc., Pls.' Exh. 1, DE # 57-1 at 1.) They also admit that Ruppel has no comparative negligence. (*Id.*) Defendants have moved to exclude Ruppel's evidence related to an alleged diffuse axonal brain injury under FEDERAL RULE OF EVIDENCE 702 and for summary judgment on Ruppel's claim for a diffuse axonal injury. (DE ## 54-56.) As explained below, both motions will be denied.

Defendants argue that two pieces of Ruppel's proposed evidence should be excluded under FEDERAL RULE OF EVIDENCE 702. First, they argue that Dr. Christine Pareigis ("Dr. Pareigis") is unqualified to diagnose a diffuse axonal injury because she is not qualified to diagnose an injury. (DE # 56 at 13.) Second, they argue that Dr. Randall Benson's ("Dr. Benson") opinion as to Ruppel's condition of a diffuse axonal injury and its causation is unreliable under RULE 702 because it is based on two controversial methods: diffusion tensor imaging ("DTI") and fractional anisotropy ("FA") quantification from that imaging and because the wording of his opinion is not sufficiently certain. (*Id.* at 15.) Defendants argue that once this evidence is excluded, Ruppel will have no evidence as to his diagnosis of diffuse axonal injury or to its causation, and therefore, summary judgment should be granted against Ruppel on his claim related to diffuse axonal injury. The court will begin with an analysis of whether the contested evidence should be excluded under *Daubert*.

I. MOTION TO EXCLUDE EVIDENCE

To be admissible, expert testimony must satisfy the conditions of FEDERAL RULE OF EVIDENCE 702 and *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993). *United States v. Parra*, 402 F.3d 752, 758 (2005). RULE 702 provides:

If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise, if (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods, and (3) the witness has applied the principles and methods reliably to the facts of the case.

Under *Daubert*, the court must be satisfied, first, that the expert can testify based on *valid* scientific, technical or specialized knowledge, *i.e.*, whether the expert's testimony is reliable, and second, whether that testimony will be of assistance to the trier of fact. 509 U.S. at 592; *United States v. Welch*, 368 F.3d 970, 973 (7th Cir. 2004); *Ammons v. Aramark Uniform Services, Inc.*, 368 F.3d 809, 816 (7th Cir. 2004). The reliability issue requires the court to determine whether the expert is qualified in the relevant field and used a reliable methodology to arrive at his or her conclusions. *Zelinski v. Columbia 300, Inc.*, 335 F.3d 633, 640 (7th Cir. 2003); *Smith v. Ford Motor Co.*, 215 F.3d 713, 718 (7th Cir. 2000).

A. Dr. Pareigis's qualifications

FEDERAL RULE OF EVIDENCE 702 provides that a witness qualified as an expert "by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise." Defendants are correct that under RULE 702, a witness may only offer an expert opinion on an area within his or her field of specialized knowledge. (DE # 56 at 15 (citing *Jones v. Elec. Co.*, 188 F.3d 709, 723 (7th Cir. 1999)).) To determine if a witness is an expert, the court must compare the area in which the witness has superior skill, knowledge, education, or expertise to the area of her proposed testimony. *Jones*, 188 F.3d at 723.

The parties contest whether Dr. Pareigis can testify as to Ruppel's diagnosis of diffuse axonal injury. Defendants argue that Dr. Pareigis cannot testify as to Ruppel's diagnosis because she is an expert in rehabilitation, not diagnosis. (DE # 56 at 16.)

Defendants also submit proposed testimony from their witness, neurologist Dr. John Talbott, that physiatrists normally do not make a diagnosis of diffuse axonal injury in a "neurology field." (John Talbott Dep. 37, Defs.' Exh. R, DE # 56-18.) In response, the Ruppels assert that Dr. Pareigis is "board certified in physical medicine and rehabilitation and is qualified by knowledge, skill, experience, training and education to testify in the form of opinion as to a diagnosis of closed head injury with diffuse axonal damage and the probable cause thereof." (DE # 57 at 4.)

Dr. Pareigis is board certified in physical medicine and rehabilitation, a practice speciality which she stated "includes the evaluation, diagnosis, and treatment of brain injury." (Dr. Christine Pareigis Aff., Pls.' Exh. 4, DE # 57-4 ¶ 5.) She is now the Medical Director of Rehabilitation at the Lakefront Medical Center in St. Joseph, Michigan. (*Id.* ¶ 2.) In that position, which she has held for 21 years, she regularly diagnoses, evaluates, and treats brain injury. (*Id.*) She also maintains a private practice in St. Joseph, Michigan where she regularly evaluates, diagnoses, and treats brain injury. (*Id.* ¶ 4.) Dr. Pareigis stated that she sees an average of ten new cases a year involving injuries like Ruppel's for a total of about two hundred cases over the course of her career. (Dr. Christine Pareigis Dep. 48, Defs.' Exh. D., DE # 56-4.)

She previously served as the Medical Director of Rehabilitation at New Medico / Visitors Hospital in Buchanan, Michigan. (Pareigis Aff. ¶ 3.) This institution is a head injury clinic, affiliated with a national program, that evaluates, diagnoses, and treats head injury patients. (*Id.*) As the Medical Director, 90% to 100% of Dr. Pareigis's practice

involved the evaluation, diagnosis, and treatment of closed head injury. (*Id.*)

First, defendants appear to argue that Dr. Pareigis cannot testify as to Ruppel's diagnosis of diffuse axonal injury because her diagnosis was based in part on the results of DTI and she received help from a radiologist in deciding to run that scan. (Christine Pareigis Dep. 23.) They also take issue with that fact that she used the abbreviations SWY/DTI explaining that she needed to do so because they were radiology terms. (*Id.*) Dr. Pareigis testified that she ordered the magnetic resonance imaging ("MRI") with SWY/DTI because she felt that it would give her "more evidence regarding axonal diffuse injuries." (Pareigis Dep. 23.) At the time of the deposition, she had not received the results of the DTI scan and she did not expect it to change the course of treatment, but she thought it might help her to understand Ruppel's injury a little better. (*Id.*)

Dr. Pareigis's testimony that she consulted with a radiologist in deciding to order the MRI does not disqualify her as an expert because she can base her conclusion on the opinions of others as long as they are the type of materials reasonably relied upon by experts in her field. *United States v. Gardner*, 211 F.3d 1049, 1054 (7th Cir. 2000). RULE 703, the corollary to RULE 702, is instructive on this matter. RULE 703 states that an expert can rely on facts and data not admissible into evidence as long as the facts and data are "of a type reasonably relied upon by experts in the particular field in forming opinions or inferences upon the subject." The Advisory Committee notes to the 1972 amendments to RULE 703 state that "a physician in his own practice bases his diagnosis on information from numerous sources and of considerable variety including

statements by patients and relatives, reports and opinions from nurses, technicians and other doctors, hospital records and X-rays." Accordingly, the FEDERAL RULES OF EVIDENCE account for the reality that doctors, like Dr. Pareigis, rely on the opinions of other doctors in reaching their diagnoses.

Further, Dr. Pareigis did not rely on the DTI scan alone in making her diagnosis. In fact, she stated that she thought the DTI scan would help her learn more about the injury but that it probably would not change her course of treatment. So her testimony is not unreliable because she consulted with another doctor in deciding the course of treatment for her patient. Instead, evidence that Dr. Pareigis consulted a radiologist to order the MRI would go to the weight that the jury may give her testimony.

Apart from her reliance on the DTI scan, defendants argue that Dr. Pareigis is not qualified to testify at all as to Ruppel's diffuse of axonal brain injury diagnosis because making a diagnosis is outside of her expertise. In making this argument defendants cite to two cases, *Jones* and *Cunningham v. Masterwear, Inc.* In both, the court determined that qualified experts cannot testify on subjects that are outside of their field of expertise. In *Jones*, the United States Court of Appeals for the Seventh Circuit found that the witness, a doctor in metallurgy, the study of metals, was not qualified to testify as to how manganese affects the human body and is processed by the lungs. 188 F.3d at 723. In his testimony, the witness admitted that toxicology and how the body absorbs certain substances was outside of his expertise. *Id.* Similarly in *Cunningham*, the court held that witness medical doctors could not testify as to whether a hazardous chemical caused

the plaintiffs' illnesses because the witnesses did not have any training in epidemiology or toxicology. No. 1:04-cv-1616, 2007 WL 1164832, at *10 (S.D. Ind. Apr. 15, 2007).

In this case, Dr. Pareigis stated that the diagnosis of brain injuries is firmly within her area of expertise. The Seventh Circuit has noted that while "extensive academic and practical expertise" may be sufficient to qualify a witness as an expert, RULE 702 "specifically contemplates the admission of testimony by experts whose knowledge is based on experience." *Smith*, 215 F.3d at 718 (internal quotations and citations omitted). As described above, in her affidavit¹ Dr. Pareigis stated that she has over thirty years of experience in diagnosing brain injuries. This is the type of "extensive hands-on experience over a meaningful period of time" that qualifies someone as an expert under RULE 702. *Jones*, 188 F.3d at 724. Thus the evidence before the court shows that Dr. Pareigis is qualified to testify as to Ruppel's diagnosis of a diffuse axonal brain injury.²

¹ Defendants argue that Dr. Pareigis's affidavit cannot be used to show her qualifications when her qualifications were not established through her deposition. It is true that an "affidavit cannot be used to create a genuine issue of material fact where the affidavit differs from the prior deposition testimony to the point that it is unreliable." *Patterson v. Chicago Ass'n for Retarded Citizens*, 150 F.3d 719, 720 (7th Cir. 1998). However, when "deposition testimony is ambiguous or incomplete . . . the witness may legitimately clarify or expand upon that testimony by way of an affidavit." *Shepherd v. Slater Steels Corp.*, 168 F.3d 998, 1007 (7th Cir. 1999). Dr. Pareigis's affidavit does not contradict her deposition testimony. Rather, the deposition testimony did not cover her qualifications and experience related to brain injury diagnosis.

² Defendants do not argue that Dr. Pareigis was not qualified to testify as to causation. Accordingly, plaintiffs have not produced much evidence that she is qualified to testify as to causation. However, medical doctors do testify as to the issue of specific causation. See e.g., *Cunningham*, 2007 WL 1164832, at *10-11 (citing Mary Sue Henifin, Howard M. Kipen & Susan R. Poulter, *Reference Guide on Medical Testimony* 444-45, in *REFERENCE MANUAL ON SCIENTIFIC EVIDENCE* (2nd ed. 2000)). Further, in her deposition, Dr.

B. Dr. Benson's testimony

1. Dr. Benson's reliance on DTI

Defendants assert that Dr. Benson's expert testimony on diffuse axonal injury is unreliable under *Daubert* and RULE 702 because he relies on DTI which defendants argue is an unreliable technology that has not gained acceptance and because his reliance on FA quantification based on DTI comparisons is not the most accurate way to diagnose diffuse axonal brain injuries.

To begin, the court will give a brief overview of diffuse axonal brain injury, closed head injury, DTI, and how Dr. Benson used DTI to diagnose diffuse axonal injury in Ruppel. According to Dr. Benson, brain injury is classified as either focal or diffuse. (Dr. Randall Benson Aff., Pls.' Exh. 7, DE # 58-1 at ¶ 5.) A focal injury is a localized injury, such as that caused by a stroke, a direct blow to the head, or a aneurysm, and is typically a contusion on the surface of the brain, visible by conventional scanning. (*Id.*) On the other hand, a diffuse axonal injury involves scattered damage to the brain substance, particularly the white matter that is comprised of axon fibers. (*Id.*) A closed head (non-penetrating) brain injury, the most common type of traumatic brain injury, can include focal injury, diffuse injury, or both. (*Id.*) A brain

Pareigis testified that she had seen "a great number of people" who suffered brain injury after motor vehicle accidents. (Christine Pareigis Dep. 47.) Thus her deposition testimony indicated that she does have experience in determining the specific causes of brain injury for her patients. Accordingly, at this time, the court will not exclude Dr. Pareigis's testimony as to the cause of diffuse axonal injury.

injury can include only evidence of diffuse axonal injury when it is a result of "relatively little direct impact to the skull such as during a motor vehicular collision with a restrained passenger and little or no impact to the head." (*Id.*)

According to Dr. Benson:

Diffuse axonal injury is the hallmark pathology in closed head injury and is not visible on conventional MRI imaging in milder cases. Diffuse axonal injury results from acceleration or deceleration of the head (skull) which causes deformations (stretch and strain) of the brain substance leading to shear injury of white matter fibers.

(*Id.*) A traditional MRI shows the structure of the brain and the majority of people with mild brain injury will have a normal MRI even if they have significant impairment.

(*Id.* ¶ 6.) DTI is a more sensitive, three-dimensional type of MRI that examines the microstructure of the white matter in the brain. (*Id.* ¶¶ 7-8.) DTI can show reduction in fractional anisotropy ("FA") meaning that the white matter in the brain has been damaged. (*Id.* ¶ 12.) Because the reduction in FA caused by a milder traumatic brain injury ("TBI") cannot be seen by looking at a single scan standing alone, a TBI patient's imaging is evaluated for damage by comparing it to images of non-TBI control group's brains. (*Id.* ¶ 13.)

First, defendants cannot exclude Dr. Benson's opinion simply because DTI is not the most reliable way to diagnose a brain injury. They argue, and Dr. Benson testified, that the only definite way to identify a diffuse axonal brain injury is by autopsy. Barring that, they argue, as their expert Dr. Valerie Drnovsek ("Dr. Drnovsek") explains, that

reduced FA may be detected through analysis with fiber-tracking algorithms.

(DE # 56 at 10.) As defendants acknowledge, it is not reasonable to expect that Ruppel would have to submit to an autopsy in order to provide proof of his injuries. Contrary to defendants' contentions, expert opinions may be admitted even if they are not stated with absolute certainty. Indeed, in *Daubert* the Court stated, "[o]f course, it would be unreasonable to conclude that the subject of scientific testimony must be 'known' to a certainty; arguably, there are no certainties in science." *Daubert*, 509 U.S. at 590.

It is also unnecessary for Dr. Benson to have used fiber-tracking algorithms. The court's focus is on whether Dr. Benson's opinion is based on a reliable method, not on a method that defendants deem to be most reliable. See e.g., *Cunningham*, 2007 WL 1164832, at *3 (stating "as long as [plaintiffs' proposed witness] used a reliable method to come up with his conclusions, it is not a problem that he did not use the method that Defendants claim is 'useful'"); cf. *Cooper v. Carl A. Nelson & Co.*, 211 F.3d 1008, 1020 (7th Cir. 2000) (stating "[o]ur case law has recognized that experts in various fields may rely properly on a wide variety of sources and may employ a similarly wide choice of methodologies in developing an expert opinion.").

Further, Dr. Drnovsek identified fiber tracking algorithms analysis as a way to address certain deficiencies with FA quantitative analysis. (Dr. Drnovsek Report 4, Defs.' Exh. H, DE # 56-8.) In his affidavit, Dr. Benson stated that is not necessary. But Dr. Benson contends that this is not necessary because the problems addressed by this method are presented by scans that look at gray matter, not those that look only at

white matter such as the ones he employs. (Dr. Benson Aff. ¶ 34.) The difference in opinion between the two experts is something that can be addressed at trial and does not make Dr. Benson's method so unreliable that his opinion need be excluded.

As will be discussed, DTI and FA quantification based on comparative scans appear to be reliable methods for Dr. Benson to arrive at his expert opinion of both Ruppel's diagnosis of diffuse axonal injury and the cause of that injury. A district court has great latitude in determining not only how to measure the reliability of the proposed expert testimony but also whether the testimony is, in fact, reliable. *United States v. Pansier*, 576 F.3d 726, 737 (7th Cir. 2009). The Seventh Circuit has advised that "[t]o determine reliability, the court should consider the proposed expert's full range of experience and training, as well as the methodology used to arrive [at] a particular conclusion." *Id.* Defendants do not take issue with Dr. Benson's qualifications; they focus instead on the reliability of the methods he employed.

The Supreme Court, in *Daubert*, laid out four general criteria for determining the validity of an expert's methodology: (1) whether the theory has been or can be tested or falsified; (2) whether the theory or technique has been subject to peer review and publication; (3) whether there are known or potential rates of error with regard to specific techniques; and (4) whether the theory or approach has general acceptance. *Daubert*, 509 U.S. at 593-94. As "these factors do not establish a definitive checklist" for determining the reliability of expert testimony, the Seventh Circuit has described the *Daubert* test as a "non-exhaustive list of guideposts." *Trustees of Chi. Painters and*

Decorators Pension v. Royal Int'l Drywall & Decorating Inc., 493 F.3d 782, 787

(7th Cir. 2007); *Am. Honda Motor Co., Inc. v. Allen*, 600 F.3d 813, 817 (7th Cir. 2010).

Further, the Seventh Circuit has employed other benchmarks which appear in the 2000 Advisory Committee's Notes to RULE 702 to gauge expert reliability, including whether the testimony relates to "matters growing naturally and directly out of research they have conducted independent of the litigation, or whether they have developed their opinions expressly for purposes of testifying"; "[w]hether the expert has adequately accounted for obvious alternative explanations"; and "[w]hether the expert is being as careful as he would be in his regular professional work outside his paid litigation consulting." *Id.* (alterations in *Allen*).

In this case, defendants argue that the DTI and FA quantification used by Dr. Benson are unreliable because 1) DTI is not generally accepted; 2) DTI cannot be tested 3) Dr. Benson has not considered alternative explanations for the comparatively decreased FA quantification found in the images; 4) Dr. Benson did not use proper methods and controls in his use of this imaging, especially considering that FA decreases with age; 5) Dr. Benson did not use the same level of intellectual rigor that is used by a regular expert in his field. (DE # 56 at 14.)

In response, the Ruppels argue that DTI is generally accepted in the relevant scientific community; DTI has been subjected to peer review and publication; DTI and FA quantification have low error rates; DTI and FA quantification was not developed for litigation; and DTI has been admitted by other courts. (DE # 57 at 20-23.) They also

argue that defendants' experts lack the knowledge and qualifications to challenge the scientific reliability of DTI testing. (*Id.* at 25.) The court will now discuss the relevant factors in turn.

a. General acceptance of DTI

The evidence shows that while DTI is a relatively new technology it is gaining general acceptance as a method for detecting TBI. First, as explained in further detail below, there have been numerous validation studies, published in peer reviewed journals, on the use of DTI to detect diffuse axonal injuries. (Dr. Benson Aff. ¶ 14.) Second, DTI is regularly used as a diagnostic tool at the Detroit Medical Center and at other locations throughout the country. (*Id.* ¶ 15.) Third, Dr. Benson, Dr. Pareigis, and Dr. Bradley Sewick, a neuropsychologist, all determined that DTI would be helpful in diagnosing Ruppel. (Dr. Bradley Sewick Aff. ¶ 10.) Fourth, the United States Army Telemedicine and Advanced Technology Research Command ("TATRC") sponsored a "Diffusion MRI TBI Roadmap Development Workshop" at which it was acknowledged: "DTI has detected abnormalities associated with brain trauma at several single centers." (Benson Aff. ¶ 4.) It was also stated that "the workshop seeks to identify and remove barriers to rapid translation of advanced diffusion MRI technology for TBI . . . in order to expedite getting the benefits of diffusion MRI to reach those who need it most, especially injured soldiers and veterans." (*Id.*)

Fifth, in 2001, the Food and Drug Administration ("FDA") approved the product "Diffusion Tensor Imaging Option for MRI" for marketing as a Class II Special Control

device. (Pl.'s Exh. 8, DE # 57-8.) Ruppel, citing to 21 U.S.C. § 360c(a)(3)(A), states that the FDA tested the software for safety and effectiveness before granting marketing permission. (DE # 57 at 21.) The letter from the FDA does not say this specifically. However, 21 U.S.C. § 360c(a)(3)(A) provides that approved Special Control devices are determined to be effective:

on the basis of well-controlled investigations, including 1 or more clinical investigations where appropriate, by experts qualified by training and experience to evaluate the effectiveness of the device, from which investigations it can fairly and responsibly be concluded by qualified experts that the device will have the effect it purports or is represented to have under the conditions of use prescribed, recommended, or suggested in the labeling of the device.

So although the FDA letter itself does not address the effectiveness of DTI, but its approval for marketing by the FDA indicates that its effectiveness was determined pursuant to 21 U.S.C. § 360c(a)(3)(A). In fact, other courts that have found DTI to be a reliable method have noted that it is "FDA approved, peer reviewed and approved, and a commercially marketed modality which has been in clinical use for the evaluation of suspected head traumas including mild traumatic brain injury." *Hammar v. Sentinel Ins. Co., Ltd.*, No. 08-019984 at *2 (Fla. Cir. Ct. 2010).

Sixth, Ruppel has pointed to several decisions in which trial court judges admitted DTI into evidence. *See e.g., Hammar*, No. 08-019984 at *2 (allowing DTI evidence to be admitted under the *Frye* standard); *Whilden v. Cline*, No. 08-cv-4210 (Col. Ct. Dist. May 10, 2010) (allowing an expert witness to rely on DTI evidence when testifying as to the diagnosis of mild TBI and its possible causation from an automobile

accident as long as the expert's opinion was not based solely on DTI).

On the other side, defendants' argument that DTI is not generally accepted is based primarily upon testimony that Dr. Benson provided in his deposition.

(DE # 56 at 13 (citing Dr. Randall Benson Dep. 13, Defs.' Exh. F, DE # 56-6).) Defendants point to this portion of Dr. Benson's deposition:

Q: I think at the beginning of your question you said some insurance companies would cover [DTI] and some wouldn't. Take your average hundred mild TBI patients, all things being equal, approximately how many of them after one or two regular MRIs showing no abnormalities would be able to get this more advanced MRI?

A: I think very few, and the reason is that this technique that we're hoping will become a standard operating technique, it is clearly not something that is far enough along. I mean in terms of the commercialization of it, that insurance companies routinely will cover.

Now having said that, we add these sequences onto standard sequences, and insurance companies do pay for it. But if a patient has already had one or two negative MRIs, I think its going to be, it is going to be very very difficult, you know, to convince the insurance company, which is why we're doing this work obviously.

(Dr. Benson Dep. 13-14.) This testimony focuses mostly on insurance companies' acceptance of DTI. Surely insurance companies' willingness to pay for a test is not dispositive of its reliability. Further, Dr. Benson also testified that some insurance companies would pay for DTI after an MRI showing no abnormality and some would not because "that is just kind of a state of where we're at with insurance these days." (*Id.* at 12.) He did not say that insurance companies do not find DTI helpful, but only that they are reluctant to pay for it after a regular MRI shows no problems.

As shown above, DTI has been accepted within the medical community. It is

regularly used at some hospitals even though it is not the regular standard of care at the average hospital. (*Id.* at 24.) Importantly, as discussed below, there are many articles published in peer-reviewed publications that cover the effectiveness of DTI in detecting mild TBI. All of the factors shown above weigh towards a finding that while DTI is a relatively new and developing technology, it is well on its way to gaining general acceptance in the scientific community as a tool for identifying mild TBI. Thus, the evidence shows that DTI and analysis of white matter in DTI images are generally accepted methods for determining mild TBI.

b. Peer review and publication

As of early 2010, there were 3,472 papers on DTI published in peer review journals. (Dr. Benson Aff. ¶ 17.) Eighty-three of these articles involved DTI in relation to TBI. (*Id.*) Of these 83 papers, a control group was used for the statistical analysis of 35 of them. (*Id.*) In the case that defendants rely upon to show the DTI has not been accepted by the courts, the trial judge determined that DTI could not be admitted to show mild traumatic brain injury in large part because the party moving to admit DTI evidence had not pointed to any articles showing that DTI was used for that purpose. *Bowles v. Pennington*, No. 06-cv-11030, at *3-4 (Col. Ct. Dist. Aug. 14, 2009). As just explained, that problem does not exist here because the Ruppels have pointed to many articles that discuss how DTI is effective in detecting mild brain injury. In fact, Dr. Benson's affidavit includes quotes from fourteen peer-reviewed articles that discuss how DTI can help detect TBI. (Dr. Benson Aff. ¶ 18.) Eleven of these excerpts specifically address the

effectiveness of DTI in detecting mild TBI ("mTBI"). (*Id.*) Here is an example:

Detection of ultrastructural damage by using DT imaging is a major advance in diagnostic imaging. Several studies have supported the capability of FA to help identify white matter abnormalities in patients with traumatic brain injury including mTBI. As confirmed by our findings, abnormal FA is detected even in the absence of other imaging abnormalities.

Michael Lipton, *Diffusion-Tensor Imaging Implicates Prefrontal Axonal Injury in Executive Function Impairment Following Very Mild Traumatic brain Injury*, RADIOLOGY, Sept. 2009, Vol. 252: No. 3. (Dr. Benson Aff. ¶ 18.f.) Another article stated, "Our study shows that DTI can be used to detect differences between patients with cognitive impairment after mild TBI and controls." Calvin Lo, *Diffusion Tensor Imaging Abnormalities in Patients with Mild Traumatic Brain Injury and Neurocognitive Impairment*, COMPUT ASSIST TOMOGR, March/April 2009, Vol. 33, No. 2. (Dr. Benson Aff. ¶ 18.i.) Thus, there are peer-reviewed articles on the effectiveness of DTI and FA quantification based on comparative DTI scans for detecting diffuse axonal brain injury. Accordingly, the concern that drove the judge's decision in *Bowles* does not exist here.

c. *Ability of DTI and FA quantification to be tested and their error rate*

As to the ability to test DTI and the FA quantification based on it and their reliability, defendants' main arguments are that decreased FA in DTI scans cannot be challenged in an objective sense and cannot be replicated.³ (DE # 56 at 13.) However, the

³ Dr. Drnovesk also concludes that Dr. Benson's study of Ruppel is flawed because the DTI scan was performed 27 months after the accident at issue and that decrease in FA caused by mild TBI is not detectable after three months from the date of the cause of an injury. (Dr. Drnovesk Report 5.) Defendants do not appear to address this conclusion in

Ruppels have presented evidence that the DTI scan and resulting FA quantification analysis can be tested and replicated and that the error rate is not higher than other methods commonly relied upon such as MRIs. (Dr. Benson Aff. ¶¶ 34-36.) According to Dr. Benson, DTI has "good test retest reliability." (Dr. Benson Dep. 15.) He stated that DTI scans have shown high reproducibility. (Dr. Benson Aff. ¶ 34.) Dr. Benson explained the numerous steps he took to minimize the error rates in his DTI analysis and he stated: "Statistically speaking, the clusters of abnormal voxels found in areas of Dale Ruppel's brain were there by chance is next to impossible." (Dr. Benson Aff. ¶¶ 29-32.) He also stated that the quantitative analysis of FA is reproducible. (*Id.* ¶ 34.)

As explained above, Ruppel has produced evidence that Dr. Benson's methods can be tested and that the error rate is not higher than that of other commonly used methods. While defendants' expert Dr. Drnovsek disagrees with Dr. Benson (Dr. Drnovsek Report 3), she does not have as much experience in this area as Dr. Benson. Dr. Benson is a behavioral neurologist who has been involved in research using advanced MRI methods for eighteen years. (Dr. Benson Aff. ¶ 4.) He has focused his research on TBI imaging for the past five years and has published a paper on how DTI scans of FA correlate with TBI severity. (*Id.*) On the other hand, Dr. Drnovsek, a

their motion or reply. Still, the court notes that Dr. Drnovsek's conclusion does not operate to block Dr. Benson's testimony on DTI and FA quantification from coming in all together. Rather it is an argument that defendants can raise at trial as to the weight that the fact-finder should afford to Dr. Benson's opinion.

neuroradiologist, does not do diffusion tensor imaging and before becoming involved in this case her only experience with DTI was a basic familiarity with the literature about DTI and attendance at conferences that “elaborate[d] on [DTI] application in different pathologies, including traumatic brain injury.” (Dr. Valerie Drnovsek Dep. 16-17, Pl.’s Exh. 15, DE # 57-15.) She has not done any personal research into DTI. (*Id.* at 17.) Her criticism of Dr. Benson’s methods was based on her reading of two articles on the subject. (*Id.* at 42.)

In *Wagoner v. Schlumberger Tech. Corp.*, a proposed expert witness, a neuroradiologist, had never reviewed a DTI scan before analyzing one for the trial and had only read one article on DTI. No. 07-CV-244, 2008 U.S. Dist. LEXIS 118764, at *2 (D. Wyo. June 20, 2008). The trial judge found that the witness did not have any special expertise on DTI and excluded any testimony from the expert about his opinion on the DTI scans. *Id.* Here, the Ruppels have not moved to exclude Dr. Drnovsek’s testimony. However, Dr. Drnovsek, like the expert in *Wagoner*, has not been shown to have special expertise in DTI and Dr. Benson has been shown to have this expertise. Therefore, the court will not exclude Dr. Benson’s testimony based on conflicting testimony from Dr. Drnovsek as to DTI’s error rate, testability, and replicability. This disagreement can be explored at trial.

d. Alternative explanations for the decreased white matter in the DTI images

Defendants argue that Dr. Benson should not be able to testify as to his

determination that the DTI image indicated that Ruppel had diffuse axonal brain injury because it showed that Ruppel's white matter had decreased in comparison to scans done of control patients because Dr. Benson did not consider alternative explanations, primarily aging, for the decreased white matter. However, this argument is not supported by the evidence. Dr. Benson testified that while Ruppel was 46 at the time of his DTI scan and the mean age of the control group was the 32, the analysis was corrected to account for age. (Dr. Benson Dep. 65.) He also stated that the age effect on FA is well-known and easily accounted for. (Dr. Benson Aff. ¶ 28.) He stated that he normalized the results to account for the effect of age. (Dr. Benson Dep. 36.) The Ruppels have also submitted a chart that shows the amount of FA in Ruppel's scan as compared to a group of 50 controls many of whom are his age or older. (DE # 58-1 at 18.) The effect of aging is certainly an issue that can be probed at trial, but it is not a basis for excluding Dr. Benson's opinion.

Defendants, pointing to Dr. Drnovsek's report, also argue that Dr. Benson did not account for alternative explanations such as the variations in FA in structures abutting the basal ganglia and thalamic nuclei. (Dr. Drnovsek Report 4.) However, Dr. Benson contends that these problems are presented by scans that look at gray matter, not those that look only at white matter such as the ones he employs. The difference in opinion between the two experts is something that can be addressed at trial and does not make Dr. Benson's method unreliable.

Further, defendants point to Dr. Benson's testimony that other diseases can affect

FA quantification. (Dr. Benson Dep. 67-69.) However, Dr. Benson explains that many of these diseases are rare, and that some of the more common ones, such as stroke and MS, would also come up on a regular MRI scan if they would come up on a DTI scan. (*Id.* at 69.) Defendants also raise the issue that Ruppel's DTI scan could have been affected by the medications he was on. (Dr. Drnovsek Report 3.) This is an issue they can address during cross-examination.

Defendants also point to Dr. Benson's testimony that "So obviously you're going to have variance, okay, with any type of measurement, there is error, there's a number of different sources, some physiologic, some machine, right, and in this case, age is a factor as well." (Dr. Benson Dep. 35.) Defendants present their argument that Dr. Benson attributed this error just to FA quantification, but it appears that he thinks these errors can accompany any type of measurement. He stated: "I am going to always let's say err[] on the side of respecting the lack of absolute certainty that we have in our field. I mean it is the nature of medicine, not just science." Dr. Benson also corrected his results for motion during the scan. (*Id.* at 68.) In any case, Dr. Benson's deposition and affidavit testimony show that he was aware of possible alternative explanations of Ruppel's decreased white matter and that both the method and Dr. Benson's application of the method accounted for these possibilities. His conclusion took into account alternative explanations for his results and that the only way to diagnose diffuse axonal injury with complete certainty is autopsy. (*Id.* at 66.) Therefore, the possibility of alternative explanations does not bar Dr. Benson's testimony; rather it

goes toward the weight to be given to his opinion. See e.g., *Cooper v. Carl A. Nelson & Co.*, 211 F.3d 1008, 1021 (7th Cir. 2000).

b. *Nature of Dr. Benson's opinion and how careful he was in reaching it*

In this case, it appears that Dr. Benson's opinion grew naturally and directly out of the research that he has conducted independently of the litigation and he has been as careful as he would be in his regular professional work outside his paid litigation consulting. First, the evidence shows that DTI and FA quantification is a regular focus of Dr. Benson's work and research. He has focused on TBI imaging for five years at the MR Research Center at Detroit Medical Center. (Dr. Benson Aff. ¶ 4.) He is also an investigator on a fifteen-year project entitled "Utility of MRI Techniques in Prediction of TBI Outcome" funded through a grant by the National Institute on Disability and Rehabilitation Research. (*Id.* ¶ 2.) In 2007, he published an article entitled *Global White Matter Analysis of Diffusion Tensor Images of Injury Severity in Traumatic Brain Injury* in the JOURNAL OF NEUROTRAUMA. (*Id.* ¶ 3.) In 2010, he testified before the United States House Judiciary about how DTI and other advanced imaging methods would improve the diagnosis and management of concussions in sports. (*Id.* ¶ 2.) Thus, the evidence shows that Dr. Benson regularly researches about and uses DTI and FA quantification to detect TBI. This is not a method or area of research that he has adopted just for litigation. It appears that as the Ruppels' retained expert, he only applied his methods to Ruppel and reached his opinion because of his involvement in this litigation. However, because

the methods he employed grew out of and is consistent with his regular work, Dr. Benson's opinion as to Ruppel appears reliable.

Second, without pointing to any evidence, defendants accuse Dr. Benson of not using "the same level of intellectual vigor that characterizes the practice of an expert in the regular field." However, Dr. Benson's expert report, deposition, and affidavit do not show that he was not careful in reaching his conclusion or that he lacked intellectual vigor. Thus, there is no evidence to show that his opinion should not be admitted on this basis. Defendants can use cross-examination and their own witnesses's testimony to raise at trial the issue of the level of intellectual vigor that Dr. Benson employed.

Overall it is important to note that DTI is just one component of Dr. Benson's diagnosis of diffuse axonal injury for Ruppel. In *Whilden*, a Colorado state trial court found that an expert could base his opinion on DTI as long as he also considered the patient's history. No. 08-cv-4210 at 4 (allowing an expert witness to rely on DTI evidence when testifying as to the diagnosis of mTBI and its possible causation from an automobile accident as long as the expert's opinion was not based solely on DTI). Here, Dr. Benson's opinion was based on four components: the patient's history, the neurologic examination of the patient, the patient's neuropsychological results, and the patient's brain imaging including DTI. (Dr. Benson Dep. 69.) Dr. Benson's clinical assessment was based on medically accepted neurological and mental status examination techniques. (Dr. Benson Aff. ¶ 8.) In his affidavit, Dr. Benson stated:

While DTI itself cannot diagnose the cause of white matter damage, the

history of the motor vehicle accident as described by Dale Ruppel and medical records reviewed provide a solid basis to conclude that the damage shown on diffusion tensor imaging using fractional anisotrophy was caused by the motor vehicle collision of January 8, 2008.

(*Id.* ¶ 33.) Thus, like the expert in *Whilden*, Dr. Benson did not use DTI alone to diagnose diffuse axonal injury. In sum, DTI and comparative FA quantification based on DTI images are reliable methods and Dr. Benson's opinion will not be excluded under RULE 702 and *Daubert*.

2. Wording of Dr. Benson's opinion

Defendants argue that Dr. Benson's opinion is invalid because he says that the evidence "suggests" that Ruppel has a diffuse axonal brain injury and that it was caused by the accident. (DE # 56 at 10-11.) It seems that this argument goes to whether Dr. Benson's testimony is relevant and whether it would assist the trier of fact. Defendants argument appears to be that Ruppel can only present evidence of his injury if he has evidence that shows with one hundred percent certainty that he has a diffuse axonal brain injury. This is not the case. *Daubert*, 509 U.S. at 590; *United States v. Cyphers*, 553 F.2d 1064, 1072-73 (7th Cir. 1977) (stating that there is no requirement that "an expert's opinion testimony must be expressed in terms of a reasonable scientific certainty in order to be admissible" and that the Seventh Circuit "adheres to the rule that an expert's lack of absolute certainty goes to the weight of his testimony, not to its admissibility"). The Seventh Circuit has stated, "we do not require utter certainty in medical opinions, nor would we expect dogmatic diagnoses from a careful scientist."

Amax Coal Co. v. Beasley, 957 F.2d 324, 328 (7th Cir. 1992).

Indeed, courts regularly admit opinion evidence that falls short of a certain conclusion. See e.g., *Coachmen Indus., Inc. v. Kemlite*, 3:06-cv-160, 2008 WL 4858385, at *8 (N.D. Ind. Nov. 10, 2008) (admitting an expert's testimony that "specific changes made to the MA resin values were 'most likely' responsible for the distortions"); *Hardiman v. Davita Inc.*, No. 2:05-cv-262, 2007 WL 1395568, at *6 (N.D. Ind. May 10, 2007) (finding that an expert's opinion that there was a 95% probability of causation was relevant and admissible); *Troutner v. Marten Trans., Ltd.*, No. 2:05-cv-40, 2006 WL 3523542, at *4 (N.D. Ind. Dec. 5, 2006) (admitting an expert's testimony when the conclusion in his expert report was that inadequate maintenance was "the most likely root cause of the failure and injury to" the plaintiff). Further, an expert may meet *Daubert's* relevancy requirement by offering a "hypothetical explanation of the possible or probable causes of an event [that] would aid the jury in its deliberations." *Smith*, 215 F.3d at 719.

In the summary of findings section of his report, Dr. Benson stated that DTI revealed a low FA in the white matter regions of Ruppel's brain "suggesting axonal injury from trauma." (Dr. Randall Benson, "Report of Findings of TBI Research Protocol," Defs.' Exh. I, DE # 56-9.) However, Dr. Benson did not only use the word "suggest" in providing his opinion. He also stated:

The absence of focal injury (contusion) and the presence of bilaterally symmetric axonal injury to deep white matter structures suggests that the mechanism of injury was acceleration/deceleration rather than direct impact to the skull. His history of motor vehicle accident is consistent with the findings on his MRI study.

(*Id.*) Thus this excerpt of his report, by stating that axonal injury to the white matter of Ruppel's brain was present, more definitively stated Ruppel's injury. Also, in his report Dr. Benson wrote that Ruppel "appears to have suffered a close head injury as a result of being rear-ended." (*Id.*)

Further, in his deposition, Dr. Benson explained that while he used the word "suggest" in his report, at the time he "really felt strongly that all the evidence pointed to diffuse axonal injury." (Dr. Benson Dep. 67.) Dr. Benson's "certainty is an issue for the jury and does not affect admissibility." *Stutzman v. CRST, Inc.*, 997 F.2d 291, 296 (7th Cir. 1993). Thus under federal evidentiary rules, Dr. Benson's opinion may be admitted under RULE 702. Importantly, Dr. Benson's language in presenting his opinion does not render it inadmissible when it is based on reliable methods. The Seventh Circuit has concluded that "the Federal Rules do not contain any threshold level of certainty requirement. As long as a medical expert's qualifications are proper and the expert relies on appropriate types of information under RULE 703, the district court does not abuse its discretion by admitting the medical expert's testimony." *Id.* Dr. Benson's testimony is not speculation because, as determined above, he used scientifically reliable methods to reach his conclusion.

In sum, defendants' motion to exclude Dr. Benson's opinion as to diffuse axonal injury will be denied. Defendants' primary arguments for exclusion of Dr. Benson's testimony were his reliance on DTI to reach his result and his use of the word "suggest" for his diagnosis. As discussed above, DTI is a reliable method especially when used in

conjunction with the other medically accepted methods relied upon by Dr. Benson. Beyond these two issues, defendants have not questioned Dr. Benson's qualifications to testify as to Ruppel's diagnosis and its causation and he appears qualified to do so. (See Dr. Benson Aff. ¶ 19; Dr. Benson Curriculum Vitae, DE # 58-1.) Dr. Benson may testify as to Dr. Ruppel's diagnosis of diffuse axonal injury and as to its causation.

II. SUMMARY JUDGMENT

Summary judgment should be granted "if the movant shows that there is no genuine dispute as to any material fact and the movant is entitled to a judgment as a matter of law." FED. R. CIV. P. 56(a). The party seeking summary judgment "bears the initial responsibility of informing the district court of the basis for its motion, and identifying" those materials listed in RULE 56(c) which "demonstrate the absence of a genuine issue of material fact." *Celotex Corp. v. Catrett*, 477 U.S. 317, 323 (1986).

Once the moving party has met its burden, the nonmovant may not rest upon mere allegations. Instead, "[t]o successfully oppose a motion for summary judgment, the nonmoving party must come forward with specific facts demonstrating that there is a genuine issue for trial." *Trask-Morton v. Motel 6 Operating L.P.*, 534 F.3d 672, 677 (7th Cir. 2008). "It is not the duty of the court to scour the record in search of evidence to defeat a motion for summary judgment; rather, the nonmoving party bears the responsibility of identifying the evidence upon which he relies." *Harney v. Speedway SuperAmerica, LLC*, 526 F.3d 1099, 1104 (7th Cir. 2008). Furthermore, when evaluating a motion for summary judgment, the court views the record and makes all reasonable

inferences in a light most favorable to the nonmovant. *Popovits*, 185 F.3d at 731. If the non-moving party cannot establish an essential element of its claim, RULE 56(a) requires entry of summary judgment for that claim. *Massey v. Johnson*, 457 F.3d 711, 716 (7th Cir. 2006) (citing *Celotex*, 477 U.S. at 322-23).

Defendants' summary judgment argument is that because all evidence of Ruppel's diagnosis of diffuse axonal injury and its causation are excluded under *Daubert* or for failure to comply with FEDERAL RULE OF CIVIL PROCEDURE 26(a)(2), he has no evidence to survive a motion for summary judgment.

The court will now address defendants' arguments related to FEDERAL RULE OF CIVIL PROCEDURE 26(a)(2). In their response to defendants' motion for summary judgment, the Ruppels presented affidavits of four physicians, Dr. Robert Ward, Dr. Bradley Sewick, Dr. Patrick Casey, and Dr. Pareigis, who treated Ruppel. (Pls.' Exhs. 3, 5, 6, DE ## 57-3, 57-5, 57-6.) In reply, defendants argue that the first three physicians' proposed testimony, as set forth in their affidavits, extends beyond what the plaintiffs had outlined in their reports and summaries pursuant to FEDERAL RULE OF CIVIL PROCEDURE 26(a)(2). Defendants, citing to *Doe v. Johnson*, 52 F.3d 1448, 1464 (7th Cir. 1995), appear to be arguing that these doctors' testimony should be limited to the statements made in their medical records because anything beyond that was not disclosed under RULE 26 and should be excluded under RULE 37.

RULE 26.2 of the LOCAL RULES OF THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF INDIANA provides that if a party seeks relief under RULE 37,

copies of the portions of the disclosures in dispute “shall be filed with the court contemporaneously with any motion filed under” that RULE. Defendants did not file a copy of plaintiffs’ RULE 26 disclosures with their response. While this may not have been required since they did not move under RULE 37 separately, it certainly would have assisted the court in evaluating their argument. Instead defendants argue that Dr. Ward’s, Dr. Casey’s, and Dr. Sewick’s testimony is inconsistent with the statements made in their medical records. In a sur-reply, plaintiffs contend that Dr. Ward, Dr. Casey, and Dr. Sewick, as well as Dr. Pareigis, were “properly disclosed” in their RULE 26 disclosures and their medical charts were provided to defendants with updates sent as Ruppel’s treatment continued. (DE # 62 at 2.) They state that Dr. Ward, Dr. Casey, Dr. Sewick, and Dr. Pareigis are all treating physicians and none of them were retained or specially employed for this litigation. (*Id.*)

First, it appears that these witnesses were only required to give statements under RULE 26(a)(2)(C) and not expert reports under RULE 26(a)(2)(B). RULE 26(a)(2)(B) states that the disclosure of expert testimony must be accompanied by a written report when the witness is “one retained or specially employed in the case or one whose duties as the party’s employee regularly involve giving expert testimony.” Effective December 1, 2010, RULE 26 was amended to add section 26(a)(2)(C). This section provides that expert witnesses who are not required to submit a report under 26(a)(2)(B) must submit a statement that provides a summary of the facts and opinions to which the witness expects to testify. The commentary to this amendment states that it

will frequently apply to "physicians or other health care professionals." They also provide that under this subsection "[c]ourts must take care against requiring undue detail, keeping in mind that these witnesses have not been specially retained and may not be as responsive to counsel as those who have." Defendants do not argue that Dr. Ward, Dr. Pareigis, Dr. Sewick and Dr. Casey were not Ruppel's treating physicians, or more importantly, that they were specially retained or employed for this litigation. Thus, they were only required to comply with RULE 26(a)(2)(C). See *Coleman v. Am. Family Mut. Ins. Co.* No. 2:10-cv-167, 2011 WL 2173674, at *4 (N.D. Ind. June 2, 2011).

Second, the court has no reason to think that the proposed testimony is so inconsistent with the RULE 26(a)(2)(C) disclosures that it should be struck down under RULE 37. Defendants have not pointed to plaintiffs' RULE 26(a)(2)(C) disclosures, so the court cannot compare them to the proposed testimony and has no basis for excluding the testimony for noncompliance with RULE 26. Defendants argue that Dr. Ward, Dr. Pareigis, and Dr. Sewick cannot testify that Ruppel has diffuse axonal injury because in their medical records for Ruppel they only stated that he had closed head injury. Defendants, without pointing to any evidence from their expert medical witnesses or otherwise, assert that what the physicians have done is similar to "a doctor who makes a diagnosis of a broken bone, tenders x-rays and information relative only to a broken foot for 2 or 3 years, then later argues that the diagnosis should have covered diagnosis of a broken hand as well because they are both broken bones." (DE # 61 at 2.)

In contrast, all five of plaintiffs' expert witness physicians offer testimony that a

diffuse axonal injury is a type of closed head injury. (Dr. Robert C. Ward. Aff. ¶ 4, Pls.' Exh. 3, DE # 57-3; Dr. Pareigis Aff. ¶ 7; Dr. Patrick Casey Aff. ¶¶ 5, 8, Pls.' Exh. 5, DE # 57-5; Dr. Bradley Sewick Aff. ¶ 5-6, Pls.' Exh. 6, DE # 57-6; Dr. Benson Aff. ¶ 5). Dr. Sewick's explanation is representative: "A diffuse axonal brain injury is often caused by a closed head injury or traumatic brain injury. A diagnosis of closed head injury and traumatic brain injury without evidence of focal injury is suggestive of diffuse axonal injury." (Dr. Sewick Aff. ¶ 5.) Accordingly, the difference between statements of closed head injury in the medical records and a diagnosis of diffuse axonal injury may not be as stark as defendants suggest. Certainly, it does not appear to provide a basis to exclude the testimony under RULE 37. Rather, this appears to be an argument that defendants can delve into during cross examination at trial. Accordingly, these witnesses can offer testimony related to diffuse axonal injury at trial.

In evaluating whether the Ruppels have sufficient evidence as to his claim of diffuse axonal injury to allow it to survive summary judgment, the court has one remaining, and familiar, argument to address. As discussed above, defendants seem to argue that Dr. Benson's opinions as to the diagnosis and causation of diffuse axonal injury will not help Ruppel survive summary judgment because Dr. Benson uses the word "suggest." While the court has already discussed that this opinion is admissible it must now address whether, under Indiana law, which applies to the substantive law questions in this case, Dr. Benson's testimony has enough probative value that Ruppel can use it towards his burden of proof for causation.

As defendants point out, in Indiana, "[w]hen the issue of cause is not within the understanding of a lay person, testimony of an expert witness on the issue is necessary." *Daub v. Daub*, 629 N.E.2d 873, 877-78 (Ind. Ct. App. 1994). To have probative value, the testimony must go beyond speculation and mere possibility. *Id.* When evaluating an expert's opinion, Indiana courts tend to look at whether the expert can testify to a reasonable degree of medical certainty, but even an opinion that something is "possible" may be admitted if presented with other evidence. *Topp v. Leffers*, 838 N.E.2d 1027, 1033 (Ind. Ct. App. 2005); *Colaw v. Nicholson*, 450 N.E.2d 1023, 1030 (Ind. Ct. App. 1983) ("[E]xpert medical opinion couched in terms less than that of a reasonable degree of medical certainty; such as 'possible,' 'probable,' or 'reasonably certain,' are admissible and do have probative value. However, such medical testimony standing alone, unsupported by other evidence, is not sufficient to support a verdict.") Therefore, an opinion does not need to be stated in terms of "medical certainty," but to be admitted alone, it must be more conclusive than stating a "possibility." *Longardner v. Citizens Gas & Coke Util.*, No. 49A02-511, 2006 WL 3230303, at *7 (Ind. Ct. App. Nov. 8, 2006); *Hardiman*, 2007 WL 1395568, at *15.

Here, Dr. Benson's report stated that Ruppel "appears to have suffered a close head injury as a result of being rear-ended." (Dr. Benson Report.) He also stated in his deposition that although he used the word "suggests" in his report he "really felt strongly that all the evidence pointed to diffuse axonal injury." (Dr. Benson Dep. 67.) Further, his opinion was based on scientifically reliable methods. He based his opinion

on Ruppel's history, his neurologic examination of Ruppel, Ruppel's neuropsychological results, and his analysis of Ruppel's brain imaging including DTI. Dr. Benson's opinion is based on more than speculation and creates an issue of material fact as to both the diagnosis and causation of diffuse axonal injury. *Hardiman*, 2007 WL 1395568, at *17.

Even if Dr. Benson's testimony can not be admitted alone, there is other evidence of Ruppel's diffuse axonal injury. Dr. Paregis wrote in her initial evaluation of Ruppel on March 28, 2008, that her impression was that Ruppel had "[c]losed head injury with probable diffuse axonal injury." (Physicians Center of Physical Medicine's Medical Records for Dale Ruppel, Defs.' Exh. C, DE # 56-3 at 32.) Dr. Paregis and the three other treating physicians all indicate that they would testify as to Ruppel's diffuse axonal injury and its causation. Defendants own expert, Dr. Peter Carney has diagnosed Ruppel with post-concussion syndrome which appears to be related to closed head injury. (Dr. Peter Carney Report Sections D and F2.1, Pl.'s Exh. 17,⁴ DE # 64-1.) So the Ruppels have sufficient evidence to create a genuine factual dispute as to whether Ruppel suffered diffuse axonal injury and whether that injury was caused by the accident with Kucanin.

⁴ The Ruppels cite to and quote from this exhibit in their summary judgment response, but it was inadvertently omitted from that filing. The Ruppels have moved for leave to file this exhibit now. (DE # 64.) The report is from defendants' expert witness, so they have had access to it. Therefore, the motion is **GRANTED**, and the court had considered the parts of the report and deposition that were relied on in plaintiffs' response.

In conclusion, for the foregoing reasons defendants' motion to exclude evidence and motion for summary judgment (DE ## 54-55) are DENIED.

SO ORDERED.

Date: June 20, 2011

s/James T. Moody
JUDGE JAMES T. MOODY
UNITED STATES DISTRICT COURT

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UNITED STATES DISTRICT COURT
DISTRICT OF MASSACHUSETTS

ROBERT A. CHIULLI, JR.,

Plaintiff,

v.

NEWBURY FINE DINING, INC.
d/b/a SONSIE'S RESTAURANT,
THE LYONS GROUP LTD,
GARRETT BURGESS aka
GARRETT REASE, JEFFREY REIMAN,
and VICTOR TORZA,

Defendants.

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Civil Action No. 10-10488-JLT

ORDER

October 17, 2012

TAURO, J.

After considering the Parties' Oppositions [#147], [#155], [#156], [#157], [#158], [#160], [#161], [#162], [#163], and [#164], this court hereby orders that:

1. Plaintiff's Motion to Preclude Nancy Hebben, Ph.D., an Expert for Defendant, Newbury Fine Dining, Inc., from Offering Testimony Which Calculates Plaintiff's Premorbid IQ Based on SAT Scores [#105] is DENIED.
2. Defendants', Newbury Fine Dining Inc. and Lyons Group Ltd., Motion in Limine to Preclude Plaintiff from Offering Articles of Dissolution as Evidence [#122] is ALLOWED as unopposed.

3. Plaintiff's Motion in Limine to Strike the Calculation of Plaintiff's Blood Alcohol Level Offered by Nancy Hebben, Ph.D., Expert for Defendants, Newbury Fine Dining Inc. and Lyons Group Ltd. [#129] is ALLOWED as unopposed.
4. Defendants', Newbury Fine Dining Inc. and Lyons Group Ltd, Motion in Limine to Preclude Plaintiff from Referencing, Introducing Evidence, or Eliciting Testimony Regarding Co-Defendant Jeffrey Reiman Being Denied Entrance to Sonsie Following the Incident in Question [#132] is ALLOWED.
5. Defendants', Newbury Fine Dining Inc. and Lyons Group Ltd., Motion in Limine to Preclude Evidence of Other Incidents Involving Any Establishment Affiliated with Newbury Fine Dining Inc. or Lyons Group Ltd. [#133] is ALLOWED IN PART and DENIED IN PART. Evidence of other incidents involving any establishment affiliated with Defendants is excluded. Evidence of a stipulation by Lyons Group as to responsibility for security at the bars it manages is not excluded.
6. Defendants', Newbury Fine Dining Inc. and Lyons Group Ltd., Motion in Limine to Preclude Plaintiff's Expert, Randall Benson, from Testifying and to Preclude Testimony of Diffusion Tensor Imaging [#134] is DENIED.
7. Defendants', Newbury Fine Dining Inc. and Lyons Group Ltd., Motion in Limine to Redact from the Plaintiff's Medical Records and Other Documents Any Statement Relating to Liability Issues [#135] is ALLOWED as unopposed.

8. Defendants', Newbury Fine Dining Inc. and Lyons Group Ltd., Motion in Limine to Preclude Plaintiff's Expert, William Burke, from Testifying [#136] is DENIED.
9. Defendants', Newbury Fine Dining Inc. and Lyons Group Ltd., Motion in Limine to Preclude Plaintiff from Referencing, Introducing Evidence, or Eliciting Testimony Regarding Criminal Investigation/Charges Related to Events of June 20, 2008 [#137] is ALLOWED.
10. Defendants', Newbury Fine Dining Inc. and Lyons Group Ltd., Motion in Limine to Preclude Any Party or Witness from in Any Way Referencing ABCC, or Licensing Board Regulations, or Any Mocal Regulation Having Anything to do with Alcohol Service at a Licensed Premises [#138] is ALLOWED IN PART and DENIED IN PART. Evidence of ABCC, MOCAL, and Licensing Board regulations is admissible to prove negligent security, but inadmissible to prove negligent service of alcohol.
11. Defendants', Newbury Fine Dining Inc. and Lyons Group Ltd., Motion in Limine to Preclude All Parties from Offering Any Evidence that Patrick Lyons was Manager of Record [#139] is ALLOWED.
12. Defendants', Newbury Fine Dining Inc. and Lyons Group Ltd., Motion for Reconsideration of Court's Ruling on Docket Number 55 [#140] is DENIED. The March 6, 2012 Order [#58] and transcript of the March 6, 2012 Pretrial Conference [#130] confirm that this court did not rule on spoliation or order a spoliation inference on March 6, 2012. Rather, on that date, this court delayed

ruling on spoliation, ordered Plaintiff to submit an affidavit on the topic of spoliation, and set a deadline for Defendants to reply to Plaintiff's affidavit and submit a proposed jury instruction.

13. Defendant's, Jeffrey Reiman, Motion in Limine to Preclude Plaintiff, Robert A. Chiulli, from Referencing, Introducing Evidence, or Eliciting Testimony Regarding (A) Any Prior Investigation into the Events of June 20, 2008, and (B) Jeffrey Reiman's Assertion of his Fifth Amendment Privilege Against Self-Incrimination Before a Grand Jury [#141] is ALLOWED.
14. Defendants', Newbury Fine Dining Inc. and Lyons Group Ltd., Motion to Quash Trial Subpoenas of Patrick Lyons, Edward Sparks, and Attorney Dennis Quilty [#142] is DENIED.
15. Defendant's, Jeffrey Reiman, Motion in Limine to Preclude Plaintiff from Eliciting Testimony or Introducing Evidence Concerning Mr. Reiman's Mental Health Status [#143] is DENIED.
16. Defendants', Newbury Fine Dining Inc. and Lyons Group Ltd., Motion in Limine to Preclude Any Party or Witness from in Any Way Referencing the Licensed Premises Inspection Notice and from Claiming Any ABCC, MOCAL, or Licensing Board Regulation has been Violated [#144] is ALLOWED IN PART and DENIED IN PART. The "Licensed Premises Inspection Notice" is excluded. Evidence of ABCC, MOCAL, and Licensing Board regulations is admissible to prove negligent security, but inadmissible to prove negligent service of alcohol.

17. Defendant's, Jeffrey Reiman, Motion in Limine to Preclude Any References During Trial that Jeffrey Reiman was Denied Entry to Sonsie Subsequent to June 20, 2008 [#145] is ALLOWED.
18. Defendant's, Jeffrey Reiman, Motion in Limine to Adopt Defendants, Newbury Fine Dining Inc. and Lyons Group, Ltd.'s Motion in Limine to Redact from Plaintiff's Medical Records all Statements Relating to Liability [#146] is ALLOWED as unopposed.

IT IS SO ORDERED.

/s/ Joseph L. Tauro
United States District Judge

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PARTIAL TRANSCRIPT

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1 STATE OF MINNESOTA

DISTRICT COURT

2 COUNTY OF RAMSEY

SECOND JUDICIAL DISTRICT

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CIVIL COURT

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5 Jean A. Hansen,

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Plaintiff,

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vs.

File No.: 62-CV-10-2435

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10 Frank R. Crain,

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Defendant.

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TRANSCRIPT OF PROCEEDINGS

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The above-entitled matter came duly on for
hearing before the HONORABLE ROBERT A. AWSUMB, Judge of
the District Court, in the Ramsey County Courthouse, in
the City of Saint Paul, and in the State of Minnesota,
commencing on Monday, April 4, 2011.

* * * * *

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2

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PROCEEDINGS

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PARTIAL TRANSCRIPT

1:28 p.m.

THE COURT: Before we call the jury back, I want to review the in limine motions with respect to Dr. Wu's opinion and the use of the PET and the other --

MR. HARPER: DTI.

THE COURT: -- DTI technology. I have reviewed the arguments of Counsel; more than cursorily have reviewed the medical literature; but I have not given it, unfortunately, the amount of time necessary to become an expert in PET technology and DTI technology, but enough to know that there are experts in those fields and that many of them have written a number of articles about it. It's clear to me that the technology involving PET scans and DTI is something that is not novel to the medical industry.

It is not novel science, it has been around for maybe some twenty years, and is relied upon by medical professionals in a number of settings. The real question is, with respect to utilizing that technology in cases involving mild traumatic brain injuries, is it

1 something that is reliable enough, accepted enough, and
2 helpful enough to be admissible. As you both know, we
3 as judges are to be the gatekeepers with respect to
4 expert testimony, in large part to weed out spurious
5 theories, rogue scientists, and other craziness so that
6 the jury is presented with evidence that is helpful to
7 them because it is, in fact, solid science.

8 This is a case involving a common type of
9 injury to peoples' brains, that being a mild traumatic
10 brain injury-type claim. It's clear to me that the use
11 of PET technology has been around and utilized in that
12 field for some time. In fact, when I read the summary
13 of the article submitted by the Defense, the medical
14 legal article, he admits in his summary that this is not
15 novel science, it's generally accepted by the medical
16 professionals, and it is utilized quite frequently in
17 diagnoses of the brain and injuries thereto.

18 The criticism is that it is not perfect. In
19 fact, many other things besides trauma can lead to a
20 similar finding on a scan of this nature. And that, in
21 part, relies on clinical correlation and past history of
22 a person's medical, psychological, or trauma conditions.
23 That, like any other causation issue such as a herniated
24 disc, if it's caused by the accident or not -- MRI
25 doesn't tell you if a herniated disc is caused by an

1 accident or not, it tells you it's a herniated disc.
2 The doctors are allowed to opine whether they believe
3 that injury or insult was caused by this, that, or the
4 other thing.

5 In this case, I'm convinced the doctor was
6 qualified to supervise and/or administer the tests
7 obtained from Ms. Hansen and to give opinions with
8 respect to what they mean with respect to her brain.
9 I'm also of the opinion that the utilization of findings
10 on the PET scan, such as in this case, form part of the
11 basis for a qualified physician's opinion as to injury
12 or causation from a motor vehicle accident passes that
13 portion of our Frye Mack test, and I believe that it
14 will be helpful to the jury.

15 Again, it is a test that has been
16 demonstrated by Mr. La Bore in his cross-examination and
17 by the multiple literature that it is not a perfect
18 test. Like anything else, it can have false positives.
19 Many people know about the concept of PSA blood tests
20 for various cancer screenings. Many times a person
21 might have a high PSA, which is a red flag for cancer,
22 and have zero cancer after they go in and take a biopsy.
23 That doesn't mean the test is not medically reliable.

24 I believe in this case, as well, the test
25 has been developed to be reliable, sufficiently accepted

1 in the particular field relating to scientists, such as
2 Dr. Wu, and applied in cases involving mild traumatic
3 brain injuries. I think that the arguments that it
4 doesn't rule out everything are left for
5 cross-examination and are weighed by the jury as part of
6 the credibility of the opinion given.

7 I lastly looked at the argument regarding
8 the fact that the test was done seven years after the
9 accident, and I gave that a lot of thought. I learned
10 that, in fact, doctors would not recommend a PET scan
11 shortly after an accident but would want to wait and, in
12 large part, look at it from a chronic standpoint.

13 I also looked at the articles that show
14 that, I think, the mean number of years after an
15 incident or insult was in the six-to-seven-year range of
16 hundreds of these examinations in some studies, and that
17 many of them were up to, I think, 25 or 30 years after
18 the accident and were still deemed reliable diagnostic
19 tests by the physicians involved in those cases.

20 I think that it passes all of the tests of a
21 Frye Mack. It's evidence that, I think, is generally
22 accepted by a physician who is competent and fully
23 trained, but who has opinions that differ from those of
24 the doctors hired by the Defense, which is not unusual.
25 So I'm going to allow the testimony with respect to the

1 PET scans themselves and the related testimony and deny
2 the motion in limine to preclude that evidence.

3 This is an issue that is very important and
4 I appreciate that it was raised. It would be helpful to
5 any judge in the future, including myself, if it could
6 be done in a manner weeks before the trial. It could be
7 hit hard and given a lot more thought and consideration
8 than I was able to do today.

9 I intend to bring the jury back in. I have
10 not had time to read the rest of the transcripts, so
11 stay away from talking about baseball players in
12 voir dire.

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CERTIFICATE OF COURT REPORTER

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Judy M. Rider

April 4, 2011

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**IN THE CIRCUIT COURT OF THE THIRTEENTH JUDICIAL CIRCUIT OF THE
STATE OF FLORIDA, IN AND FOR HILLSBOROUGH COUNTY
CIVIL DIVISION**

BETHANY HAMMAR and TOM
HAMMAR, her husband,

Plaintiffs,

Case No.: 08-019984

vs.

Division: C

SENTINEL INSURANCE COMPANY,
LTD.,

Defendant.

**ORDER DENYING DEFENDANT'S *FRYE* CHALLENGE REGARDING
ADMISSIBILITY OF MRI WITH DTI AND RESULTING TESTIMONY**

THIS CAUSE having come before this Court upon Defendant's Motion in limine/to exclude Testimony and Evidence, Plaintiffs' Response and Memorandum of Law in opposition to Defendant's Motion for *Frye* Hearing, Defendant's Memorandum in Support of Defendant's *Frye* Challenge and Plaintiffs' Response to Defendant's Memorandum in Support of Defendant's Motion in Limine (*Frye*) on admissibility of MRI with DTI and testimony pertaining to same on September 2, 2010, and the Court having considered the extensive filings, expert testimony, scientific and legal publications, peer reviewed journals, and judicial opinions and after having heard argument of counsel and being further advised on the premises, this Court finds as follows:

1. Diffusion Tensor Imaging (DTI) is not new or novel science.
2. Plaintiffs have demonstrated that the basic underlying principles of DTI have been sufficiently tested and accepted by the relevant scientific and medical communities.

3. DTI of the brain is a proven and well-established imaging modality in the evaluation and assessment of normal and abnormal conditions of the brain. DTI demonstrates evidence of traumatic brain injury pathology and can reveal abnormalities that are not visible on standard MRIs. According to Dr. David Herbst, a Board Certified Radiologist, DTI studies are definitely accepted by practicing radiologists and are depended upon by physicians who order them to assist in diagnosing and treating brain injuries.

4. DTI is generally accepted by the medical community, FDA approved, peer reviewed and approved, and a commercially marketed imaging modality which has been in clinical use for the evaluation of suspected head traumas including mild traumatic brain injury.

5. This Court's findings are further buttressed by the position of the American College of Radiology (ACR), who defines practice guidelines and technical standards for radiologic practice on the Performance and Interpretation of Magnetic Resonance Imaging (MRI) of the Brain, which clearly provides that indications for MRI of the brain with diffusion imaging, if available, is helpful in many indications, including but are not limited to, acute and chronic neurological deficits, headache, mental status change, suspicion of non-accidental trauma, suspicion of acute intracranial hemorrhage or evaluation of chronic hemorrhage, functional imaging, brain mapping, blood flow and brain perfusion study, post-traumatic conditions.


6. The ACR explains that advanced imaging techniques such as diffusion weighted imaging, diffusion tensor imaging, susceptibility weighted imaging, functional imaging, perfusion imaging, parallel imaging and volumetric, morphometric, and other quantitative applications provide added utility for MRI of the brain.

7. The weight to be given to stated scientific theories, and the resolution of legitimate but competing scientific views, are matters appropriately entrusted to the trier of fact.

It is thereby **ORDERED AND ADJUDGED** as follows:

8. Defendant's *Frye* challenge to the admissibility of the MRI with Diffusion Tensor Imaging is hereby **DENIED**;

DONE AND ORDERED in Chambers, at Tampa, Hillsborough County, Florida, this 27th day of September, 2010.



HONORABLE JAMES M. BARTON, II
CIRCUIT COURT JUDGE

Conformed Copies To:
J. Daniel Clark, Esq.
Teresa Jones, Esq.
Jason Lamoureux, Esq.

7

DISTRICT COURT, JEFFERSON COUNTY, COLORADO 100 Jefferson County Parkway Golden, Colorado 80401-6002	
MARION WHILDEN AND MARY WHILDEN Plaintiff, v. KIMBERLY CLINE, ELMER DUDDEN and COLORADO CAB COMPANY, L.L.C. Defendants.	<div style="text-align: right;">COURT USE ONLY</div> <hr/> Case Number: 08CV4210 Div.: 7 Ctrm.: 4-A
ORDER	

THIS MATTER comes before the Court upon Defendant's Motion in *Limine* re Testimony of William W. Orrison. The court having considered the motion, the supporting materials and oral argument, hereby **DENIES** the motion.

Plaintiff claims to have been injured in motor vehicle accidents in which the various Defendants were at fault. He claims to have suffered mild brain trauma as a result. Dr. Orrison, administered a 3-Tesla MRI to Plaintiff and read the results. He also employed computer software called Diffusion Tensor Imaging ("DTI") and auditory functional magnetic resonance imaging ("fMRI") and read those results. In his opinion Plaintiff's brain shows signs of axonal shearing, damaged or missing connective fibers, abnormal blood flow pattern and a smaller than expected hippocampus. Dr. Orrison has diagnosed Plaintiff with a mild traumatic brain injury. He relies on these readings in forming his opinion.

DTI and fMRI are the type of novel scientific processes that were once governed by *Frye v. United States*, 293 F. 1013 (D.C.Cir.1923) and are now

governed by *People v. Shreck*, 22P.3d 68 (Colo. 2001). See also *People v. Hampton*, 746 P.2d 947, 950-951 (Colo.1987). The admission of expert testimony is governed by CRE 702 and CRE 403. *Shreck*, at 77. The Court's inquiry should focus on the reliability and the relevance of the scientific evidence, and a determination should be made as to (1) the reliability of the scientific principles; (2) the qualifications of the witness; and (3) the usefulness of the testimony to the jury. *Id.* at 78. The Court's inquiry should consider the totality of the circumstances in the case and be broad in nature. *Id.* Finally, to ensure the probative value of the evidence not be substantially outweighed by unfair prejudice, the Court should apply its discretionary authority under CRE 403. *Id.* at 79.

The court has considered two distinct questions. The first is the reliability of the 3-Tesla MRI and associated software ("the technology") in producing its results - evidence of axonal shearing, damaged or missing connective fibers, abnormal blood flow patterns and a smaller than expected hippocampus. The second is the appropriateness of using those results diagnostically.

The court finds the technology to be sufficiently reliable and scientifically accepted so as to be of benefit to the jury. Therefore the motion in limine will be denied.

3-Tesla MRI machines are powerful and expensive. The DTI and fMRI software is also expensive. This technology is not in general use, is seldom used by clinicians and is very rarely considered (because it is so rarely available) in forming a diagnosis. This court is convinced that it produces predictable, reproducible results and accurately images the portions of the brain to which it is applied. For these purposes, it is sufficiently accepted in the scientific and medical communities.¹ It has been the subject of a substantial number of published studies and articles, including peer reviewed articles.²

¹ Many of the Defendants' own expert witnesses have used many of these techniques. See Response.

² There have been at least 2504 articles on hippocampal atrophy with at least 135 involving brain injury and

7. The weight to be given to stated scientific theories, and the resolution of legitimate but competing scientific views, are matters appropriately entrusted to the trier of fact.

It is thereby **ORDERED AND ADJUDGED** as follows:

8. Defendant's *Frye* challenge to the admissibility of the MRI with Diffusion Tensor Imaging is hereby **DENIED**;

DONE AND ORDERED in Chambers, at Tampa, Hillsborough County, Florida, this 27th day of September, 2010.


HONORABLE JAMES M. BARTON, II
CIRCUIT COURT JUDGE

Conformed Copies To:
J. Daniel Clark, Esq.
Teresa Jones, Esq.
Jason Lamoureux, Esq.

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**IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEW MEXICO**

**BLAYNE L. BOOTH, LORI K. BOOTH,
ALEXANDRA R. BOOTH, and
JACOB A. BOOTH,**

Plaintiffs,

v.

Civ. No. 06-1219 JP/KBM

**KIT, INC., a New Mexico corporation,
SURENDRA B. SHARMA,
TNJ CONSTRUCTION, a general
partnership of Tusharkumar A. Patel and
Jayesh A. Patel, AQUATIC POOLS, INC., a
New Mexico corporation, GRAHAM
MECHANICAL, a general partnership of
Shannon Graham and Cheyene Graham,
MIDSOUTH CONSTR., INC., a New Mexico
corporation, A&K MECHANICAL
CONTRACTORS, LLC, a New Mexico
Limited Liability Company,**

Defendants.

**MEMORANDUM OPINION AND ORDER DENYING JOINT MOTION TO STRIKE,
LIMIT OR EXCLUDE TESTIMONY OF DR. WILLIAM W. ORRISON, JR., MD**

On March 9, 2009, Defendants TNJ Construction and Management ("TNJ"), KIT, Inc. ("KIT") and Surendra Sharma ("Sharma") (together, "Defendants") filed their Joint Motion *In Limine* To Exclude The Opinion Testimony Of Plaintiffs' Expert William W. Orrison, Jr., M.D. (Doc. No. 358) (the "Motion") and Memorandum In Support of the Motion (Doc. No. 359). On March 19, 2009, Plaintiffs filed their Response to the Motion ("Response") (Doc. No. 385). Neither side requests a hearing on the Motion; Defendants did not ask for a hearing in the Motion, itself, or in the supporting Memorandum, and Plaintiffs did not request a hearing in their

Response.¹ Having reviewed the Motion, the arguments and the law, the Court has determined that a hearing is not necessary and will deny the Motion.²

Background

This lawsuit stems from an incident in July 2005 in which Plaintiffs, Blayne and Lori Booth, their five year old daughter Alexandra and their 18 month old son Jacob were exposed to carbon monoxide gas while guests at the AmerHost Inn & Suites ("Motel") in Ruidoso Downs, New Mexico. Plaintiffs allege that the carbon monoxide gas leaked from a poorly constructed or repaired exhaust venting system related to the Motel's pool heating equipment. Defendant KIT owns the Motel, and Defendant Sharma is the president of KIT. Defendant TNJ was the general contractor for the construction of the Motel. In February 2008, Plaintiffs designated as an expert witness Dr. William W. Orrison, Jr., M.D., a board certified neuroradiologist who practices at the Nevada Imaging Center. Dr. Orrison will provide expert opinion testimony on findings he made after performing Magnetic Resonance Imaging (MRI) studies on Lori, Alexandra and

¹ If the Court misunderstood, and the parties do want a *Daubert* hearing, they may contact the office of District Judge James O. Browning, the judge presiding at the trial, to schedule a *Daubert* hearing on the Motion as requested by Judge Browning in his Minute Order entered on March 23, 2009 (Doc. No. 388).

² In their Response, Plaintiffs ask that the Court award them costs and attorneys' fees incurred in connection with responding to the Motion as a sanction arguing that the Motion is frivolous and that Defendants misrepresent certain facts such as the results of Dr. Orrison's MRI study on a party to another lawsuit filed in connection with the same carbon monoxide incident. (Resp. at 12.) Plaintiffs do not cite the rule or statute upon which their request for sanctions is based. The Court assumes that the request is based on an alleged violation of Fed. R. Civ. P. 11. Rule 11(c)(2) states that a motion for sanctions "must be made separately from any other motion and must describe the specific conduct that allegedly violates Rule 11(b)." Also, a motion for sanctions must be served as provided in Rule 5, and "it must not be filed or be presented to the court if the challenged paper, claim, defense, contention, or denial is withdrawn or appropriately corrected within 21 days after service or within another time the court sets." Fed. R. Civ. P. 11(c)(2). The record contains no suggestions that any of these conditions have been met, and the Court, therefore, declines to entertain Plaintiffs' request for sanctions.

Jacob Booth. In Dr. Orrison's opinion, Lori, Alexandra and Jacob sustained brain injuries caused by the exposure to carbon monoxide.

On June 27, 2006, Dr. Orrison performed 3.0T MRI studies on Lori and Alexandra Booth. On July 12, 2006, Dr. Orrison performed a 3.0T MRI study on Jacob Booth. Dr. Orrison has reviewed approximately 100,000 MRI studies in his career, out of which 150-200 involved persons exposed to carbon monoxide. (Mot. Ex. B, Orrison Dep. 27:17-20, 39:9-10.)

In the Motion, Defendants argue that Dr. Orrison's testimony is unreliable, has not been subject to peer review, could be erroneous and should not be permitted under the guidelines of Fed. R. Evid. 702, *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993) and *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999).

Rule 702 and Daubert Analysis

The admission of expert testimony is governed by Federal Rule of Evidence 702. Rule 702 provides:

[i]f scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise, if (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods, and (3) the witness has applied the principles and methods reliably to the facts of the case.

Fed. R. Evid. 702. Under Rule 702 and *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 592 (1993) the Court performs an important "gatekeeping role in assessing scientific evidence." *Hollander v. Sandoz Pharmaceuticals Corp.*, 289 F.3d 1193, 1203-04 (10th Cir. 2002) (citations omitted) (upholding determination that plaintiffs' expert testimony was not sufficiently reliable regarding role of drug Parlodel in causing intracerebral hemorrhage).

In determining whether to admit expert opinion evidence, the Court performs a two-step

analysis. *Ralston v. Smith & Nephew Richards, Inc.*, 275 F.3d 965, 969 (10th Cir. 2001). First, the Court has to determine whether the expert is qualified by “knowledge, skill, experience, training, or education” to render an opinion. Fed. R. Evid. 702. Second, the Court determines whether the proffered evidence is both “reliable” and “relevant.” *Hollander*, 289 F.3d at 1204 (citing *Daubert*, 509 U.S. at 589). Reliability is determined by assessing “whether the reasoning or methodology underlying the testimony is scientifically valid.” *Id.* (citing *Daubert*, 509 U.S. at 592-93) (emphasis added). Relevance depends upon “whether [that] reasoning or methodology properly can be applied to the facts in issue.” *Id.* (citing *Daubert*, 509 U.S. at 593). The Court expects the jury will be instructed that it may give as much or as little weight to expert opinions as the jurors think those opinions deserve.

1. Dr. Orrison’s Qualifications

Defendants do not directly attack Dr. Orrison’s qualifications, but Defendants assert that Dr. Orrison does not have sufficient experience evaluating MRI scans of patients exposed to carbon monoxide to render opinions in this case. Dr. Orrison testified that out of 100,000 patients he has seen over the course of his 27-year career, 150 to 200 of them were carbon monoxide exposed patients. (Mot. Ex. B, Orrison Dep. 26:20-27:12.) Defendants point to Dr. Orrison’s admission that he uses a check list when reviewing MRIs of persons with carbon monoxide exposure, and his admission that he, like all other radiologists, has made mistakes and has changed his opinion in the past after another neuroradiologist gave a conflicting opinion. Defendants have failed to convince the Court that Dr. Orrison is unqualified to give an opinion about evaluations and interpretations of MRIs performed on persons who experienced exposure to carbon monoxide. Dr. Orrison is a neuroradiologist with experience examining the MRI’s of carbon monoxide-exposed patients and admitted to using a checklist because this type of

evaluation is very complex and the list is extensive. Dr. Orrison reviewed Lori's, Alexandra's and Jacob's medical histories, performed a PET scan and an MRI scan on Lori and Alexandra, performed an MRI scan and a Diffusion Tensor Imaging (DTI) study on Jacob, and cited several sources of medical literature in support of his opinions.

2. Dr. Orrison's Reading Not Tested

Defendants argue that despite Dr. Orrison's admissions that readings of MRI scans are subjective, that no two human brains are identical, and that there is a range of "normal" in terms of brain physiology, Dr. Orrison did not attempt to confirm the accuracy of his conclusions either by using a computer program available to verify his readings or by comparing these scans to either healthy patients or patients that were exposed to carbon monoxide. Any weakness in the readings due to lack of confirmation goes to the weight of Dr. Orrison's opinion not its admissibility. Defendants have failed to show that Dr. Orrison's methodology is so suspect as to be wholly unreliable. *See Goebel v. Denver and Rio Grande Western R. Co.*, 346 F.3d 987, 991 (10th Cir. 2003) (focusing on an expert's methodology rather than the conclusions it generates).

3. Dr. Orrison's Lack of Peer Review

Defendants argue that Dr. Orrison's opinion that all three Plaintiffs suffered brain damage from carbon monoxide exposure was not confirmed by submission to a blind study or by submission for a "second opinion." Defendants also argue that Dr. Orrison has no peer reviewed publications on the subject of carbon monoxide induced brain damage other than one article that he co-authored that appeared in the *Acta Neurologica Scandinavica*. Again, these perceived weaknesses in Dr. Orrison's opinions can be brought out on cross examination, but are insufficient to exclude the opinions. *Daubert*, 509 U.S. at 596 (stating that vigorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of

proof are the traditional and appropriate means of attacking admissible opinion evidence).

4. Dr. Orrison's Rate of Error

Defendants argue that Dr. Orrison admits that he has made mistakes in reading MRI scans in the past and admits that two neuroradiologists may read a scan and interpret the scans differently. Defendants also assert that Dr. Orrison's opinions are unreliable because they are inconsistent. Defendants use as an example Dr. Orrison's findings that both Lori and Alexandra Booth suffered "cerebral atrophy." Dr. Orrison's description of their cerebral atrophy is virtually identical in both reports, but Dr. Orrison concludes that Lori suffered "mild" cerebral atrophy while Alexandra Booth suffered "diffuse" cerebral atrophy. Defendants argue that this unexplained difference in conclusions will confuse the jury and thus justifies the exclusion of Dr. Orrison's opinions. Defendants may proffer a qualified expert to point out this alleged inconsistency or develop the inconsistency through cross examination, but the Court will not exclude the opinion on that basis. *See Goebel*, 346 F.3d at 991 (stating that no court is in a position to declare or even to know with any degree of certainty whether otherwise admissible expert testimony is, in fact, correct).

5. Dr. Orrison's Methodology Is Not Generally Accepted

Defendants finally argue that Dr. Orrison's conclusions that all three Plaintiffs have abnormal MRI scans should be excluded because it is statistically suspect. Defendants cite a study of 73 carbon monoxide exposed patients in which only 12% were found to have abnormal MRI scans. Plaintiffs respond that this incident involved a large amount of carbon monoxide exposure, and thus it is not surprising that three of the Plaintiffs suffered brain damage. Defendants further argue that in the companion case filed in state court in New Mexico, Dr. Orrison determined that all 13 of those plaintiffs suffered brain damage from carbon monoxide

exposure. Plaintiffs argue that Defendants have misrepresented the facts of that lawsuit. According to Plaintiffs, Dr. Orrison's opinions based on MRI studies, contain different findings for each plaintiff in that lawsuit, and that Dr. Orrison determined that one plaintiff did not have an identifiable brain abnormality. Again, any perceived weakness in Dr. Orrison's conclusions may be attacked on cross examination or by contradictory opinions by one or more other qualified experts.

THEREFORE IT IS ORDERED that the Motion (Doc. No. 358) is denied (subject to the parties' ability to request a *Daubert* hearing as mentioned in footnote 1).


UNITED STATES SENIOR DISTRICT JUDGE

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2 of 3 DOCUMENTS

MELISSA LEBOEUF VERSUS B & K CONTRACTORS, INC., GEMINI INSURANCE COMPANY AND DELGADO COMMUNITY COLLEGE CONSOLIDATED WITH: DAVID K. BROOME VERSUS EDWARD PORTE, B & K CONTRACTORS, INC. AND GEMINI INSURANCE COMPANY

NO. 2008-CA-1351 CONSOLIDATED WITH: NO. 2008-CA-1352

COURT OF APPEAL OF LOUISIANA, FOURTH CIRCUIT

2008 1351 (La.App. 4 Cir. 05/27/09); 10 So. 3d 897; 2009 La. App. Unpub. LEXIS 324

May 27, 2009, Decided

NOTICE: NOT DESIGNATED FOR PUBLICATION.

PLEASE CONSULT THE LOUISIANA RULES OF APPELLATE PROCEDURE FOR CITATION OF UNPUBLISHED OPINIONS.

PUBLISHED IN TABLE FORMAT IN THE SOUTHERN REPORTER.

SUBSEQUENT HISTORY: Writ denied by *Leboeuf v. B & K Contrs., Inc.*, 18 So. 3d 126, 2009 La. LEXIS 2822 (La., 2009)

Decision reached on appeal by *Leboeuf v. B & K Contrs., Inc.*, 2009 La. App. Unpub. LEXIS 672 (La.App. 4 Cir., Nov. 12, 2009)

PRIOR HISTORY: [*1]

APPEAL FROM CIVIL DISTRICT COURT, ORLEANS PARISH. NOS. 2004-12740 C/W 2004-12746, DIVISION "B-15". Honorable Rosemary Ledet, Judge.

DISPOSITION: AFFIRMED.

COUNSEL: Randolph C. Slone, Slidell, LA, COUNSEL FOR PLAINTIFF/APPELLEE, DAVID BROOME.

Samuel J. Accardo, Jr., ACCARDO LAW FIRM, L.L.C., LaPlace, LA, COUNSEL FOR PLAINTIFF/APPELLEE, MELISSA LEBOEUF.

Sidney W. Degan III, Travis L. Bourgeois, Brian E. Sevin, DEGAN BLANCHARD & NASH, New Orleans, LA, COUNSEL FOR DEFENDANTS/APPELLANTS,

B & K CONTRACTORS, INC. AND GEMINI INSURANCE COMPANY.

JUDGES: Court composed of Judge Patricia Rivet Murray, Judge James F. McKay, III, Judge Edwin A. Lombard. MCKAY, J., CONCURS IN THE RESULT.

OPINION BY: Patricia Rivet Murray

OPINION

[Pg 1] This is a personal injury suit. The plaintiffs, David Broome and Melissa LeBoeuf, filed this suit seeking to recover for the personal injuries they sustained as a result of being struck by a ladder that an employee of the defendant, B & K Contractors, Inc. ("B&K"), hurled over a fence. The trial court granted partial summary judgment on the issue of the liability of the defendants, B&K and its insurer, Gemini Insurance Company ("Gemini"). Following a trial on the issue of damages, the trial court rendered judgment awarding [*2] damages of \$ 761,860.94 to Mr. Broome and \$ 133,027.74 to Ms. LeBoeuf. From that judgment, B&K and Gemini appeal. For the reasons that follow, we affirm.

FACTUAL AND PROCEDURAL BACKGROUND

On September 4, 2003, Mr. Broome and Ms. LeBoeuf, who were classmates, were working together on a project in an herb garden at Delgado Community College, City Park Campus. Without warning, Edward Porte, an employee of B&K, tossed a large aluminum ladder over the brick fence located adjacent to the herb

garden in which they were working. The ladder struck Mr. Broome on the head and Ms. LeBoeuf in the neck area. As a result of the impact, both of them fell to the ground and sustained injuries. Mr. Broome had a cut on the head and was [Pg 2] bleeding. Ms. LeBoeuf instructed him not to move and went to get help. When she returned in about two or three minutes, Mr. Broome had not moved. Ms. LeBoeuf, a teacher, and another student assisted Mr. Broome from the ground into a classroom. After reporting the accident to the campus police, Ms. LeBoeuf drove Mr. Broome to the Ochsner emergency room. Both Mr. Broome and Ms. Leboeuf were treated for their injuries and released that day.

On September 2, 2004, Ms. LeBoeuf [*3] filed suit against B&K, Gemini, and Delgado Community College ("Delgado"). On that same date, Mr. Broome filed suit against Mr. Porte, B&K, and Gemini. On May 9, 2007, the trial court consolidated the two suits. Following a hearing, the trial court in January 2008 rendered a partial summary judgment in favor of Mr. Broome and Ms. LeBoeuf as to liability.

In June 2008, a two-day bench trial was held on the issue of damages--the nature and degree of the injuries sustained by Mr. Broome and Ms. LeBoeuf. On the morning of trial, Ms. LeBoeuf dismissed her claims against Delgado.

In July 2008, the trial court rendered judgment in favor of Mr. Broome and Ms. LeBoeuf and against B&K and Gemini.¹ As to Mr. Broome, the trial court awarded total damages of \$ 761,860.94, which it itemized as follows: \$ 400,000 general damages, \$ 100,000 loss of enjoyment of life, \$ 20,160.94 past medical expenses, and \$ 241,700 future medical expenses. As to Ms. Leboeuf, the trial court awarded total damages of \$ 133,027.74, which it itemized as \$ 125,000 general damages and \$ 8,027.74 past medical expenses. The trial court denied the motion for new trial filed by B&K and Gemini. From this judgment, B&K and [Pg [*4] 3] Gemini appeal contending that the damage awards are excessive. Mr. Broome answered the appeal contending that the damage awards were inadequate and that the trial court erred in failing to award him future loss wages and diminution of wage-earning capacity.

¹ Although Mr. Broome's petition names Mr. Porte (B&K's employee who threw the ladder) as a defendant, the trial court's judgment does not impose liability on Mr. Porte. Mr. Porte is not a party to this appeal.

DISCUSSION

A plaintiff in a personal injury case has the burden of proving by a preponderance of the evidence that the

accident more probably than not caused the claimed disabling condition. *Jones v. Peyton Place, Inc.*, 95-0574, pp. 12-13 (La. App. 4 Cir. 5/22/96), 675 So.2d 754, 763. The plaintiff satisfies this burden if expert medical and lay testimony is presented establishing that it was more probable than not that the claimed condition was caused by the accident. *Id.* Whether the accident caused the plaintiff's injuries is a factual question, which should not be reversed on appeal absent manifest error. See *American Motorist Ins. Co. v. American Rent-All, Inc.*, 579 So.2d 429, 433 (La. 1991). Credibility determinations, [*5] including evaluating expert witness testimony, are for the trier of fact. *Sportsman Store of Lake Charles, Inc. v. Sonitrol Security Systems of Calcasieu, Inc.*, 99-0201, p. 6 (La. 10/19/99), 748 So.2d 417, 421. Such credibility determinations are factual findings governed by the well-settled manifest error standard of review. Under the manifest error rule, a "reviewing court must give great weight to factual conclusions of the trier of fact; where there is conflict in the testimony, reasonable evaluations of credibility and reasonable inferences of fact should not be disturbed upon review, even though the appellate court may feel that its own evaluations and inferences are as reasonable." *Canter v. Koehring Co.*, 283 So.2d 716, 724 (La. 1973).

[Pg 4] When, as here, the trier of fact (in this case, the judge) has made a general damage award and the parties are contending that award is excessive (B&K and Gemini) or inadequate (Mr. Broome), the "much discretion" standard applies. *Youn v. Maritime Overseas Corp.*, 623 So.2d 1257 (La. 1993). The rationale behind the application of the much discretion standard is that "awards of general damages, at least as to the amount awarded for injuries [*6] proved to have been caused by the tort, cannot be calculated with mathematical certainty." *Gulilory v. Insurance Co. of North America*, 96-1084, p. 1 (La. 4/8/97), 692 So.2d 1029, 1036 (Lemmon, J., concurring)(citing *Viator v. Gilbert*, 253 La. 81,216 So.2d 821 (1968)). This rationale is codified in both *La. C.C. art. 1999*, which provides that "[w]hen damages are insusceptible of precise measurement, much discretion shall be left to the court for the reasonable assessment of these damages," and *La.C.C. art. 2324.1*, which provides that "[i]n the assessment of damages in cases of offenses, quasi offenses, and quasi contracts, much discretion must be left to the judge or jury."

A reviewing court's initial inquiry is whether the particular effects of the particular injuries on the particular plaintiff are such that there has been an abuse of the "much discretion" vested in the trier of fact. *Youn*, 623 So.2d at 1260; *Cone v. National Emergency Services, Inc.*, 99-0934, p. 8 (La. 10/29/99), 747 So.2d 1085, 1089 (citing *Youn, supra*, and noting that the abuse of discretion standard is difficult to express and necessarily is

"non-specific"). Because "[r]easonable persons frequently disagree about [*7] the measure of general damages in a particular case," a reviewing court may disturb a general damage award on appeal only when "the award is, in either direction, beyond that which a reasonable trier of fact could assess for the effects of the particular injury to the particular plaintiff under the [Pg 5] particular circumstances." *Youn*, 623 So.2d at 1261. In sum, the jurisprudential theme that has emerged is that "the discretion vested in the trier of fact is 'great,' and even vast, so that an appellate court should rarely disturb an award of general damages." *Id.*

Although the parties invite us to resort to a consideration of awards for generically similar injuries and contend that the awards in this case are disproportionate to such prior awards, the jurisprudence is settled that a "resort to prior awards is only appropriate after an appellate court has concluded that an 'abuse of discretion' has occurred." *Cone, supra*; *Reck v. Stevens*, 373 So.2d 498, 501 (La. 1979). Because we find no abuse of discretion, a comparison of prior awards is inappropriate. Instead, we focus our analysis of the effects of the particular injuries on the particular plaintiffs under the particular circumstances [*8] of this case. We divide our analysis into the following three sections: (1) Defendants' Appeal: Mr. Broome's Damages; (2) Mr. Broome's Appeal: His Damages; and (3) Defendants' Appeal: Ms. LeBoeuf's Damages.

(1) Defendants' Appeal: Mr. Broome's Damages

At trial, Mr. Broome called the following seven witnesses: (i) Dr. Morteza Shamsnia, a neurologist; (ii) Dr. Gerard Gianoli, a neurologist; (iii) Dr. Susan Andrews, a neuropsychologist; (iv) Shael Wolfson, an economist; (v) Ms. LeBoeuf; (vi) Jessica Guntner, Mr. Broome's girlfriend; and (vii) Mr. Broome. B&K and Gemini called the following two witnesses: Dr. Donald Adams, the independent medical examiner ("IME") and a neurologist; and Dr. Kevin Bianchini, a clinical psychologist and neuropsychologist. The testimony of these witnesses is summarized below.

Dr. Morteza Shamsnia

[Pg 6] On September 9, 2003, Dr. Shamsnia, who was qualified by the trial court as an expert in neurology, first saw Mr. Broome. Mr. Broome provided a history of a head trauma five days earlier as a result of being struck on the head by a ladder while at a local college. Mr. Broome reported that he lost consciousness and fell to the ground. Mr. Broome further reported [*9] that he did not recall what happened to him until he was in the car on his way to the hospital. Mr. Broome complained of headaches in the temporal area, which occurred every day since the accident with some nausea. He also com-

plained of difficulty sleeping and focusing in his classes since the accident. He reported that his school performance had dropped. Mr. Broome denied any other significant associated symptoms. Dr. Shamsnia found that Mr. Broome had a head trauma in that he had a cut of more than an inch, which required three or four stitches.

Dr. Shamsnia's initial impressions were post-concussion syndrome with post-traumatic headaches and sleep dysfunction or central sleep disorder. Dr. Shamsnia restricted Mr. Broome by instructing him to stay off of school for two weeks. (Dr. Shamsnia acknowledged that this was the only restriction that his records reflected he ever placed on Mr. Broome.) Based on Mr. Broome's complaints, Dr. Shamsnia ordered diagnostic testing: a MRI of the brain, an EEG or brain wave, and sleep studies. He also instructed Mr. Broome to return for a follow-up evaluation in two weeks.

On September 15, 2003, the MRI was done; it was normal. On October 9, 2003, the [*10] EEG was done; it was normal. On October 18, 2003, the sleep study (polysomnogram) was done; as noted below, it was abnormal.

On November 17, 2003, Dr. Shamsnia saw Mr. Broome for a second time. On this visit, Dr. Shamsnia reviewed the abnormal results of the sleep study, which [Pg 7] reflected that Mr. Broome had periodic limb movements and early rapid eye movement (REM), which indicated that his sleep structures were impaired. Dr. Shamsnia testified that these sleep abnormalities probably were related to Mr. Broome being struck in the head with the ladder. He also noted that Mr. Broome continued to have difficulty sleeping and that his other symptoms were essentially unchanged. Dr. Shamsnia prescribed Klonopin, a sleep medication, and instructed Mr. Broome to return for a follow-up evaluation in eight weeks.

On March 22, 2004, Dr. Shamsnia saw Mr. Broome a third time. Mr. Broome reported that his headaches had decreased in frequency, but he complained of dizziness and vertigo with head movements and intermittent ringing in his ears. Dr. Shamsnia testified that it was not unusual for Mr. Broome to complain for the first time six months post-head trauma of vertigo. He noted that Mr. Broome [*11] had signs of ear problems on the initial visit at which he complained of dizziness and that subsequently Mr. Broome had dizziness plus other symptoms--vertigo or ringing in his ears. Dr. Shamsnia testified that "whatever happened in his ear was getting worse." For this reason, Dr. Shamsnia referred Mr. Broome to Dr. Gianoli for a neuropathology evaluation after his head trauma. Dr. Shamsnia prescribed Tylenol No. 3 for the headaches and instructed Mr. Broome to

see him for a follow up evaluation after he had completed his consultation with Dr. Gianoli.

On September 8, 2004, six months later, Dr. Shamsnia saw Mr. Broome for a fourth time. On this visit, Mr. Broome's symptoms had improved, and Dr. Shamsnia characterized him as "essentially neurologically asymptomatic." By "neurologically asymptomatic," Dr. Shamsnia explained he meant that Mr. Broome did not have "much symptoms." He noted, however, that symptoms fluctuate. Dr. Shamsnia also noted that Mr. Broome had seen Dr. Gianoli for his [Pg 8] ringing in the ear.² On that visit, Dr. Shamsnia discharged Mr. Broome from his clinic and instructed him to return as needed.

2 As discussed elsewhere, Dr. Gianoli saw Mr. Broome on two occasions: [*12] June 10, 2004, and February 27, 2008.

Two months later, on November 24, 2004, Mr. Broome returned to Dr. Shamsnia. On this fifth visit, Mr. Broome complained of increased headaches, which were occurring about three times per week, and ringing in his ears. After reviewing Mr. Broome's diagnostic testing, Dr. Shamsnia referred Mr. Broome back to his regular work and instructed him to return for a follow up evaluation in eight weeks.

On July 26, 2006, almost two years later, Dr. Shamsnia saw Mr. Broome for a sixth time.³ On this visit, Mr. Broome complained of increased headaches, which were occurring about two days per week. Mr. Broome's other symptoms were unchanged. Mr. Broome reported that he had been taking Ibuprofen and Tylenol #3. Dr. Shamsnia prescribed Topamax (a seizure medication that the FDA has approved for use in treating migraine headaches) and provided Mr. Broome with samples of other medicines (Imitrex and Zomig). Mr. Broome was instructed to return for a follow up evaluation in eight weeks.

3 As noted elsewhere in this opinion, this two year gap in treatment can be attributed, at least in part, to Hurricane Katrina, which struck the New Orleans area on August 29, 2005.

On [*13] June 6, 2007, Dr. Shamsnia, without actually seeing Mr. Broome, prepared a narrative report in which he stated that "[i]n the last few years, the patient has been asymptomatic with medications." Continuing, he stated:

The patient's diagnosis is first concussion syndrome with posttraumatic headaches, as well as abnormal sleep including periodic limb movement disorders and

abnormal sleep deficiencies since the head trauma.

[Pg 9] Based on the patient's history of the head trauma, his symptoms and his findings are causally related to his accident of 09/04/2003. I am not aware of the other workup that this patient had. He will be required to be under the care of a physician for treatment of his symptoms especially in regard to his headaches, and if he continues to have intermittent ringing in his ears and vertigo, he will need to have a neurotology [(sic)] evaluation. He has not reached maximum medical improvement. His condition has become chronic, and will require treatment on a regular basis. He will need approximately an every two or three month follow-up visit with medication treatment including prevention, as well as pain medications for treatment of his headaches. It is difficult [*14] to assess the future medical bills, but his treatment for chronic headaches and the medications that he needs will be approximately \$ 2,000.00 to \$ 3,000.00 a year, and he may require further diagnostic workup including a new high-resolution MRI of the brain with 3.0 tesla resolution for a better evaluation of his head injury.

Dr. Shamsnia explained that he characterized Mr. Broome's condition as chronic because "on and off when [he] had seen him, [Mr. Broome] was symptomatic. That is what chronic condition means."

On July 16, 2007, Dr. Shamsnia saw Mr. Broome for the seventh time. On this visit, Mr. Broome reported that the migraine headaches were well-controlled with the current medical therapy, including Topamax. He further reported that he was having episodes of headaches about three times per week; however, the episodes were not severe and were of a shorter duration. He still further reported that he was continuing to have episodes of vertigo with intermittent buzzing sensation in the left ear. The vertigo episodes were about sixty seconds each and were occurring about three times per week. At this time, Dr. Shamsnia continued the current medication therapy. Dr. Shamsnia also scheduled [*15] a repeat MRI of the brain and instructed Mr. Broome to follow up in three months or when the studies had been completed.

[Pg 10] On August 16, 2007, Mr. Broome had a high resolution 3.0 Telsa MRI of the brain at the Nevada Imaging Centers in Las Vegas, Nevada.⁴ According to the

report by Dr. William Orrison of Nevada Imaging Centers, Mr. Broome's MRI reflected three findings consistent with post-traumatic changes: (i) moderate bilateral hippocampal atrophy, (ii) dilated perivascular (Virchow-Robin) spaces, and (iii) decrease in corpus callosum fiber tracks. Dr. Shamsnia characterized this MRI as objective evidence of traumatic brain injury. Dr. Shamsnia pointed out that the hippocampus is located in the temporal lobe of the brain and is responsible for regulating emotional response. He testified that atrophy of the hippocampus will affect Mr. Broome's ability to retain and process information as he ages. He further testified that due to the head trauma Mr. Broome will be more susceptible to memory and emotional problems as he ages. His ability to deal with the daily stress of life and to adapt into his environment will diminish faster than others his same age that do not have this [*16] problem.

4 Dr. Shamsnia explained that the reason he referred Mr. Broome to the Nevada Imaging Centers for the MRI was because "Nevada is in the forefront of the head injuries because of the boxing . . . and Nevada apparently is one of the centers that has been a pioneer in this area." Dr. Shamsnia further noted that he had been using Nevada Imaging Centers for years because he gets a comprehensive, detailed report from them.

On December 3, 2007, Dr. Shamsnia saw Mr. Broome for the eighth time. On this visit, Mr. Broome complained of migraine headaches, tinnitus, and vertigo. His migraine headaches were occurring at least three times per week. Dr. Shamsnia noted that Mr. Broome indicated that "things are improving." He further noted that the neuropsychological tests had been completed by Dr. Andrews in October 2007. The neuropsychologist's findings, which are discussed elsewhere, indicated that Mr. Broome should be encouraged to continue to be mentally active and should be able to continue in his present occupation. On this visit, Dr. [Pg 11] Shamsnia continued Mr. Broome on Topamax and added Axert as a "rescue medication." Mr. Broome was instructed to follow up in three months.

On March [*17] 12, 2008, Dr. Shamsnia saw Mr. Broome for the last time before trial. At this time, Mr. Broome reported that his symptoms were improving and that his migraine headaches were well-controlled with Topamax. Mr. Broome further reported that "he has not had any migraines as long as he takes his medications, although if he happens to forget, the Axert medication is helping as a rescue medication." Dr. Shamsnia refilled Mr. Broome's medication and instructed him to follow up in three months.

Although Dr. Shamsnia hesitated to testify that Mr. Broome would be required to take medication for life, he testified that Mr. Broome would be required to take it for "an indefinite period of time." Dr. Shamsnia testified that the particular medication he was prescribing for Mr. Broome's headaches was expensive: the Topamax cost between \$ 297.99 and \$ 345.95 for a month supply, and the Axert cost between \$ 133.96 to \$ 163.95 for a supply of six pills (\$ 22.32 to \$ 27.32 per pill).

Dr. Shamsnia testified that the symptoms Mr. Broome periodically reported to him were consistent with the diagnosis of traumatic brain injury. According to Dr. Shamsnia, the most probable cause of Mr. Broome's traumatic brain [*18] injury was being struck in the head with the ladder in 2003. Characterizing Mr. Broome's conditions as permanent, Dr. Shamsnia testified:

I think it's permanent because he had the MRI done four years after his brain injury. We give now a year or two for him to recover. And people do recover. Clinically, he has recovered. He has improved. Treated with medications, he improved. But, these new technologies allow us to look at the brain that we couldn't do it before and say what it is now. . . . So he has brain damage because of this. And I think he has reached what we call MMI, maximum medical improvement.

[Pg 12] Dr. Shamsnia further added that Mr. Broome's symptoms may "wax and wane, but they just don't go away."

Dr. Shamsnia testified that he saw no evidence of any exaggerating or malingering on Mr. Broome's part. He further testified that he never had the feeling that Mr. Broome was lying or exaggerating or having symptoms that were inconsistent with what happened to him. Finally, he testified that Mr. Broome's symptoms and the fact he had a brain injury were verified by, among other things, the 2007 MRI and the neuropsychological testing.

Dr. Gerald Gianoli

Dr. Gianoli was qualified by [*19] the trial court as an expert in neurotology, a subspecialty of the ear, nose, and throat that deals specifically with the ear and the inner ear and skull-based disorders. On June 10, 2004, Dr. Gianoli first saw Mr. Broome, who was referred to him by Dr. Shamsnia. Dr. Gianoli testified that Mr. Broome related to him that he had suffered a head injury after a ladder fell on his head resulting in a loss of consciousness for a couple of minutes and a laceration of his

scalp. Mr. Broome's complaints were dizziness, tinnitus, and headaches. Mr. Broome indicated that the dizziness was much more severe during the first two months after the accident and had improved considerably since then, but he still had symptoms of dizziness.⁵ At that time, Mr. Broome's dizzy spells were lasting about ten seconds per episode and were occurring about once per week. These episodes were sometimes associated with nausea and tylosis, which is that sort of excess salivation one gets before throwing up.

5 Dr. Gianoli explained that dizziness is a nonspecific term that can mean many different things ranging from lightheadedness to headaches. In contrast, he explained that vertigo is a medical term with a specific [*20] meaning: "it's hallucination of motion. More specifically, it usually means a rotary type motion, feel like things are spinning or moving or you're moving or spinning."

[Pg 13] Mr. Broome related that the activities that exacerbated his symptoms were fast head movements, coughing, straining, using inversion boots, and running. He also related that especially during the first two months after the accident almost any head movement would bring on the symptoms. Mr. Broome reported some fluctuation of hearing and a fullness or pressure feeling in his ears. Dr. Gianoli testified that he did not make any specific recommendations to Mr. Broome with regard to physical activities; however, he generally tells patients who present with vertigo or dizziness to use extreme caution when engaging in certain activities. He also testified that he probably told Mr. Broome to stop using inversion boots.

Based on a series of diagnostic tests that he conducted, Dr. Gianoli's initial impressions were as follows: "[Mr. Broome] had a mild vestibular disturbance that was perhaps on the left side with associated benign positional vertigo that is for the most part compensated and resolved. He also has a suggestion [*21] of cochlear dysfunction on the left side as noted by the Otoacoustic emissions. This could objectively corroborate the symptom of tinnitus." Dr. Gianoli noted that the treatment for benign positional vertigo is generally canalith repositioning--a non-invasive office procedure that is highly effective (90-95% of patients). For patients who do not respond to this procedure, a surgical procedure was noted to be an option, but required four to six weeks of postoperative rehabilitation. As to the tinnitus, Dr. Gianoli noted that "the tinnitus is likely a permanent sequelae of this injury and treatment for this is often unsuccessful." He noted that treatment options that were available for tinnitus include pharmacologic therapy, tinnitus retraining therapy, and masking devices.

[Pg 14] On March 6, 2008, Dr. Gianoli saw Mr. Broome for a repeat evaluation.⁶ At that time, Mr. Broome related that he still had tinnitus and dizziness, but that it "waxes and wanes, at times it is more severe and other times less noticeable." He described the tinnitus as intermittent, high-pitched, and non-pulsatile, but varying in intensity. As to the dizziness, he described a rotary type sensation that occurs [*22] for seconds per episode. He stated that the episodes were occurring multiple times per day. These episodes were associated with nausea and exacerbated by lying down and movement, especially fast movement. He also reported a constant unsteadiness. He indicated that he was having one to two migraines per month and that he was taking Topamax which seemed to help the headaches.

6 Although scheduled for a follow-up visit with Dr. Gianoli in September 2005, Mr. Broome was not available for this appointment because he had moved out of state in late August 2005 due to Hurricane Katrina.

Summarizing his findings from the second evaluation, Dr. Gianoli stated:

Mr. Broome has findings of an inner ear abnormality consistent with left labyrinthine fistula and benign paroxysmal positional vertigo. This is more probable than not caused by the accident in which the ladder struck his head. The patient's subjective symptoms correlate very well with the objective findings on testing and the patient showed no evidence of symptom magnification or non-physiologic responses on testing.

Dr. Gianoli noted that treatment options include medical therapy and surgery.⁷ However, he acknowledged that he had neither [*23] provided any treatment nor recommended surgery for Mr. Broome.

7 At this time, Dr. Gianoli recommended a CT scan of the temporal bones to rule out superior semicircular canal dehiscence. That CT scan was normal.

Dr. Gianoli testified that Mr. Broome passed all the malingering tests and opined that the blow to Mr. Broome's head was the cause of the ear-related symptoms he was experiencing. Insofar as the several other head injuries in the [Pg 15] past noted in Dr. Gianoli's report,⁸ Dr. Gianoli testified that those incidents were in the far distant past and that Mr. Broome was completely asymptomatic from that point until the ladder incident.

Dr. Gianoli testified that the fact Mr. Broome had no problems until years later when he was hit by the ladder made it unlikely that any of the prior head traumas had any relevance to his current condition.

8 These incidents involved being struck by a bat at age eight, by a bottle at age twenty, by a brick, and running into a car. None of these prior incidents involved loss of consciousness. Dr. Bianchini also noted in his report that Mr. Broome gave a history of head injury as a child with no loss of consciousness: "He was hit in the head a few times [*24] while playing with his brothers. One time he was on a bicycle and his brother pushed him and his head hit the back of a vehicle; he got a knot on his head."

Dr. Susan Andrews

Dr. Andrews, who the trial court qualified as an expert in clinical neuropsychology, testified that she saw Mr. Broome on referral from Dr. Shamsnia to conduct a neuropsychological evaluation. On October 16 and 18, 2007, Dr. Andrews' office performed the evaluation. Dr. Andrews noted that Mr. Broome's complaints at the time of the evaluation included migraine headaches (about twice per week), difficulty sleeping since the accident, and vertigo and tinnitus in his left ear. He also reported memory difficulties at school. He elaborated that when the accident occurred he was enrolled at Delgado taking horticulture. Since the accident, he reported that he had significant difficulty memorizing and recalling new information in the more difficult classes and that he had quit school.

Dr. Andrews testified that her neuropsychological evaluation showed evidence of a traumatic brain injury. Of the twenty-three tests she administered, Mr. Broome's test results were abnormal on thirteen. Mr. Broome scored lower than predicted [*25] on five measures: (i) general intellectual functioning, (ii) measures of attention and executive functioning, (iii) motor functions, (iv) language functions, and (v) perceptual functions. Mr. Broome had some difficulties with his [Pg 16] ability to learn new information and with his executive functioning in certain areas. He had right hand motor weakness related to his left side of his brain. He had difficulties with attention and concentration. His naming was mildly impaired on the Boston naming test.

Dr. Andrews testified that in her opinion it was more probable than not that Mr. Broome's performance on the tests was related to the 2003 head trauma he suffered as a result of being struck in the head with a ladder. She stated that she had not seen any indication that before being struck with the ladder Mr. Broome had any brain injury. She indicated that the test results reflected residual diffi-

culties related to the 2003 head trauma. Dr. Andrews commented that "[b]asically, they were mild findings that demonstrated four years later that the left side of the brain primarily had been damaged."

As to the Minnesota Multiphasic Personality Inventory ("MMPI") (a social-emotional functioning [*26] test), Dr. Andrews testified that it reflected Mr. Broome had a large number of physical complaints, which included headaches that had continued for a number of years and inner ear dysfunction. He was not particularly depressed. Dr. Andrews testified that her clinical impression was that Mr. Broome had a cognitive disorder, not otherwise specified, which is a general diagnosis that is used for cognitive deficits that are secondary to some kind of brain dysfunction, but not necessarily related to drugs or related to other physical kinds of problems. Dr. Andrews found no basis to support Dr. Bianchini's diagnosis of an adjustment disorder. She testified that Mr. Broome had made a good adjustment to his injuries [Pg 17] and to the residual deficits that he had. She found it significant that he was working and going on with his life.

Dr. Andrews stated in her report that Mr. Broome "appears excessively preoccupied with bodily concerns and may be inclined to somatization, e.g., expressing physical health problems as a result of psychological difficulties." She explained that Mr. Broome had a high score on the somatization scale because he tends to focus on the large number of physical complaints [*27] that he has. Nonetheless, Dr. Andrews testified that a diagnosis of somatization was not appropriate given that Mr. Broome actually had physical injuries.

Dr. Andrews reported that Mr. Broome's test results were consistent with the results of the 2007 MRI and the location of Mr. Broome's scalp laceration. She noted that one of the results of the 2007 MRI was a decrease in corpus callosum fiber tracks connecting the two sides of the brain consistent with post-traumatic change. She explained that this referred to a decrease in fiber tracks anteriorly and posteriorly on the left in a coupe-contre-coup pattern. Dr. Andrews further explained that coupe-contre-coup is French for a strike and against the strike or a hit against the hit. It refers to the mechanism of the injury. "[T]he brain is hit on one side and it bounces against the opposite side causing, from a variety of different sources, injury on both sides of the brain." Dr. Andrews testified that her findings based on neuropsychological test results were consistent with the coupe-contre-coup type of injury that Mr. Broome sustained in that the testing revealed some deficits on both sides of the brain.

In terms of memory difficulties, [*28] Dr. Andrews testified that Mr. Broome tested in the normal range. She

noted in her report that "[c]ontrary to subjective complaints of memory difficulties, Mr. Broome's current memory abilities are [Pg 18] average and consistent with current intellectual functioning." Explaining this statement, Dr. Andrews testified that "[p]eople who have cognitive difficulties of various types, because they are not schooled in neuropsychology, often just kind of lump them together as memory complaints." Insofar as Mr. Broome's report that he was having more difficulty in school, Dr. Andrews testified that based on Mr. Broome's Delgado records it would be hard to document any decline.

On cross-examination, Dr. Andrews testified that she agreed there was no way for a "brain injury" to become neurologically asymptomatic and then symptomatic again several years later, but she added that "headaches are a different issue."

On all of the testing for exaggerating or malingering, Dr. Andrews testified that Mr. Broome scored one hundred percent. She agreed that this indicated that he was being truthful and candid in communicating his symptoms. Dr. Andrews testified that from a brain injury standpoint she would [*29] consider Mr. Broome's condition to be mild. She noted in her report that Mr. Broome had significantly improved in function since the accident, which was over four years before this evaluation. She opined that from a neuropsychological standpoint, Mr. Broome was capable of continuing in his present occupation. She further opined that Mr. Broome did not need any type of rehabilitation given that he has continued to work, which she characterized as a "very solid form of rehabilitation." Indeed, she found it to his credit that he is working. She did not recommend any restrictions on him in terms of work. Nonetheless, she testified that as Mr. Broome gets older, he will have a greater risk for developing dementia-type syndromes earlier.

Shael Wolfson

[Pg 19] Mr. Wolfson, who was qualified as an expert economist, testified that he was provided with a letter from Dr. Gianoli outlining certain future medical and prescription costs and asked to prepare present value estimates for these costs over Mr. Broome's life expectancy. Based on Mr. Broome's life expectancy of 44.4 years and a 4.5% annual increase in the cost of prescription drugs, Mr. Wolfson calculated the present value of future prescription [*30] medication costs for the two medications Mr. Broome was taking to be \$ 5,651 per year and \$ 223,736 total. ⁹ Mr. Wolfson also calculated Dr. Gianoli's follow up costs for office visits and audio testing to be \$ 225 a year and \$ 8,041 for his life expectancy in present value terms assuming a four percent

increase in the fees associated with providing these services.

9 As noted earlier, Dr. Shamsnia testified that at the time of trial Topamax cost between \$ 297.99 and \$ 345.95 for a month supply, and Axert costs between \$ 133.96 to \$ 163.95 for a supply of six Axert (\$ 22.32 to \$ 27.32 per pill).

Melissa LeBoeuf

Ms. LeBoeuf, the other plaintiff in this matter, testified that at the time of the accident she and her classmate, Mr. Broome, were bent over in the herb garden at Delgado observing a honey bee when an object hit them and knocked them to the ground. She described it as a shock. She testified that they initially did not know what the object was or where it came from. Ms. LeBoeuf described Mr. Broome immediately after the accident as lying on the ground with a large cut on his head that was bleeding; he was glassy eyed, and dazed. She testified that "[i]t was obvious -- he was not [*31] all there." He had no recollection of what had happened. On cross-examination, Ms. LeBoeuf acknowledged that she could not say for sure that Mr. Broome lost consciousness; nor, assuming he lost consciousness could she give an estimate of how long it lasted.

[Pg 20] At trial, Ms. LeBoeuf identified pictures of the large aluminum ladder that was thrown over the fence and the laceration on Mr. Broome's head. Ms. LeBoeuf testified that before the accident Mr. Broome was in good physical shape, very active, and enjoyed being outside. He liked physical activities such as skateboarding. She further testified that before the accident she never heard Mr. Broome complain of headaches or ringing in his ears. She stated that when Mr. Broome returned to school after the accident he complained about headaches, and due to the headaches he would have to get up and leave class.

Jessica Guntner

Ms. Guntner, Mr. Broome's girlfriend, testified that she lived with Mr. Broome and their two children, ages two and one. (The children bear Mr. Broome's name.) She knew Mr. Broome for about one year before the accident; they started living together shortly before the accident occurred. Ms. Guntner was working when [*32] the accident occurred, and Mr. Broome called her to inform her that he had been hurt. She first saw him when she arrived home from work that night. She described him as having a big gash on his head with stitches and a patch over it. He was not moving around much, and he was nauseous and sleepy. She testified that she was afraid to let him go to sleep that night because of his head injury. According to Ms. Guntner, Mr. Broome was

unable to return to school or to work for the next couple of weeks, and she had to drive him to his doctor's appointments.

Ms. Guntner testified that Mr. Broome has been taking Topamax on a daily basis since it was prescribed to him and that he also takes Axert, which is for bad headaches, about three times per week. She testified that she has picked up his [Pg 21] prescription medications several times, and she identified a receipt for Axert for \$ 1,339.59.

Ms. Guntner testified that she has noted the following changes in Mr. Broome's behavior since the accident: He often complains of headaches. He gets dizzy and nauseous when he overexerts himself such as when he plays with their little boy. (The dizziness is followed by a headache.) He forgets things that [*33] she has just told him and that he is definitely a "lot more flighty." He kicks in his sleep as if he is fighting in his dreams.

Ms. Guntner characterized Mr. Broome as a very active person before the accident. The hobbies he previously engaged in included working out at the gym, jujitsu, wrestling, and landscaping. As to landscaping, she elaborated that he enjoyed putting koi ponds together, building retention walls, and working in the yard. Before the accident, Mr. Broome never sat around and watched television. Since the accident, when Mr. Broome comes home from work he wants to sit around. She stated that he has tried to go back to the gym, but he comes home sick with a migraine and has to miss work. Before the accident he did not miss work on a regular basis. She noted that Mr. Broome has gained weight (about four pants sizes) since the accident, which depresses him.

Ms. Guntner testified that when they moved to North Carolina after Hurricane Katrina Mr. Broome did not seek medical attention because they had a baby and ran out of money. Although she acknowledged that Mr. Broome was tasered by the police on May 17, 2007, Ms. Guntner testified that Mr. Broome's [Pg 22] complaints did [*34] not change after the taser incident.¹⁰ Rather, she testified that his condition consistently has stayed the same since the 2003 accident.

¹⁰ Mr. Broome testified that the taser incident occurred when he and Ms. Guntner were having a domestic dispute, and Ms. Guntner called the police. Ms. Guntner acknowledged that Mr. Broome was charged with disturbing the peace, battery of a police officer, and resisting arrest. Mr. Broome testified that he has never been convicted of a felony.

David Broome

Mr. Broome, who was thirty-two at the time of trial and twenty-seven at the time of the accident, confirmed Ms. Guntner's testimony that they live together with their two young children. At the time of trial, Mr. Broome was employed full time as a lead greensman for a union; his job consists of supervising the building of sets for movies. He characterized himself as an average student. He obtained a General Equivalency Diploma ("GED"). When the accident occurred, in September 2003, he was enrolled at Delgado in horticulture. He testified that he subsequently quit school without obtaining a degree from Delgado.

Mr. Broome corroborated Ms. LeBouef's testimony that at the time of the accident they were [*35] working together in an herb garden at Delgado. The next thing he recalled was being driven by Ms. LeBouef to the hospital and asking her what happened. He recalled neither the accident nor the visit to the Ochsner emergency room. On cross examination, Mr. Broome disputed the accuracy of the Ochsner emergency room records insofar as those records indicated that he denied a loss of consciousness. He testified when he got home that night he felt dizzy and that Ms. Guntner took care of him after the accident.

Mr. Broome indicated that his primary problem following the accident was painful headaches. Dr. Shamsnia was the first doctor he saw following the emergency room visit. Dr. Shamsnia told him that he had migraine headaches. A [Pg 23] few months later, he also developed ringing in the ear, tinnitus. Mr. Broome described the tinnitus as a hit and miss symptom, which occurred sometimes once per week, but then it stopped for a few weeks. Mr. Broome also indicated that he had a short-term memory problem. Ms. Guntner would catch him slipping and forgetting things that she just told him five minutes earlier. He testified that the doctor's testimony that the testing revealed he has a traumatic [*36] brain injury made him scared for his family.

At the time of trial, Mr. Broome testified he was still being treated by Dr. Shamsnia and Dr. Gianoli. Mr. Broome testified that he was taking two medications for his headaches: Topamax and Axert. Mr. Broome estimated that he has to take an Axert about once or twice a week. Mr. Broome identified his medical expenses, which totaled \$ 20,160.94.

Mr. Broome denied having any prior medical problems. He testified that the prior head injuries that he reported to Dr. Gianoli were incidents in which he was "just rough housing with his older brother." On those prior occasions, he was not knocked out, did not receive medical treatment, and did not experience any subsequent headaches or ringing in the ears. Mr. Broome also denied any head injury as a result of the taser incident;

rather, he testified that when he was tasered he landed on his butt.

Addressing the gaps in treatment, Mr. Broome attributed a large gap to Hurricane Katrina. During that period, he had no medical insurance, and his priority was getting a job and paying his bills not reconnecting with his doctors. He acknowledged that the gap from September 2004 to August 2005 was not related [*37] to Hurricane Katrina.

[Pg 24] Before this accident, Mr. Broome testified that he rarely missed work. Since the accident, he has missed work multiple times due to migraine headaches. He estimated that he has missed up to two months of work. Mr. Broome testified that before the accident he was in great health. He described his prior hobbies as including martial arts, landscaping, working out at the gym, skateboarding, jogging, and participating in biathlons. Mr. Broome testified that since the accident he has gained about fifty pounds (from 180 to 230 pounds). He attributed this weight gain to his inability to engage in physical activities since the accident. He explained that he gets very sickly when he moves around a lot. When he plays with his children, he readily becomes tired and has to rest. Mr. Broome testified that his physical appearance has changed since the accident. Not only has he gained weight, but also he still has a scar on his head from the ladder striking him.

Dr. Donald Adams

Testifying for the defendants, Dr. Adams, who was qualified as an expert in neurosurgery, stated that he was retained to perform an IME on Mr. Broome. Dr. Adams testified that according to the medical [*38] literature an assessment immediately or very shortly after a head injury is crucial. " Dr. Adams thus focused on the Ochsner emergency room records regarding Mr. Broome's treatment immediately following the accident. The emergency room records reflect that Mr. Broome complained of a laceration to the head, which Dr. Adams characterized as a "small scalp laceration." Mr. Broome told both the triage nurse and emergency room [Pg 25] physician that he had not been knocked out; he specifically denied loss of consciousness, headache, vomiting, and neck pain. Dr. Adams noted that the emergency room staff did not note Mr. Broome to be confused and did not note any other complaints referable to a head injury. Dr. Adams further noted that the emergency room staff neither made a concussion diagnosis, nor ordered a MRI, which is part of the standard workup on an acute basis for someone who has been unconscious. Rather, the emergency room staff sutured Mr. Broome's head laceration and discharged him. Dr. Adams still further noted that on September 15, 2007, when Mr. Broome returned to Ochsner to have his sutures removed he made no men-

tion of headache, confusion, or vertigo. Although the Ochsner [*39] records show that he was discharged that day with a notation "improved with symptoms resolved," he complained on that same date when he went to have an MRI of constant migraines, nausea, dizziness, and balance offset.

11 Dr. Adams identified several well accepted categories in the medical literature for measuring the severity of sports injuries or brain injuries. One category widely used by emergency personnel is the Glasgow Coma Scale, which ranges from 3 to 15, with 15 being normal. Another category is based on the length of altered consciousness; less than thirty minutes is characterized as a mild traumatic brain injury. All of these categories depend on an assessment immediately or shortly after the injury occurring, such as in the emergency room. Dr. Adams noted that in sports, if a player has a mild brain injury that clears within fifteen minutes, the player is sent back into the game.

Dr. Adams indicated that even assuming that the emergency room staff simply overlooked Mr. Broome's head injury, Mr. Broome had no worse than a mild traumatic brain injury (a mild concussion). Dr. Adams thus concluded in his report that "[s]ince it is generally agreed in the medical literature that [*40] the after effects of a concussion produce symptoms that are maximum at or shortly after the injury, it is very difficult to relate his subsequent complaints to this particular injury."

Dr. Adams disputed Dr. Shamsnia's opinion that Ms. Broome's current problems are related to the 2003 accident; he stated:

The natural history of problems that follow a concussion is that they get better and generally resolve. The symptoms of what has been termed the persistent post concussive syndrome are thought in the medical literature to be primarily related to medication overuse or [Pg 26] psychological issues. In Mr. Broome's case, the records document that his symptoms went away as would be expected.

Dr. Adams further stated that "[a]lthough it took longer than usual for the symptoms following a blow to the head to resolve in this case, they are clearly documented as having gone away." In support of the position that the symptoms went away Dr. Adams cited Dr. Shamsnia's September 8, 2004 office note, which stated that Mr. Broome was "essentially neurologically asymptomatic"

and discharged him. Dr. Adams thus concluded that there was "no possible biological mechanism to relate the current problems [*41] to the accident in question."

Dr. Adams emphasized that the neuropsychological testing failed to show any difficulties in the areas generally known to be affected by mild traumatic brain injuries. "The anticipated difficulties would most prominently affect attention and concentration and speed of information processing" and possibly short term memory. Although problems with language were noted in the testing, Dr. Adams pointed out that this is not an area of brain function affected by this type of injury and that one would have to review Mr. Broome's prior school records to determine if he had prior problems in this area. Regardless, Dr. Adams pointed out that Mr. Broome acknowledged that his perceived cognitive difficulties had resolved. Insofar as the sleep abnormalities, Dr. Adams stated that injuries of the type Mr. Broome sustained are not associated with permanent changes in brain architecture or sleep function.

As to the 2007 MRI, Dr. Adams disputed the need for Mr. Broome to go to Las Vegas for a MRI. He opined that the local MRI facilities were acceptable and that "[h]igh field strength magnets are necessary to do diffusion tensor imaging studies, but the changes seen with this [*42] methodology do not, to date, have any [Pg 27] accepted meaning in the evaluation of brain injury and no consistent correlation with observed changes in function or on psychometric testing." Dr. Adams testified that he did not observe atrophy of the hippocampus on the 2007 MRI film. Although the hippocampus is exquisitely involved in memory functioning, the neuropsychological testing did not show Mr. Broome to have problems with his memory. Dr. Adams noted that when hippocampal atrophy is seen in the general population, the most common causes are alcohol and marijuana use. Dr. Adams also noted that the medical literature supports a finding of hippocampal atrophy in cases involving severe brain injury, not mild head injuries such as the type Mr. Broome sustained.

Dr. Adams also testified that he was unable to observe dilated perivascular spaces on the MRI. He noted that about fifteen to twenty percent of the normal population has some sort of minor white matter abnormality on high resolution MRI scanning. Dr. Adams testified that he thus would not call this an abnormality. He pointed out that this is the reason why it is important to focus on how the brain works and on the neuropsychological [*43] tests. He still further noted that in severe brain injury cases where there is atrophy there also is an increased size of the Virchow-Robin spaces.

As to the vertigo, Dr. Adams emphasized that Dr. Shamsnia's records did not reflect a complaint or diagno-

sis of vertigo until March 2004, six months after the accident. Describing vertigo as a "noxious symptom," Dr. Adams stated that it was unlikely it would have been overlooked. He further noted that "[s]ince vertigo has many potential causes, this delay in onset makes it very difficult to relate the current complaints to the accident of 09/03/2003 in which he was struck in the head by the ladder." Dr. Adams also disputed the notion that Mr. Broome's vertigo [Pg 28] could have improved and then reoccurred and worsened. Dr. Adams noted that when Mr. Broome returned to Dr. Gianoli in 2008 after a four year gap the testing results changed and were consistent with vertigo related to a fistula. According to Dr. Adams, "[v]ertigo related to a fistula would not have latency of onset and would have begun at or very shortly after the accident of September 2003 if it were related to it." He further noted it was unlikely that someone with the symptoms [*44] vertigo produces would have gone years without having it evaluated. Dr. Adams also acknowledged that a fistula could develop from any form of direct blow to the ear or from an electrical charge or a taser.

In sum, Dr. Adams' conclusions were as follows:

. The records do not document that Mr. Broome suffered a concussion at the time he was hit in the head in September 2003. Assuming that he was briefly unconscious, or perhaps simply stunned, he was clearly alert, oriented, and coherent with an unremarkable cognitive evaluation within a brief period of time. If one applied the current guidelines for management of concussion in sports, he would have been felt to have a grade 1 or the most minimal concussion, and once the post concussive symptoms had cleared (which they appear to have done by the time he left the emergency department), if an athlete he would have been allowed to return to the football game or whatever contest had been in progress when he was injured.

. Lasting sequelae from an injury of this degree are not expected and probably do not occur in younger individuals. We also know from the medical records that this man's symptoms had resolved by 2004. There is, therefore, no [*45] reason to relate the current complaints to the accident in question. By Mr. Broome's own description he no longer has any problems with cognitive processing.

. Given the significant delay in onset of his complaint of vertigo, the significant change in the character of that vertigo, and the new findings on evaluation in 2008, I do not see a basis for relating the current problem with vertigo to the accident involving the ladder.

Although Dr. Adams testified that he did not see any indication that Mr. Broome was not giving a valid effort or malingering, he also testified that he did not see any evidence that Mr. Broome was impaired.

[Pg 29] *Dr. Kevin Bianchini*

The defendants' other expert who testified was Dr. Bianchini, a clinical psychologist and neuropsychologist. Dr. Bianchini testified that he was retained by B&K and Gemini to evaluate Mr. Broome. Dr. Bianchini tested Mr. Broome over the course of a three day period in March 2009. At that time, Mr. Broome attributed the following three symptoms to the accident involving the ladder: (i) dizziness--several things triggered these symptoms, including heights and moving quickly from back to front and anything that jars his head, and he becomes [*46] nauseous; (ii) tinnitus--he had constant ringing in his ears; and (iii) headaches--he had migraines and also smaller headaches once or twice a week that lasted for two to three hours.

Dr. Bianchini, like Dr. Adams, testified regarding the importance with brain injuries to focus on the symptoms at the time of the injury. For this reason, he characterized the emergency room report as the most important document. Dr. Bianchini noted that considering the emergency room report from Ochsner, there was no indication that Mr. Broome experienced even the mildest form of traumatic brain injury. Even assuming a brief loss of consciousness, Dr. Bianchini opined that the record does not support a finding of anything more than a mild traumatic brain injury, also known as a concussion. Based on the studies that have been conducted, he noted out that most people (85 to 90%) recover from such injury within a period of months. As to the subset of people who have persistent symptoms, the studies have shown that this group has motivational factors, such as litigation, that are believed to explain their persistent symptoms.

Overall, Dr. Bianchini's opinion was that Mr. Broome did not have residual neurocognitive [*47] problems that were attributable to being struck in the head by the [Pg 30] ladder. Dr. Bianchini noted Mr. Broome indicated that he had no problems with concentration, memory, speech, or processing speed; that he was helped from hearing the positive results from Dr.

Andrews' testing, presumably meaning that he was not impaired; and that "he has improved and does not have meaningful cognitive impairments at this time." Like Dr. Adams, Dr. Bianchini disputed Dr. Shamshia's conclusion that Mr. Broome had hippocampal atrophy given that Mr. Broome did not have any short term memory deficit. Dr. Bianchini also disagreed with Dr. Andrews insofar as she suggested that the results of her neurological testing were consistent with the location of Mr. Broome's scalp laceration and the 2007 MRI findings. He noted that "Dr. Andrews reports some findings that she indicates are consistent with the mechanism of injury, including consideration of the MRI. Some of these are problems that are not typically impaired as a result of concussion, including motor and language function." Disagreeing, he stated that "the idea of relating a set of neuropsych findings to a scalp laceration is not supported by the [*48] literature."

In response to the trial court's question regarding what he would attribute the problems in Mr. Broome's testing results, Dr. Bianchini testified that:

The naming, the lowered verbal I.Q. score, which really doesn't come even with more severe forms of traumatic brain injury seems to suggest and is somewhat consistent with Mr. Broome's history of himself in academics. He was not real, you know, wasn't knocking the lights out as a student. Those things could be related to that, the language problem.

Dr. Bianchini noted the formal symptom validity and symptom evaluation measures that were included in the testing were entirely negative. He thus noted that during the evaluation there was no indication of Mr. Broome's intentional exaggeration of symptoms or intentional poor performance on the testing.

[Pg 31] Returning to the issue of whether the general damage award was excessive (or inadequate), we note that general damages may be established in three ways: (i) the circumstances of the case, (ii) expert medical testimony, and (iii) the tort victim's testimony. Frank L. Maraist & Thomas C. Galligan, Jr., *Louisiana Tort Law*, §7-2 (c)(1996). In this case, the circumstances of the [*49] 2003 ladder accident were virtually undisputed. Mr. Broome's complaints regarding his symptoms were noted by all the experts to be truthful. The experts also were in agreement that he was not a malingerer. The expert medical testimony regarding the nature and degree of injuries Mr. Broome sustained, however, was conflicting. Resolving that conflict in Mr. Broome's favor, the trial court concluded that:

David Broome suffered a mild brain injury with residual symptomatology of chronic headaches, decreased verbal and motor skills, and a likelihood of early dementia. Mr. Broome also suffers from a traumatically induced inner ear injury with chronic symptoms of vertigo and tinnitus.

Mr. Broome also suffered a severe head laceration and nausea following the accident which has resolved, as well as depression, worry and anxiety regarding his medical condition and his injuries would prevent him from taking [care] of his two young children. The court finds these injuries were causally related to the accident of September 4, 2003 when he was struck in the head by a ladder.

Based on its finding that the evidence established Mr. Broome sustained a mild brain injury, inner ear damage, and a deep scalp [*50] laceration as a result of this accident, the trial court awarded Mr. Broome general damages in the amount of \$ 400,000. Under the particular circumstances of this case, in light of the pain and suffering that Mr. Broome experienced shortly after the accident and the migraine headaches and other physical problems he continues to experience we cannot say that the trial court clearly abused its discretion or that the award is so high that it [Pg 32] shocks the conscience. Accordingly, we decline to disturb the trial court's award of general damages.

The trial court also awarded Mr. Broome \$ 100,000 for his loss of enjoyment of life. In so doing, the trial court reasoned that "Mr. Broome's ongoing problems with headaches, dizziness, and ringing in the ears have resulted in his inability to participate in the activities and pleasures of life that he formerly enjoyed." The court thus found Mr. Broome suffered a "detrimental alteration of his lifestyle as a result of his physical injuries."

Although a form of general damages, loss of enjoyment of life is conceptually distinct from pain and suffering. It "refers to detrimental alterations of the person's life or lifestyle or the person's inability [*51] to participate in the activities or pleasures of life that were formerly enjoyed prior to the injury." *McGee v. AC and S, Inc.*, 05-1036, pp. 3-4 (La. 7/10/06), 933 So.2d 770, 773-75. The record supports the trial court's finding that Mr. Broome can no longer pursue many of the physical activities and hobbies he once enjoyed due to the accident. Mr. Broome, corroborated by his girlfriend (Ms.

Guntner), testified regarding his inability to engage in certain activities since the accident. Given his young age, the loss of enjoyment of life he has sustained will span most of his lifetime and result in the curtailment of many activities that he otherwise would have been expected to enjoy. As with the general damage award, we cannot say that the trial court clearly abused this discretion or that this award is so high that it shocks the conscience. Accordingly, we decline to disturb the trial court's award of loss enjoyment of life damages.

[Pg 33] The trial court awarded Mr. Broome past medical expenses of \$ 20,160.94, which are documented in the record. At trial, Mr. Broome identified these expenses. We find no error in this award.

The trial court also awarded Mr. Broome future medical expenses [*52] in the amount of \$ 241,700, which included \$ 233,700 in future prescription medication expenses and \$ 8,000 in future medical treatment. The trial court explained this award as follows:

Mr. Broome testified his migraines are sometimes as often as once a week or it may be a few weeks between episodes. Mr. Shael Wolfson, plaintiff's expert economist, totaled Mr. Broome's annual prescription costs at \$ 5,651.00. This figure is based on an average combined cost of six Axerts Mr. Broome is prescribed for headaches a monthly supply of plaintiff's seizure medicine, Topamax. Based on Mr. Broome's life expectancy of 44 years, an inflation rate of 4.5% for the cost of the medication, and a present day discount value, Mr. Wolfson calculated the cost of plaintiff's future prescription medications at \$ 233,700.00.

Also, Mr. Wolfson averaged expenses associated with Mr. Broome's future medical care with Dr. Gianoli to have a present day value of approximately \$ 8,000.00.

Future medical expenses are a form of special damages. The Louisiana Supreme Court has held that "[f]uture medical expenses must be established with some degree of certainty and will not be awarded in the absence of medical testimony [*53] that they are indicated and sets out their probable cost." *Hanks v. Seale*, 04-1485, p. 16 (La. 6/17/05), 904 So.2d 662, 672 (citing *Duncan v. Kansas City So. Railway Co.*, 00-0066, p. 17 (La. 10/30/00), 773 So.2d 670, 685). The proper standard for determining whether a plaintiff is entitled to an award

of future medical expenses is "proof by a preponderance of the evidence that the future medical expenses will be medically necessary." *Hall v. Folger Coffee Co.*, 02-0920, p. 23 (La. App. 4 Cir. 10/1/03), 857 So. 2d 1234, 1250 (quoting *Hoskin v. [Pg 34] Plaquemines Parish Government*, 97-0061, pp. 4-6 (La. App. 4 Cir. 12/1/97), 703 So.2d 207, 210-11). When the record sufficiently establishes the need for future medical care, but not the exact cost of such care, "the factfinder may make a reasonable award." *Lacy v. ABC Ins. Co.*, 97-1182, p. 13 (La. App. 4 Cir. 4/1/98), 712 So.2d 189, 196. The record in this case supports the trial court's finding that Mr. Broome met his burden of proving an entitlement to future medical expenses. Dr. Shamshia testified that Mr. Broome will need to take the prescribed medication for the indefinite future. We thus find that the record supports the future medical [*54] expenses award.

(2) Mr. Broome's Appeal: His Damages

Mr. Broome's appeal seeks an increase in general damages and loss of enjoyment of life damages. For the reasons set forth above, we find no basis to disturb these awards. Mr. Broome's appeal further seeks review of the trial court's failure to award damages for lost wages and impairment of earning capacity. We find no evidence in the record to support such awards. We therefore find the trial court did not err in failing to award such damages.

(3) Defendants' Appeal: Ms. LeBoeuf's Damages

Ms. LeBoeuf introduced into evidence the deposition testimony of her three physicians: Dr. Bradley Bartholomew, a neurosurgeon; Dr. Fred DeFrancesch, an expert in the fields of physical medicine and rehabilitation; and Dr. Thomas Lyons, an orthopedic surgeon. Ms. LeBoeuf testified as a witness on her own behalf. B&K and Gemini called in opposition Dr. John Steck, the IME and a neurologist.

Melissa LeBoeuf

Describing her injuries and course of treatment, Ms. LeBoeuf testified that at the time of the accident at Delgado she had an immediate onset of pain in her neck [Pg 35] and arms. She was treated that day at the Ochsner emergency room. At the emergency [*55] room, her complaints were soreness in her neck and pain in her arms. On September 10, 2003, Ms. LeBoeuf went to Dr. Dominic Arcuri, her primary care physician, with complaints of pain in her arm, and a sore neck. She also indicated that she had begun to feel a bit of tingling in her fingers. He recommended that she rest, apply ice, and "keep an eye on it."

From October 2003 through May 2004, Ms. LeBoeuf treated with Dr. Marshall Book, an orthopedic surgeon. Her complaint during this time was soreness

and pain in her neck that would radiate down her arms. She had tingling in her third and fourth finger and "[i]t would eventually start to go numb." Based on Dr. Book's recommendation, she attended physical therapy for about one month, which provided some short term relief. She did not dispute a reference in Dr. Book's records of her complaining of hurting her neck when moving a couple of Christmas trees.

In November 2004, Ms. LeBoeuf changed doctors and went to Dr. Bartholomew because she was continuing to have pain and physical therapy was not helping. Again, in August 2005, she changed doctors and went to Dr. DeFrancesch because Dr. Bartholomew wanted her to undergo another round of Vertis, [*56] ¹² which she testified was painful, and because she was not getting any better.

12 Vertis is also called percutaneous neuromodulation therapy ("PNT").

On August 1, 2006, Ms. LeBoeuf was in a subsequent automobile accident. According to Ms. LeBoeuf, she experienced an increase in pain after the [Pg 36] automobile accident. For that reason, she saw Dr. Lyons on one occasion in August 2006.

Ms. LeBoeuf testified that she has radiating pain in her left shoulder, which goes through her arm; numbness and tingling in her third and fourth fingers of her left hand; and headaches. All the conservative treatment she has received has provided only short term relief. Ms. LeBoeuf testified that before the 2003 ladder accident she had no prior accidents or injuries to her neck and that since the 2006 automobile accident she has had no subsequent accidents. She testified that following the 2006 automobile accident her neck and arm pain were worse for about three months and then returned to the same level of pain that she had been experiencing since the 2003 ladder accident.

Ms. LeBoeuf described herself as very active and in good physical condition before the 2003 accident. She testified that before the [*57] 2003 accident she enjoyed exercising, playing golf, playing basketball, and running. She noted that in high school she played golf in the Junior PGA and that she was an avid golfer. She testified that she is no longer able to play golf because it is uncomfortable for her to swing a golf club. She testified that she also no longer exercises, jogs, plays tennis or lift weights.

At the time of trial, Ms. LeBoeuf was twenty-five years old and working as a project manager for a landscaping company. She testified that her job has drastically changed since the accident. Her present job responsibilities require her to oversee landscaping and maintenance crews. She indicated that she would prefer to work

outside with plants as she did before the 2003 accident, but because of her neck injury she has assumed more administrative duties. Ms. LeBoeuf [Pg 37] acknowledged that the injury from the 2003 accident did not interfere with her academic performance and that she obtained her decree.

Dr. Bradley Bartholomew

On November 16, 2004, Ms. LeBoeuf first saw Dr. Bartholomew, a neurosurgeon. She gave a history of being injured on September 4, 2003, when she was hit in the neck by a ladder, and she denied [*58] a loss of consciousness. She reported that she had immediate neck pain and that she was treated in the emergency room where she was x-rayed and released. She also reported having seen two other physicians for this injury: Dr. Arcuri, her primary care physician; and Dr. Book, an orthopedic surgeon.

On her first visit to Dr. Bartholomew, Ms. LeBoeuf's complaints were continuing neck pain, pressure, pinching, and a painful sensation going to the left shoulder. She reported that the pain in the neck was not constant and not every day and that the pain was brought on by things that put stress on the neck. She also reported pain going to the left upper extremity to approximately the forearm, which also was not constant and not every day. She still further reported occasional left hand numbness and weakness and tingling in the left hand digits three and four. She denied any previous history of neck pain. Dr. Bartholomew noted that a MRI of the spine dated April 26, 2004 was normal. He concluded Ms. LeBoeuf was not a surgical candidate given the continuing spasm she was experiencing despite conservative measures. Dr. Bartholomew prescribed a muscle stimulator to use at home and medication (Skelaxin [*59] and Naprosyn). He instructed her to return in one month.

On January 25, 2005, Dr. Bartholomew saw Ms. LeBoeuf for a second time. On this visit, she reported that her neck was better. She stated that she was using [Pg 38] the stimulator every day. She indicated that she had pain every other day for three to four hours and that the pain was worse at night and in the afternoon. She stated that when the weather changed she experienced a picking type or pulsating sensation into the left upper extremity. Overall, Ms. LeBoeuf estimated that she was about "50% better." Dr. Bartholomew continued her on the muscle stimulator and instructed her to return in two months.

On March 22, 2005, Dr. Bartholomew saw Ms. LeBoeuf a third time. On this visit, she stated that her neck had been fine for about six weeks, but about three weeks earlier without any trauma she woke with a stiff, sore neck. Given Ms. LeBoeuf's MRI was normal, Dr.

Bartholomew recommended a home exercise program along with a muscle relaxant (Robaxin) and continued the home stimulator. He instructed her to return in about one month.

On March 26, 2005, Dr. Bartholomew saw Ms. LeBoeuf a fourth time. She reported some pulsating pain that [*60] became worse about three weeks earlier. She indicated that the pain was in the left neck area and trapezius. She also reported pain in the left elbow to the wrist and numbness in the third and fourth fingers. On this visit, he gave her a trigger point injection in the left trapezius area, which he noted provided her with some immediate decrease in pain in the area.

On May 17, 2005, Dr. Bartholomew saw Ms. LeBoeuf a fifth time. She reported that for a week and a half following the trigger point injection 80% of the pain was gone, but it gradually returned. She reported pain in the neck going to the left upper extremity. She indicated that the left upper extremity pain was not constant, but that the neck pain was constant. She described the pain as sometimes sharp. Dr. Bartholomew opined that most likely the radicular symptoms were a [Pg 39] result of the spasm. He noted that she agreed with his recommendation to try Vertis, which he noted is called percutaneous neuromodulation therapy ("PNT").

On August 9, 2005, Dr. Bartholomew saw Ms. LeBoeuf for the last time. On this visit, Ms. LeBoeuf had her first PNT. Dr. Bartholomew noted that the PNT was painful at the insertion of the needles [*61] on the left side where she was having the spasm. He further noted that Ms. LeBoeuf tolerated the treatment and that she was going to consider whether she wanted to have another PNT. He discussed other treatment options including massage therapy and a chiropractor. He again opined that she was not a surgical candidate.

Dr. Fred DeFrancesch

On January 17, 2006, Dr. DeFrancesch, an expert in the fields of physical medicine and rehabilitation (a pain management doctor), first saw Ms. LeBoeuf. At this time, Ms. LeBoeuf's complaints were paresthesias in the left third and fourth fingers and occasional weakness throughout her hand. Dr. DeFrancesch found that she had cervicalgia, possibly left C6-C7 radiculitis/radiculopathy, and myofascial pain. He prescribed medication and suggested that she have an EMG (electromyogram) and nerve conduction study to determine if neurological issues were present. On February 14, 2006, the tests were done, which showed nerve abnormalities. On February 27, 2006, Ms. LeBoeuf had a second MRI of the cervical spine, which was compared to the prior one of April 2004. The MRI was normal; it showed no evidence of disc herniation.

On June 20, 2006, Dr. DeFrancesch last [*62] saw Ms. LeBoeuf. On this visit, Ms. LeBoeuf related that "[s]he was doing okay." She rated her pain as 4 out of 10 (10 being the most intense) in intensity, but noted that a week earlier she had one episode of exacerbation at 8 out of 10 when she extended her neck and had [Pg 40] "pinching in the neck." Dr. DeFrancesch's diagnosis was cervicgia, facet disorder, myofascial pain, cervical strain, and soft tissue injury. He continued her on medication (Celebrex and Robaxin) and a home exercise plan. Although he also continued her on physical therapy (which she went to in March and May 2006), Dr. DeFrancesch noted that "it has not provided significant relief."

Dr. DeFrancesch testified that Ms. LeBoeuf appeared to be truthful in her complaints and that she was not malingering. In response to whether he would expect her to still be experiencing pain when he saw her, Dr. DeFrancesch replied that some patients who have similar symptoms have pain that never resolves.

Dr. Thomas Lyons

Dr. Lyons, an orthopedic surgeon, testified that he saw Ms. LeBoeuf on one occasion, August 2, 2006. On this visit, Ms. LeBoeuf's complaints were pain in her neck, upper back, headaches, and pain involving the [*63] left arms and extending into the hand. Dr. Lyons testified that these complaints for which Ms. LeBoeuf sought treatment arose from a motor vehicle accident that had occurred the prior day, August 1, 2006. Ms. LeBoeuf never mentioned to Dr. Lyons the September 2003 ladder accident; however, she related to him that she had prior neck pain and upper extremity symptoms.

Dr. John Steck

Testifying for the defendants, Dr. Steck, a neurosurgeon, stated that he saw Ms. LeBoeuf on one occasion, on July 31, 2006, for an IME. According to Dr. Steck, Ms. LeBoeuf provided a history of being struck by a ladder in the lower cervical spine at the junction of the spine and the trapezius. She was knocked to the ground. Her primary symptoms were neck pains and numbness and paresthesias into the third and fourth fingers of the left hand. Based on the history, [Pg 41] physical exam, and review of the medical records from Dr. Bartholo-

mew's office, Dr. Steck concluded that Ms. LeBoeuf had a soft tissue injury to the muscles of the neck and the supporting structure of the left shoulder. Dr. Steck testified that "[h]er examination was normal other than a slight decrease in pin prick or a sensitivity to pin sensation [*64] in the fourth finger of the left hand." He testified that this generally was not something that would cause pain or disability. He concluded that more than likely her injuries could be managed conservatively and would not require surgery. In response to the trial court's questions, Dr. Steck testified that the existence of a pending lawsuit is something that is put in a patient's medical records because it "may be a motivating factor for them to either complain more, complain longer, or not to respond to therapy."

As noted, the trial court awarded Ms. LeBoeuf \$ 125,000 in general damages and \$ 8,027.74 in past medical expenses. In its reasons for judgment, the trial court stated that it agreed with the defendants' expert neurosurgeon, Dr. Steck, that Ms. LeBoeuf sustained a soft tissue cervical injury. The court noted that Dr. Steck testified "the EMG ordered by Dr. Fred DeFrancesch, plaintiff's treating physician, showed abnormalities in the C-6, C-7 nerve distribution. This objective finding supports plaintiff's complaints of chronic pain." The jurisprudential doctrine that a treating physician's opinion should be accorded greater weight than the opinion of a doctor who examines a patient [*65] only once for purposes of litigation (or for purposes of rendering an expert opinion concerning the party's condition) is not irrebuttable. Rather, "the inquiry is whether, based on the totality of the record, the jury was manifestly erroneous in accepting the expert testimony presented by defendants over that presented by plaintiff." *Miller v. Clout*, 03-0091, p. 6, n. 3 (La. 10/21/03), 857 So.2d 458, 462. Given the particular circumstances of this [Pg 42] case, we cannot say that the trial court abused its vast discretion. Accordingly, we decline to disturb the trial court's award of general damages. We further find the award of past medical expenses supported by the record.

DECREE

For the foregoing reasons, the judgment of the trial court is affirmed.

AFFIRMED

10

Slip Copy, 8 Misc.3d 1001(A), 2005 WL 1364515 (N.Y.Sup.), 2005 N.Y. Slip Op. 50882(U)
(Table, Text in WESTLAW), Unreported Disposition
(Cite as: 2005 WL 1364515 (N.Y.Sup.))

H

NOTE: THIS OPINION WILL NOT APPEAR IN A
PRINTED VOLUME. THE DISPOSITION WILL AP-
PEAR IN A REPORTER TABLE.

Supreme Court, New York County, New York.
Salvatore LAMASA and Ana G. Lamasa, Plaintiffs,
v.
John K. BACHMAN, Defendant.
No. 129996/93.

April 13, 2005.

MARTIN SHULMAN, J.

*1 Defendant, John K. Bachman ("defendant" or
"Bachman"), moves for an order seeking the following
relief in relation to a jury verdict rendered on June 7,
2004 ^{FN1}:

FN1. Normally, a motion to challenge a jury
verdict pursuant to CPLR § 4404(a) is gov-
erned by the 15-day time limit of CPLR §
4405. This Court permitted the parties to stipu-
late to extend their time to present written ar-
guments. See, "(CPLR 2004; see, 4 Weinstein-
Korn-Miller, N.Y. Civ Prac para. 4405.05) ..." *Brown v. Two Exchange Plaza Partners*, 146
A.D.2d 129, 539 N.Y.S.2d 889 (1st
Dept., 1989).

1) dismissing the complaint; 2) setting aside the jury
verdict as against the weight of the evidence (CPLR §
4404[a]); 3) alternatively, seeking remittitur; 4) seek-
ing defense costs and fees as against the plaintiffs,
Salvatore LaMasa and Ana G. LaMasa (where appro-
priate: "plaintiff", "Salvatore" or "plaintiffs") in con-
nection with plaintiffs' counsel's "withdrawal of his
proffer of PET and QEEG evidence following the rul-
ing of the Court precluding said evidence during the
trial and for costs in connection with plaintiff's egre-
gious discovery abuses." Plaintiffs oppose the motion

a) Past pain and suffering

and cross-move for additur.

The motion and cross-motion are consolidated for dis-
position.

Salvatore initiated what had become a protracted action
against the defendant in November, 1993 for injuries he
purportedly sustained as the driver of the stationary,
front vehicle Bachman rear-ended during the early
morning hours of November 25, 1992 at the intersection
of Delancey and Clinton Streets just prior to entering
the Williamsburg Bridge (the "Collision"). After being
marked off the calendar at least three times, this matter
was restored to the trial calendar and thereafter trans-
ferred to the New York County Civil Court on Novem-
ber 10, 1999 (see, CPLR § 325[d]). After languishing
for four years, the parties appeared at several pre-trial
conferences and the case was eventually referred to the
Supervising Judge of that court. ^{FN2}

FN2. Due to the confusing procedural posture
of the case and an inordinate number of com-
plex *in limine* motions/issues as well as the po-
tential value of the case (based upon a prima
facie showing), the parties' counsel concurred
that the matter should be re-transferred to the
Supreme Court and this Court agreed to preside
over the jury trial.

Jury selection began on May 4, 2004 and the trial ended
on June 7, 2004. As noted on the Jury Verdict Sheet
(Exhibit A to Bachman Motion), five out of the six
members of the jury reached an agreement and prelim-
inarily reported that defendant's negligence in causing
the rear-end collision was a substantial factor in causing
Salvatore's injuries. The same five members of the jury
further reported that as a result of the Collision, plaintiff
suffered a serious injury under the No-Fault Law, Insur-
ance Law § 5102(d) (see, Jury Question Nos.: 1A-1C).
Salvatore was then awarded the following damages:

\$240,000

Slip Copy, 8 Misc.3d 1001(A), 2005 WL 1364515 (N.Y.Sup.), 2005 N.Y. Slip Op. 50882(U)

(Table, Text in WESTLAW), Unreported Disposition

(Cite as: 2005 WL 1364515 (N.Y.Sup.))

b) Future pain and suffering	\$400,000 (over 20 years)
c) Past Lost Earnings	\$460,713
d) Future lost earnings	\$774,892 (over 13 years)
e) Past medical expenses	\$ 40,768
f) Future Medical expenses	\$ 95,040 (over 20 years)
g) Past loss of medical insurance	\$ 38,985
h) Future loss of medical insurance	\$ 95,840 (over 13 years)
i) Future loss of social security	\$122,273 (over 7 years)

The jury also awarded Salvatore's spouse, Ana LaMasa, \$250,000 for past loss of services (on her derivative claim for loss of consortium) and awarded an identical sum for future loss of services (the latter to cover a period of 20 years).

It should be readily apparent that both parties had a full and fair opportunity to argue and brief the court (where necessary) and make their record, *inter alia*, concerning their respective *in limine* motions, evidentiary issues and procedural and substantive trial issues (e.g., the proper jury charges, verdict interrogatories, etc.). While this Court granted Bachman's counsel leave to make this post-verdict motion, nonetheless, to avoid any redundancy, this Court expressed an unwillingness to entertain any application addressing the liability issues and/or the varied evidentiary rulings made prior to and during the jury trial. However, this Court stated it would consider whether the jury awards were excessive and unreasonable (CPLR § 5501[c]). Still, defendant took advantage of his right to move under CPLR § 4404(a) and "re-argued" almost every one his overruled objections and denied motions duly made on the record during the course of the trial and duly preserved for a potential appeal. In its post-verdict motion, defendant's counsel argues that: Salvatore's proof of injuries never met the statutory threshold to constitute a serious injury (i.e., no loss of consciousness and no complaints of pain and/or other physical or cognitive disabilities at the time of the Collision made to the police or his late brother-in-law, no loss of ambulation, no emergency room or hospital admission at the time of the Collision, no initial complaints of headaches, depression and/or anxiety at or close in time to the Collision, a normal neurological examination seven weeks post-Collision, no evidence of

either temporary or permanent traumatic brain injury ("TBI") at or close in time to the Collision and no objective findings of injuries to Salvatore's neck and back); plaintiff's proof was insufficient to show a causal connection between the Collision and Salvatore's alleged injuries (*viz.*, all of plaintiff's experts failed to opine on causation and any and all purported positive findings of TBI, post-traumatic stress disorder ["PTSD"] and neck and back injuries were reported years after the collision by medical experts retained by plaintiffs' counsel solely for trial); and plaintiffs' discovery abuses warranted the extreme sanction of dismissal of the plaintiffs' complaint.

*2 Defendant's post-verdict motion further took issue with various court rulings he deemed erroneous such as permitting plaintiff's expert neuroradiologist, Dr. Michael Lipton, to testify with respect to an innovative MRI modality utilizing Diffusion Tensor Imaging ("DTI")^{FN3} as this modality is not generally accepted in the field of radiology or neuroradiology to diagnose TBI or diffuse axonal injury; precluding defendant's expert neurologist from testifying concerning Evoked Potential testing^{FN4} which plaintiff argued was not addressed in defendant's expert witness disclosure notice; granting plaintiff a directed verdict on the issue of negligence; overruling certain objections to references about insurance made by various plaintiffs' witnesses; denying defendant's request for a missing witness charge with respect to various witnesses such as Dr. Wiseman (pain management specialist who treated Salvatore), Dr. Leo J. Shea III (psychologist who treated Salvatore) and Mariusz Ziejewski, Ph.D. (accident reconstruction engineer); granting plaintiffs' counsel's application to modify certain no-fault interrogatories on

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the verdict sheet to eliminate the phrase, “[a]s a result of the accident” but otherwise accurately reciting the text of these no-fault questions in accordance with PJI 2:88E, 2:88F and 2:88G; and granting plaintiffs’ counsel application to amend certain damages questions on the verdict sheet after completion of instructions to the jury to include a claim for loss of past and future medical insurance and future loss of social security benefits (or payments) and furnishing the jury with a supplementary charge with respect thereto.

FN3. DTI is an imaging technique used to study the random motion of hydrogen atoms within water molecules in biological tissue (e.g., brain white matter) and spatially map this diffusion of water molecules, *in vivo*. DTI provides anatomical information about tissue structure and composition. Changes in these tissue properties can often be correlated with processes that occur, among other causes, as a result of disease and trauma.

FN4. Evoked Potentials sometimes called evoked responses are tests that record the brain’s responses to sound, touch and light. These tests help to evaluate a number of neurological conditions.

After the foregoing challenges, Bachman’s motion then raises the issue of remittitur urging the court to either set aside or reduce the jury awards for past lost earnings (\$460,713) and future lost earnings (\$774,892)^{FN5}, reduce the jury award for past medical expenses from \$40,780 to \$25,000, set aside the jury award for past and future medical insurance as being duplicative, set aside the jury award for future loss of social security retirement benefits as being totally speculative or alternatively reduce the \$122,273 award to \$80,700 and reduce the jury awards for loss of past and future services to Ana LaMasa from \$500,000 to \$50,000.

FN5. Specifically, defendant contends that Salvatore’s pre-accident employment history reflects a patchwork of short-term jobs, that plaintiffs’ most recent employment before the accident at Ogden Allied was only for two and

a half years, that Salvatore intended to leave Ogden Allied to become a Con Edison meter reader rendering plaintiffs’ expert economist’s projections and calculations uncertain and speculative, that the calculation of the past and future lost earnings on an annualized basis erroneously utilized an increase rate of 3.5% rather than the union contract increase rate, that the economist failed to consider plaintiffs’ pre-accident health condition (i.e., scoliosis and degenerative disc disease), that the jury ignored testimonial evidence proffered by Dr. Remling, Salvatore’s treating chiropractor, to the effect that plaintiff could return to work at a less demanding job or seek part time work, and that plaintiffs’ expert recognized that the rate of increase for future lost earnings could have been 3.5% rather than 4.5% justifying a reduction of this award by approximately \$50,000 or \$60,000.

Finally, due to plaintiff’s purportedly frivolous efforts to seek the admission of QEEG^{FN6} and PET scan^{FN7} evidence, Bachman should be awarded attorney’s fees pursuant to 22 NYCRR § 130-1.1 as well as defense expert witness expenses totaling approximately \$50,000.

FN6. EEG is the recording of electrical patterns at the scalp’s surface showing cortical electrical activity or brain waves. This recording is called an electroencephalograph, commonly referred to as an EEG. As a diagnostic tool, Quantitative EEG or QEEG provides a digital recording of the EEG which is apparently utilized to perform a comparative analysis of many EEG tracings of a patient suffering from brain disease or trauma against a normative data base of EEG tracings.

FN7. Positron Emission Tomography (“PET”) is a medical imaging technique which scans a body’s chemistry and function to detect cancer, Alzheimer’s and other medical conditions.

Plaintiffs’ cross-motion seeks additur and through the following arguments tells a different story:

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Testimonial and documentary evidence presented before the jury preponderated in favor of Salvatore establishing that he suffered serious injury (Insurance Law § 5102) including, but not limited to, neck and back injury, TBI^{FN8}, post-traumatic stress disorder ("PTSD"^{FN9}) and a non-permanent, medically determined injury, viz., non-performance of customary and daily activities for 90 of 180 days after the Collision. Each of these conditions standing alone, plaintiffs argue, would satisfy the statutory serious injury threshold;

FN8. Plaintiffs contend that treating specialists Dr. Lewis Weiner (Salvatore's treating neurologist), Dr. Steven Stein (neuropsychologist), Dr. Daniel Kuhn (Salvatore's treating psychiatrist) and Dr. Joshua Greenspan (pain management specialist), Dr. Rachel Yehuda (neuroendocrinologist/psychologist) and experts Dr. Nils Varney (neuropsychologist) and Dr. Lipton jointly and severally opined that LaMasa suffered TBI as a result of the Collision. Their findings, impressions and conclusions, counsel argues, were based on hundreds of clinical examinations performed and duly reported, treatment regimens (i.e., series of drug treatments administered for over 12 years, all proven unsuccessful), medically accepted batteries of neuropsychological tests, MRI and/or DTI studies (the latter imaging studies revealed anatomical damage such as frontal lobe, hippocampus and para hippocampal atrophy and hemocitarin residue [from internal bleeding] consistent with frontal lobe injury).

FN9. Plaintiffs similarly contend that the severity of Salvatore's PTSD defies text book analysis. Salvatore's counsel, drawing from Dr. Yehuda's testimony, starkly captures a singular feature of what this specialist diagnosed as one her worse cases of this disorder: "[A]s a result of the immense psychological barriers inflicted by his PTSD, LaMasa remains psychologically frozen in time. He really has no present or future, since his PTSD holds him captive in a

perpetual state of fear and terror, stuck in the moments surrounding the [Collision] ..." (Flomenhaft Aff. In support of Cross-Motion at ¶ 37 paraphrasing from the Yehuda trial transcript at pp. 16 and 42-45).

*3 Unrefuted testimonial and documentary evidence presented before the jury established that as a result of the Collision, Salvatore suffered, and continues to suffer, from panic disorder, severe depression accompanied by suicidal ideation and bouts of violence, electrical dysfunction of the brain, epilepsy, chronic severe headaches, sleep cycle disorder/insomnia^{FN10};

FN10. Studies done at Mt. Sinai Medical Center Sleep Laboratory revealed "abysmally abnormal qualities in Salvatore's sleep cycles and sleep oxygenation." (Flomenhaft Aff. in support of Cross-Motion at ¶ 32).

Defendant unnecessarily reiterates his objections to the many discovery issues fully argued and briefed prior to and during the trial, which the court ruled upon on the record^{FN11} and requires no serious rebuttal. Moreover, defendant conveniently overlooked his counsel's own discovery "abuses" during the course of the trial;

FN11. To illustrate, plaintiff's counsel acknowledged defendant's understandable concern about the "eleventh hour" proffer of Grahme Fisher, an accident reconstruction specialist. Exercising its discretion to ameliorate any perceived prejudice and surprise, this Court afforded defendant's counsel ample opportunity to depose Mr. Fisher during the course of the trial and obtain all relevant data he relied upon to not only conduct effective cross-examination, but also to furnish an appropriate defense to the effect that the Collision was low-impact in nature and incapable of causing the mixed bag of injuries Salvatore claims to have suffered therefrom. In this context, plaintiffs' counsel retorted that the court ruling precluding defendant's neurologist from testifying about

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Evoked Potentials testing was proper because the relevant CPLR § 3101(d) notice made no mention of this subject for testimony.

References to the word, "insurance", during the testimony of some of plaintiffs' witnesses were benign in context and non-prejudicial as most of the references to insurance were made in the context of discussing the payment of plaintiff's medical bills and did not warrant a mistrial;

This Court correctly granted plaintiffs a directed verdict on the issue of negligence, correctly denied defendant's request for a missing witness charge, vis-a-vis, Drs. Weissman, Shea and Ziejewski; correctly permitted the semantic changes to the no-fault interrogatories eliminating the introductory phrase, "[a]s a result of the accident", while retaining the text of each question in accordance with the PJI. After determining if plaintiff suffered a serious injury by responding affirmatively to the three no-fault questions, the jury properly determined the issue of causation by answering Question No.2, namely, "Was the collision involving the plaintiff and defendant a substantial factor in causing any of the injuries alleged by plaintiff?" (Exhibit A to Bachman Motion at p. 2)

Contrary to defendant's confusing assertions, the jury awards for past and future medical insurance costs were not duplicative of the awards for medical expenses, but rather awards for loss of income, that is to say, the replacement costs of health insurance Salvatore ostensibly would have to purchase in lieu of free union health care coverage he would have otherwise received had he continued working at Ogden Allied (Exhibit B-4 to Bachman Motion; Leiken trial transcript at pp. 24-30) ^{FN12};

FN12. In explaining his calculation of this loss, the expert economist determined an annualized cost of health insurance for an individual to be \$5000 from 1995 (after the Collision, Salvatore's union continued to provide him with health insurance coverage for a few years) through age 65 and factored in an annual 6%

increase thereto for a total cost of \$134,796 (past medical insurance cost of \$38,985 and future medical insurance cost of \$95,840).

Dr. Leiken similarly projected the loss of social security retirement benefits as an additional component of lost income to be \$170,000 (see, Exhibit B-4 to Bachman motion at pp. 26-30) and the jury further reduced this sum to \$122,273 over a seven year period. Defendant's counsel blurs this item of income loss with Bachman's right to pursue adjustments of the judgment at a post-verdict collateral source hearing;

Without proffering any economist to refute Dr. Leiken's assumptions, calculations and projections on behalf of plaintiffs, defendant's challenges to the past and future lost earnings awards rest on a selective and skewed analysis of the testimony, expert and other ^{FN13}, thus, the jury awards were fair and reasonable;

FN13. Counsel contends it was reasonable for Dr. Leiken to assume that LaMasa would have remained at Ogden Allied, because the Con Edison position, if taken, would have been in addition to his porter work at New York University. Counsel further argues that LaMasa's work history reflected plaintiff's ongoing desire to work regularly, that no part time work was available after the Collision and that even assuming some incremental improvement of his neck and back through chiropractic treatment, LaMasa still suffered from TBI and its concomitant psychiatric problems rendering him disabled from the time of the Collision.

*4 Plaintiffs agree that the past medical expense award should be reduced from \$40,768 to \$25,000 based upon the evidence of record; and

The aggregate award of \$500,000 to Ana LaMasa for loss of services was fair and reasonable based upon her credible testimony (Mrs. LaMasa had to replace Salvatore as the head of the household raising their two sons and constantly had to care for her husband since the Collision and must continue to do so for the

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rest of his life).

Counsel's cross-motion further addressed the mean-spirited nature of defendant requesting costs referable to the potential proffer of testimony concerning QEEG and PET testing performed on Salvatore finding said request to be without merit as a matter of law.

Finally, plaintiffs seek additur to increase the total awards for past and future pain and suffering from \$640,000 to an appropriate seven-figure number. Counsel finds support from appellate case law involving similarly situated plaintiffs who suffered from TBI and PTSD. (Flomenhaft Aff. in support of Cross-Motion at pp. 34-41).

In reply, defendant's counsel factually distinguishes the case law plaintiffs rely upon for additur, reiterates her objection to the trial testimony of Salvatore's treating specialists questioning the value of their testimony due to purported gaps in time and in treatment (i.e., Dr. Greenspan did not see Salvatore until eleven years after the Collision, etc), and reiterates defendant's position as to the lack of record evidence of causation and serious injury. For ease of reference, defendant's counsel prepared a chart as part of his "wherefore" relief. Bachman therefore seeks an order vacating the jury award *in toto* and granting a new trial or, alternatively, reducing plaintiff's total lost earnings award to \$60,000, reducing plaintiff's past medical expenses award to \$25,000, reducing plaintiff's total past and future loss of medical insurance costs award to \$0, reducing plaintiff's future loss of social security benefits award to \$80,700 and reducing Ana LaMasa's total loss of services award to \$50,000.

Discussion

Preliminarily, this Court grants the unopposed branch of defendant's motion reducing the past medical expense award from \$40,768 to \$25,000.

Having otherwise carefully reviewed the relevant portions of the trial transcript furnished by the parties, this Court finds the jury verdict is supported by sufficient

evidence as a matter of law. Stated differently, the verdict is not utterly irrational and there was sufficient evidence to raise issues of fact (i.e., causation and serious injury) for the jury to resolve. *Garricks v. City of New York*, 1 NY3d 22, 769 N.Y.S.2d 152 (2003). Further, there were valid lines of reasoning and permissible inferences for the jury to draw upon that would lead these rational jurors to reach their conclusions based upon the testimonial and other admitted evidence presented at trial and decide the triable issue of whether Salvatore suffered serious injury causally related to the Collision. *Cohen v. Hallmark Cards, Inc.*, 45 N.Y.2d 493, 410 N.Y.S.2d 282 (1978). This ample trial record does not justify a judgment notwithstanding the verdict dismissing the complaint without re-submission of the action to another jury.

*5 Having found sufficient evidence in the trial record to support the verdict, this Court must then inquire as to whether the conflicting medical and other expert testimonial evidence presented by the parties and which resulted in "a verdict for the plaintiff[s] ... so preponderate[d] in favor of the defendant that [the verdict] could not have been reached on any fair interpretation of the evidence ..." *Moffat v. Moffatt*, 86 A.D.2d 864, 447 N.Y.S.2d 313 (2nd Dept., 1982) and quoted with approval with bracketed matter added in *Lolik et al., v. Big v. Supermarkets, Inc.*, 86 N.Y.2d 744, 631 N.Y.S.2d 122 (1995). In conducting a factual inquiry of the trial record, this Court further finds no basis to set aside the verdict as against the weight of the evidence and direct a new trial.

The facts of the Collision are essentially undisputed, i.e., a rear-end collision of a stationary vehicle waiting for a light change which occurred on a wet roadway. And the issue of Bachman's negligence was resolved as a matter of law in favor of Salvatore when this Court granted plaintiffs' application for a directed verdict on the question of negligence.

This Court digresses to discuss the merits of that branch of Bachman's post-verdict motion rearguing his opposition to plaintiffs' application for a directed verdict on this issue. Bachman again makes reference to a pre-trial decision and order of the Hon. Joan A. Madden issued

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January 13, 1998 (Exhibit C to Bachman Motion) which denied plaintiffs' motion for summary judgment finding defendant's purported negligence to be a triable issue of fact. For reasons fully stated on the record at the close of the entire case and prior to summations, this Court made it clear that Justice Madden's decision and order did not mandate that the jury decide the issue of Bachman's negligence. It must be emphasized that "[a] denial of a motion for summary judgment is not necessarily *res judicata* or the law of the case that there is an issue of fact in the case that will be established at trial ..." *Sackman-Gilliland Corporation v. Senator Holding Corp.*, 43 A.D.2d 948, 351 N.Y.S.2d 733 (2nd Dept., 1974). Further, the "proof offered to defeat a motion for summary judgment does not meet the standard of proof required to resolve an issue of fact at trial ..." *Cushman & Wakefield, Inc., v. 214 East 49th Street Corp.*, 218 A.D.2d 464, 639 N.Y.S.2d 1012, 1015 (1st Dept., 1996). Bachman's testimony and other supporting evidence in his defense neither included any non-negligent explanation for the Collision nor rebutted the presumption of negligence under all of the circumstances underlying the Collision. Defendant's excuse that the roadway was wet preventing him from stopping sufficiently in time to avoid the impact was wholly unavailing. *Mitchell v. Gonzalez*, 269 A.D.2d 250, 703 N.Y.S.2d 124 (1st Dept., 2000). Thus, plaintiffs were not foreclosed from obtaining a directed verdict on the issue of negligence. See, *Gubala v. Gee*, 302 A.D.2d 911, 754 N.Y.S.2d 504 (4th Dept., 2003).

*6 As to the issues of causation and the precise physical injuries Salvatore suffered from as a result of the Collision, the parties had numerous expert witnesses testifying and "in considering the conflicting testimony of the parties' respective expert witnesses, the jury was not required to accept one expert's testimony over that of another, but was entitled to accept or reject either expert's position in whole or in part ..." *Mejia v. JMM Audubon, Inc.*, 1 AD3d 261, 767 N.Y.S.2d 427 (1st Dept., 2003). To reiterate, the verdict as to the Collision being a substantial factor in causing Salvatore "serious injury" as defined under the Insurance Law § 5102(d) was not against the weight of the evidence and will not be disturbed.^{FN14}

FN14. In answering Question # 2 on the verdict sheet (Exhibit A to Bachman Motion), the jury deliberated on the precise issue of causation and the wording of the question made it clear that it had to determine whether the Collision was a substantial factor in causing *any* of Salvatore's injuries. The Jury's answers to Questions 1A, 1B and 1C determined the no-fault threshold issue of whether Salvatore's injuries constituted a "serious injury". This Court does not find that the deletion of the phrase, "[a]s a result of the accident", from these three threshold questions prejudiced defendant in any way or ran afoul of the applicable "serious injury" PJI charges underlying these jury questions. In short, the jury squarely disposed of the separate and discrete issues of causation and serious injury under the no-fault statute.

Defendant's disguised reargument of certain *in limine* motions this Court denied and which defendant perceives, if granted, would have otherwise either resulted in a judgment of dismissal notwithstanding the verdict or its vacatur and a directive to conduct a new jury trial is without merit.

As to defendant's charge of discovery abuses^{FN15}, it is essentially admitted that raw EEG epochs contained in the treatment records of Dr. Kuhn were belatedly turned over and similar records of Dr. Weiner were purportedly destroyed in the ordinary course of that physician's business. Yet, this Court ruled that Dr. Weiner could not testify about any alleged objective findings of TBI noted on such EEG data. As noted in the trial transcript, defendant was able to have an expert witness, Dr. Marc Nuwer, testify concerning Dr. Kuhn's data at trial, who offered a contrary interpretation of such data and, for that matter, a contrary opinion concerning the collision not being a competent producing cause of Salvatore's deteriorating physical condition. Defendant's motion stridently argues about the severe prejudice in belatedly receiving the respective CPLR § 3101(d) notices and reports/data of plaintiff's experts in the fields of neuropsychology (Nils Varney, Ph.D.), sleep medicine (Dr. Stasia Wieber) and accident reconstruction/en-

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gineering (Grahme Fisher, P.E.).

FN15. Defendant claims plaintiff failed to produce and/or timely produce raw EEG data from certain treating physicians and laboratories, failed to produce neuropsychological testing records from psychologists and untimely served expert witness notices reflecting changes in the theory of Salvatore's case (i.e., mild TBI changed to "moderate to severe" TBI and a low speed collision changed to a moderate to high speed collision).

Nonetheless, this Court afforded defendant sufficient time and opportunity prior to, and during, the trial to review such notices, reports and data and consult with and produce their own expert witnesses in these respective fields for purposes of mounting an appropriate defense; all borne out by the extensive trial record. Moreover, this Court issued rulings which tailored certain of the plaintiffs' expert witnesses' testimony after considering certain defense arguments.^{FN16}

FN16. In written communications to this Court after the motion and cross-motion became *sub judice*, Plaintiffs' counsel urged this Court to resolve an issue concerning the unanticipated costs plaintiffs incurred in obtaining the printout of raw data EEG data of Salvatore taken at the New York University School of Medicine, Department of Psychiatry as well as Dr. Wieber's raw sleep study data collected at Mt. Sinai School of Medicine which were ordered to be produced and turned over to defendant prior to and during the course of the trial. Consistent with this Court's discussions with respective counsel on this matter, this Court directs that these costs incurred in this data production should be shared by the parties.

Counsel has also reargued certain adverse rulings concerning the merits of defendant's *in limine* motions to preclude due to plaintiffs' failure to timely turn over and/or not turn over records of Dr. Leo J. Shea (neuropsychologist-treatment records), Dr. Charles Wetli (pathologist), Dr. Kenneth Alper

(neurologist-QEEG records),

Dr. Monte Buchsbaum (psychiatry-PET scan data). Neither the potential testimony of these witnesses nor their records, reports and data were proffered during the course of the trial based on this Court's rulings and/or other considerations. Revisiting these issues again appears to be pointless. All of defendant's remaining challenges to this Court's rulings on the admission of evidence and/or at the formal charge conference are without merit and require no additional discussion.^{FN17}

FN17. However, one example should suffice. The mere mention of the word, "insurance", during the course of testimony and the context of how insurance was discussed was not prejudicial to defendant. No testimony was elicited which publicly noted that Bachman had liability insurance and the resources to satisfy any potential judgment. In this vein, this well-educated jury evidently could not have lost sight of the fact that Bachman was represented by two prominent law firms from New York and Washington D.C. with no less than three attorneys at the defense table each day of trial. Since Bachman was a retired airline pilot, the jury had ample reason to speculate where the source of funds for the enormous defense costs of this lengthy trial was coming from even if no witness ever mentioned the word insurance.

*7 In continuing the requisite analysis as to the correctness of the verdict, CPLR § 5501(c) states, in relevant part:

In reviewing a money judgment in an action in which an itemized verdict is required in which it is contended that the award is ... inadequate and that a new trial should have been granted unless a stipulation is entered to a different award, the appellate division shall determine that an award is ... inadequate if it deviates materially from what would be reasonable compensation.

Trial courts may also apply this material deviation standard in overturning jury awards but should exercise

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its discretion sparingly in doing so. *Shurgan v. Tedesco*, 179 A.D.2d 805, 578 N.Y.S.2d 658 (2nd Dept., 1992); *Prunty v. YMCA of Lockport*, 206 A.D.2d 911, 616 N.Y.S.2d 117 (4th Dept., 1994); see also, *Donlon v. City of New York*, 284 A.D.2d 13, 727 N.Y.S.2d 94 (1st Dept., 2001) (implicitly approving the application of this standard at the trial level). For guidance, a trial court will typically turn to prior verdicts approved in similar cases, but must undertake this review and analysis with caution not to rigidly adhere to precedents (because fact patterns and injuries in cases are never identical) and/or substitute the court's judgment for that of the jurors whose primary function is to assess damages. *Po Yee So v. Wing Tat Realty, Inc.*, 259 A.D.2d 373, 374, 687 N.Y.S.2d 99, 101 (1st Dept., 1999).

With the exception of the conceded reduction for past medical expenses, this Court finds that the jury were able to assess the severity of Salvatore's physical injuries, his physical and mental disorders, his historic and current treatment therefor and his poor prognosis. Accordingly, the pain and suffering and medical expenses awards did not deviate materially from what would be reasonable compensation under the circumstances. *Barrowman v. Niagara Mohawk Power Corp.*, 252 A.D.2d 946, 675 N.Y.S.2d 734 (4th Dept., 1998). Thus, the branches of Bachman's post-verdict motion for remittitur and plaintiffs' cross-motion for additur as to these awards are respectively denied.

Plaintiffs' expert's *per se* calculations of Salvatore's past loss of earnings (\$460,713) and future loss of earnings (\$774,892) were essentially unchallenged. Plaintiff had sufficient job continuity as a porter for Dr. Leiken to properly rely on Salvatore's 1992 annualized salary of \$32,380 and it was perfectly reasonable for this economist to utilize a conservative rate of interest of 3.5% set by the U.S. Department of Labor to calculate annual salary increases (after 25 years, the U.S. Department of Labor set an increase rate of 4.5% which Dr. Leiken utilized for the year 2005 and going forward) to compute these losses. Bachman submitted no evidence of negotiated union contracts covering Salvatore's job title which contained annual salary increases which were lower than the percentage increases Dr. Leiken relied

upon for his calculations. All of defendant's challenges to the loss of earnings awards are meritless and unsupported by trial evidence (e.g., Salvatore would have left his job as a porter to become a full-time Con Edison meter reader, etc.). In short, the expert's reliance on certain facts as well as certain fair and reasonable assumptions and his calculations based thereon are fully supported by the extensive trial record. *Diaz v. West 197th Street Realty Corp.*, 290 A.D.2d 310, 736 N.Y.S.2d 361 (1st Dept., 2002).

*8 Concerning the jury's awards to Ana LaMasa for loss of services, the trial record amply established that since the Collision in 1992 and during the ensuing years, Salvatore's physical and mental condition precipitously declined and Ms. LaMasa was forced to assume his familial duties in addition to her own and to provide for her family's financial welfare. The jury has had the opportunity to assess her trial testimony and the corroborating testimony of her children as to the diminished quality of her life with Salvatore. And as borne out by expert testimony, Ana LaMasa must continue to spend the rest of her life providing "24/7" care to a spouse with, *inter alia*, severe psychiatric/psychological disorders, a role which renders her a "captiv[e][to] her marital responsibilities ..." (Flomenhaft Aff. in support of Cross-Motion at ¶ 94). Therefore, the \$500,000 total award to Ana LaMasa for loss of services similarly does not deviate from what would be reasonable compensation under her circumstances. *Cf., Dooknah v. Thompson*, 249 A.D.2d 260, 670 N.Y.S.2d 919 (2nd Dept., 1998).

In addition, the cost of medical insurance is a component of lost income and in Salvatore's case constituted a "soft dollar" benefit he had been receiving under his union contract and potentially would have been receiving had he continued working as a porter until age 65. The costs for obtaining medical insurance coverage and unreimbursed medical expenses are clearly not one and the same (see, *Schlachet v. Schlachet*, 176 A.D.2d 198, 574 N.Y.S.2d 320 [1st Dept., 1991]). Accordingly, the expert's calculation of medical insurance costs were fair and reasonable and the jury awards based thereon do not constitute a double recovery for past and future medical expenses.

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(Table, Text in WESTLAW), Unreported Disposition

(Cite as: 2005 WL 1364515 (N.Y.Sup.))

As noted earlier, Bachman took issue with this Court's somewhat novel ruling to amend the verdict sheet to add two additional categories of damages for past and future loss of medical insurance and future loss of social security benefits as components of lost earnings/income. Plaintiffs' counsel's request for this change was made immediately after summations and completion of the jury charge and just prior to deliberations. While conceding this amendment was unorthodox, nonetheless, Bachman has failed to show how the amendment to the verdict sheet prejudiced defendant's substantive and due process rights. First, defendant did not proffer his own expert economist to take issue with any of Dr. Leiken's testimony and particularly the calculations of these components of lost income. Second, defendant's counsel's closing argument did not even address any deficiencies, vis-a-vis, Dr. Leiken's trial testimony including his calculation of the past and future loss of earnings and their sub-categories. It cannot be said that Bachman's counsel relied on the pre-amendment version of the jury verdict sheet to structure his summation and therefore had been prejudiced by the inclusion of these new sub-categories of loss of earning damages on the verdict sheet ultimately introduced to, and considered by, the jury with additional jury instructions. Finally, defendant has neither shown that this verdict sheet amendment violated any trial rule or procedure nor constituted an abuse of this Court's discretion.^{FN18}

FN18. Unlike the sub-category of loss of medical insurance, defendant's counsel apparently recognized some merit to the jury award for loss of social security benefits when, in the alternative, counsel requested the court to reduce this award from \$122,273 to \$80,700. (Murphy Aff. at ¶ 98 annexed to Bachman Motion).

*9 To conclude this discussion, it is necessary to address defendant's requests for costs and attorneys' fees in mounting a vigorous defense opposing the potential admissibility of expert testimony about QEEG and PET scan studies plaintiff was relying upon to corroborate Salvatore's TBI caused by the Collision. While this Court ruled that the QEEG and PET scan studies did not meet the *Frye* standard to warrant their admission and

granted Bachman's *in limine* motions to preclude such testimony with respect thereto, plaintiffs' counsel's trial strategy to proffer such data as evidence of TBI in low to moderate impact collisions was not beyond the pale and certainly not frivolous. Nor can QEEG and PET data be viewed as junk science. In addition, counsel's withdrawal of certain expert witnesses who would otherwise have testified utilizing QEEG and PET studies was directly due to this Court's bench colloquy and rulings on the record. Parenthetically, defendant's counsel overlooks the fact that this Court conducted a *Frye* inquiry relying on dueling expert affidavits and respective supporting scientific literature as well as dueling affirmations and memoranda of law; all without the need for either party to incur the exorbitant cost of producing experts for a formal *Frye* hearing. While this Court concluded expert testimony relying on these tests did not meet the *Frye* standard at this time; still, these tests and related research are "works in progress" as to their potential, broad-based applications in the diagnosis and treatment of disease. Thus, there is simply no legal/factual basis to invoke any 22 NYCRR § 130-1.1 sanction against plaintiffs and their counsel for attempting to proffer evidence of Salvatore's TBI utilizing QEEG and PET studies to support their case.

For the foregoing reasons, this Court grants the unopposed branch of defendant's post-verdict motion reducing the award for past medical expenses from \$40,768 to \$25,000. In all other respects, the remaining branches of defendant's motion and plaintiffs' cross-motion are respectively denied. Plaintiffs shall submit a proposed money judgment, on notice, for signature consistent with this Court's Decision and Order. This constitutes the Decision and Order of this Court. Courtesy copies of same have been provided to counsel for the parties.

N.Y.Sup.,2005.

Lamasa v. Bachman

Slip Copy, 8 Misc.3d 1001(A), 2005 WL 1364515 (N.Y.Sup.), 2005 N.Y. Slip Op. 50882(U)

END OF DOCUMENT

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RECEIVED

JUL 19 2006

FILED DISTRICT COURT
Third Judicial District

JUL 17 2006

SALT LAKE COUNTY

By Deputy Clerk

IN THE DISTRICT COURT OF THE THIRD JUDICIAL DISTRICT

IN AND FOR SALT LAKE COUNTY, STATE OF UTAH

ESPRA ANDRUS,	:	COURT'S RULING
Plaintiff,	:	CASE NO. 040904243
vs.	:	
MARK RUSSELL FULGHAM and STANDARD	:	
PLUMBING SUPPLY, INC.,	:	
Defendants.	:	

The Court has before it a request for decision filed by the defendants seeking a ruling on defendant Standard Plumbing Supply, Inc.'s ("Standard Plumbing's") Motion in Limine to Exclude Novel Scientific Testimony and Evidence. Standard Plumbing's Motion seeks to exclude the plaintiff's evidence based on diffusion tensor imaging (DTI), arguing that it is a novel method of imaging and one that is inherently unreliable.

The plaintiff has filed an Opposition to this Motion, detailing the reliability of DTI testing and citing a recent case which admitted DTI evidence over objections similar to those being made by Standard Plumbing. In addition, the plaintiff has referenced a wide array of medical literature and articles discussing DTI, its acceptance in the neuro-imaging field and its usefulness in diagnosing and evaluating brain

ANDRUS V. FULGHAM

PAGE 2

COURT'S RULING

injuries and abnormalities, where more conventional imaging has been less reliable.

The Court notes that Standard Plumbing did not file a reply to the plaintiff's Opposition and therefore has not controverted the numerous medical authorities relied on by the plaintiff in arguing that DTI testing is reliable. Under these circumstances, the Court is persuaded by the plaintiff's position and determines that while DTI Imaging is a developing technology, there is nothing to suggest that it is inherently unreliable or inadmissible under the standards set forth in Rimmasch. Therefore, Standard Plumbing's Motion in Limine is denied.

This Court's Ruling will stand as the Order of the Court, denying Standard Plumbing's Motion in Limine.

Dated this 17 day of July, 2006.

(S)
LESLIE A. LEWIS
DISTRICT COURT JUDGE

ANDRUS V. FULGHAM

PAGE 3

COURT'S RULING

MAILING CERTIFICATE

I hereby certify that I mailed a true and correct copy of the foregoing Court's Ruling, to the following, this 17 day of July, 2006:

Elizabeth A. Bowman
Attorney for Plaintiff
8 E. Broadway, Suite 413
Salt Lake City, Utah 84111

John M. Chipman
Attorney for Defendant Standard Plumbing
215 S. State Street, Suite 500
Salt Lake City, Utah 84111

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STATE OF MINNESOTA
COUNTY OF WASHINGTON

**F
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File # _____
WASHINGTON COUNTY
DISTRICT COURT
JAN 17 2014
COURT ADMINISTRATOR

**F
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DISTRICT COURT
TENTH JUDICIAL DISTRICT

By Deputy

Chelsea Nordstrom,
Plaintiff,

ORDER

vs.

File No. 82-CV-11-5842

Fleet Farm of Menomonie, Inc. a
Wisconsin corporation d/b/a Mills
Fleet Farm,
Defendant.

The above-entitled case came on for hearing before the undersigned, the Honorable Richard C. Ilkka, Judge of the above-named Court, at the Washington County Government Center, Stillwater, Minnesota, on November 15, 2013.

William D. Harper, Esq., appeared on behalf of Plaintiff. John A. Cotter, Esq., and John A. Kvinge, Esq., appeared on behalf of Defendant.

Based upon the entire file, records and proceedings herein, the Court makes the following:

ORDER

1. Defendant's motion to exclude all evidence of the results of the March 26, 2012 diffusion tensor imaging (DTI) study is **DENIED**.
2. Defendant's motion to preclude Plaintiff's experts from testifying regarding DTI is **DENIED**.
3. Defendant's motion to prohibit Plaintiff from utilizing the DVD containing computer animations of Plaintiff's DTI scan compared to a normal control is **GRANTED**.

4. Defendant's motion to prohibit Plaintiff from offering the testimony of Dr. Myers, is **GRANTED**.

5. Defendant's motion to exclude the testimony of Dr. Wu is **DENIED**.

6. Defendant's motion to prohibit Plaintiff from calling Dr. Adam is **DENIED**.

7. Defendant's motion to prohibit Plaintiff from calling Thomas M. Misukanis, PhD, is **DENIED**.

8. Defendant's motion to prohibit Plaintiff's retail safety expert J. Terrence Grisim from testifying that industry standards required the cabinet to be secured and that the cabinet could not withstand expected interactions unless secured is **GRANTED**.

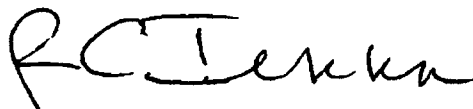
9. Defendant's motion to exclude Mr. Grisim's opinions regarding the ultimate issues of negligence and causation is **GRANTED**.

10. The attached Memorandum is made a part hereof by reference.

11. The Washington County Court Administrator shall mail a copy of this Order by U.S. Mail to counsel for the parties. Such mailing shall constitute due and proper service of this Order for all purposes.

Dated: _____

1-17-2014



Richard C. Ilkka
Judge of District Court

**STATE OF MICHIGAN
IN THE WAYNE COUNTY CIRCUIT COURT**

JOSEPH G. RYE and ANNE V. RYE,

Plaintiffs,

v.

KIA MOTORS AMERICA, INC., a
foreign corporation, and DICK SCOTT KIA CANTON,
INC., A Michigan corporation,

Defendants.

RYE JOSEPH G v KIA MOTORS AMERICA
Hon. Robert L Ziolkowski 01/12/2007



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**ORDER ON DEFENDANTS' MOTION IN LIMINE TO PRECLUDE TESTIMONY OF
DR. RANDALL BENSON**

At a session of said Court held in the City of Detroit,
County of Wayne, State of Michigan

on **FEB 16 2010**

PRESENT: HONORABLE **ROBERT L ZIOLKOWSKI**
Circuit Court Judge

This matter having come before the Court upon Defendants' Motion in Limine to


Preclude Testimony of Dr. Randall Benson; the Court having heard oral argument; and
being otherwise fully advised in the premises;

IT IS HEREBY ORDERED that Defendants' Motion is DENIED.

SO ORDERED.

ROBERT L. ZIOLKOWSKI
CIRCUIT COURT JUDGE

Approved as to form:


Counsel for Plaintiff


Counsel for Defendants

A TRUE COPY
CATHY M. GARRETT
WAYNE COUNTY CLERK
BY Bulkes DEPUTY CLERK

14

IN THE 20TH JUDICIAL CIRCUIT COURT
IN AND FOR COLLIER COUNTY, FLORIDA

CASE NO. 08-05836-CA

**Condensed
Transcript**

BARBARA SWORIN,

Plaintiff,

v.

LARRY HARRIS,

Defendant.

TRANSCRIPT OF PROCEEDINGS

DATE: January 13, 2014
TIME: 9:50 a.m. to 12:17 p.m.
LOCATION: Collier County Courthouse
3315 Tamiami Trail East
Naples, FL 34112
BEFORE: Hon. Cynthia Pivacek
REPORTER: Karen White, FPR, RPR, CRR

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1 has written, and you have his affidavit that he is
2 actively researching DTI in traumatic brain injury.

3 And just when Miss Weaver talks about groups
4 versus individuals, of course a group is a group of
5 individuals, but the key issue is the -- they talk
6 about inter-subject differences. So when the
7 studies do group studies, the group as a whole maybe
8 has a deficit in one area, but if you compared the
9 individuals, some of them would not have a deficit
10 in that area.

11 That's what we talk about when we talk about
12 individual versus group studies. And that's what
13 the Hulkower, the "10 Years and 100 Articles" talks
14 about, an area that needs further research in
15 inter-subject differences, because not everybody's
16 brain injury is the same.

17 So those are the two points I wanted to make.

18 THE COURT: Okay. Very good. All right then.
19 I'm going to be denying the defense motion to
20 exclude the opinions and expert report and testimony
21 of plaintiff's expert, Randall Benson, M.D. That's
22 the way the motion is styled.

23 I'm going to be asking Miss Weaver to draft an
24 order on this --

25 MS. WEAVER: Yes, ma'am.

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1 THE COURT: -- unless you brought a proposed.
2 I don't know if you did.

3 MS. WEAVER: Yes, ma'am.

4 THE COURT: Okay. Can we go off the record for
5 a moment?

6 MR. MORRIS: Sure.

7 THE COURT: Yes, Miss Harris -- Miss Weaver?

8 MS. WEAVER: Huh?

9 MR. MORRIS: Can we go off the record?

10 THE COURT: Can we go off the record for a
11 minute?

12 MS. WEAVER: Yeah, yes.

13 (Discussion off the record.)

14 THE COURT: Do you want to go on the record
15 then?

16 MS. WEAVER: Yes, ma'am.

17 THE COURT: Very good. So then basically in
18 summary, Counsel, you'll submit a proposed order,
19 and we'll be relying only on the submissions that
20 the Court received prior to the hearing --

21 MS. WEAVER: Yes, ma'am.

22 THE COURT: -- and the argument, of course,
23 before the Court.

24 Okay. Now, there was another issue that was
25 raised in terms of defendant's expert witness,

Page 92

1 Dr. Alan Raphael. And he hired, apparently, his own
2 attorney, and there's some question as to what
3 documents he's going to be bringing to the
4 deposition.

5 MS. WEAVER: He has with -- been withdrawn by
6 defense counsel as an expert --

7 THE COURT: Oh.

8 MS. WEAVER: -- so that issue is resolved.

9 THE COURT: Oh.

10 MS. WEAVER: However, we do have a court order
11 that is directed to him and Dr. Golden to produce
12 the raw materials. And I hired an expert to look at
13 the raw materials because, although I think I know
14 them, I didn't mean to make a representation to you.

15 There are three tests that were given to her
16 that they did not give us the raw material. I know
17 this is not Mr. Morris' fault. I told him I would
18 supply him with that report and ask him to go back
19 and ask for that raw data. If he is not able to get
20 it, then I will come back to the Court and ask you
21 to address it, please.

22 THE COURT: Okay. But if -- if Dr. Raphael is
23 not going to be called, was his material then relied
24 upon by other experts?

25 MS. WEAVER: Yes, ma'am.

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1 THE COURT: Okay. So you obviously are going
2 to need to have that material.

3 MS. WEAVER: Yes, ma'am.

4 THE COURT: Okay. Or it would appear that you
5 would need that material. And I do appreciate that
6 you made it very clear, you know, that Mr. Morris
7 wasn't being an obstructionist on that particular
8 issue.

9 MR. MORRIS: As do I.

10 THE COURT: Excuse me?

11 MR. MORRIS: As do I. I appreciate that.

12 THE COURT: I don't see that very often.

13 Okay. Are we all done?

14 MS. WEAVER: Yes, ma'am.

15 THE COURT: Where are we in terms of -- we
16 don't have a set trial.

17 MS. WEAVER: Your Honor has said that the
18 discovery is to be concluded January 30th, and we
19 have a mediation set February 6th.

20 THE COURT: Okay.

21 MS. WEAVER: The only quirk in that discovery
22 is they want to take a deposition of a woman in
23 Kentucky, and I -- from what I understand, Richard,
24 her mother has died now, and I have been desperately
25 trying -- not me personally, my staff. And we

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IN THE CIRCUIT COURT OF THE
20TH JUDICIAL CIRCUIT IN AND
FOR COLLIER COUNTY, FLORIDA

GENERAL JURISDICTION DIVISION

CASE NO. 08-05836-CA

BARBARA SWORIN,

Plaintiff,

v.

LARRY HARRIS,

Defendant.

**MEMORANDUM FOR ORDER DENYING DEFENDANT, LARRY
HARRIS' MOTION TO EXCLUDE THE OPINIONS AND EXPERT
REPORT OF PLAINTIFF'S EXPERT RANDALL BENSON, M.D.**

Plaintiff, BARBARA SWORIN, moves the Court for an Order denying Defendant, LARRY HARRIS' Motion to Exclude the Opinions and Expert Report of Plaintiff's Expert Randall Benson, M.D. on the following grounds.

SUMMARY OF ARGUMENT

THE DAUBERT STANDARD

Effective July 1, 2013, the Florida Legislature rewrote Florida Statute 90.702 Testimony by experts (Laws 2013, c. 2013-107). The Preamble (Laws 2013, c.2013-107) states:

"WHEREAS, the Supreme Court of the United States in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993) replaced the standard for expert testimony in all federal courts that was first articulated in *Frye v. United States*, 293 F.2d 1013 (D.C. Cir 1923) with a new standard that is known as the *Daubert* standard, and

"WHEREAS, the United States Supreme Court has subsequently reaffirmed and refined the *Daubert* standard in the cases of *General Electric Co. v. Joiner*, 522 U.S. 136 (1997) and *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999), and

"WHEREAS, Florida's Evidence Code is generally patterned after the Federal Rules of Evidence,

"WHEREAS, Rule 702 of the Federal Rules of Evidence, applicable to all federal courts, was amended in 2000 to reflect the holdings in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993), *General Electric Co. v. Joiner*, 522 U.S. 136 (1997) and *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999), and

"WHEREAS, as a result of the 2000 amendment, Rule 702 of the Federal Rules of Evidence provides that:

"A witness who is qualified as an expert by knowledge, skill, experience, training, or education may testify in the form of an opinion or otherwise if:

- "(a) The expert's scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue;
- "(b) The testimony is based on sufficient facts or data;
- "(c) The testimony is the product of reliable principles and methods; and
- "(d) The expert has reliably applied the principles and methods to the facts of the case; and

"WHEREAS, by amending s. 90.702, Florida Statutes, to pattern it after Rule 702 of the Federal Rules of Evidence as amended in 2000, the Florida Legislature intends to adopt the standards for expert testimony in the courts of this state as provided in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993), *General Electric Co. v. Joiner*, 522 U.S. 136 (1997) and *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999), and to no longer apply the standard in *Frye v. United States*, 293 F.2d 1013 (D.C. Cir 1923) in the courts of this state, and

"WHEREAS, by amending s. 90.702, Florida Statutes, the Florida Legislature intends to prohibit in the courts of this

state pure opinion testimony as provided in Marsh v. Valyou, 977 So.2d 543 (Fla. 2007), NOW THEREFORE,"

[90.702 Florida Statutes is amended as follows]:

If scientific, technical, or other specialized knowledge will assist the trier of fact in understanding the evidence or in determining a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education may testify about it in the form of an opinion or otherwise, if:

- (1) The testimony is based upon sufficient facts or data;
- (2) The testimony is the product of reliable principles and methods; and
- (3) The witness has applied the principles and methods reliably to the facts of the case.

Nature of the Trial Court's "Gatekeeping" Scrutiny

A district court's gatekeeper role under *Daubert* "is not intended to supplant the adversary system or the role of the jury. Allison v. McGhan, 184 F.3d 1300, 1311 (11th Cir. 1999). "Vigorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof are the traditional and appropriate means of attacking [debatable] but admissible evidence." Allison v. McGhan, 184 F.3d 1300, 1311 (11th Cir. 1999) (quoting *Daubert*, 509 U.S. at 596, 113 S.Ct at 2786) "[F]ederal district courts ... perform [their] important gatekeeping function by screening the reliability of all expert testimony, but they have substantial discretion in deciding how to test an expert's reliability and whether the expert's relevant testimony is reliable."

While the trial court must function as the "gate-keeper," and must critically analyze and apply the *Daubert* factors to the expert opinions that are the subject of the admissibility challenge in question, there is no requirement that the trial court hold a hearing in ruling upon the *Daubert* challenges. U.S. v. Taylor, 262 F.3d 1217, 1234 (11th Cir. 2001); City of Tuscaloosa v. Harcros Chemicals Inc., 158 F.3d 548 (11th Cir. 1999).

**DIFFERENTIAL DIAGNOSIS AND DIFFUSION TENSOR IMAGING (DTI) -
THE MEDICINE AND THE SCIENCE AS IT APPLIES TO BARBARA SWORIN**

The memorandum and the affidavits filed by defendant in this case suggest DTI (Diffusion Tensor Imaging) is the sole diagnostic tool being used in this matter. The defendant incorrectly argues that this is a mild traumatic brain injury and that there is no support in the medical or scientific community for the clinical use of DTI in conjunction with other diagnostic tools to evaluate the result of a traumatic brain injury. Further, the defendant incorrectly suggests that the use of DTI as a part of a differential diagnosis is frowned upon if the matter is in litigation.

The three themes of the defendant are not supported by the medical records in this case and are not supported by the vast majority of scientific papers published concerning this particular diagnostic tool. It is notable that more than five of the "scientific" cites referred to in the motion are quotes from an article written by Hal Wortzel. The article written by Dr. Wortzel was published in a peer-review journal but the journal simply dealt with the use of scientific evidence in litigation. Dr. Wortzel opined that the use must be looked at carefully as its use MAY be used improperly. Dr. Wortzel is NOT EVEN AN EXPERT in Diffusion Tensor Imaging. **Exhibit #1 is the testimony of Dr. Wortzel that did not arrive prior to the time of filing this Memorandum.** He did not publish on the science itself and, in fact, Dr. Wortzel has admitted under oath that he is not an expert on DTI and cannot interpret DTI imaging. A copy of his testimony has been ordered and will be presented with all exhibits on January 6, 2014 which is the final date for submission of exhibits in this case.

Plaintiff further points out to the Court that the two experts retained by defendant to testify concerning the DTI study done in this matter on Barbara Sworin did not even

review the study and nowhere in their affidavit do they dispute the findings of Dr. Randall Benson. Dr. Benson has been recognized as one of the leading authorities on DTI in the world. **See Exhibit #2 attached hereto.**

Plaintiff, in this memorandum, will quote from various articles written by Dr. Benson and other scientists who are qualified to interpret Diffusion Tensor Imaging but will not attach the entire publications to this memorandum as there is too much material for electronic filings of the entire publications. It is respectfully suggested that the Court should look at the affidavits of the defendant's chosen experts with some degree of skepticism as neither Dr. Zimmerman nor Dr. Schmahmann have REVIEWED THE DTI STUDIES that are being challenged. **See the ASFNR Guidelines for Clinical Application of Diffusion Tensor Imaging attached hereto as Exhibit #3-A and DTI studies/articles attached hereto as Exhibit #3-B.** When the Court allowed the addition of Dr. Benson in this matter, the Court allowed the defendant to add TWO additional experts to rebut his opinion and the defendant chose two experts who have not even reviewed the DTI images which are the subject of Dr. Benson's testimony and do not suggest Dr. Benson's analysis was wrong.

As an introduction to the use of DTI in evaluating traumatic brain injury, the plaintiff attaches to this memorandum testimony of Dr. Benson before the United States Congress in which he was requested to testify and explain the science of DTI and its appropriate use in traumatic brain injury. **See Exhibit #4 attached hereto.**

The appropriateness of the use of DTI in evaluating Barbara Sworin's traumatic brain injury is shown by addressing the other medical records concerning her injury and the differential diagnosis of brain injury which is the opinion of ALL of her treating

doctors. Their diagnosis of brain injury and the anatomical location of such injury was made long before Dr. Benson ever examined and evaluated Mrs. Sworin. Dr. Benson's evaluation from a 4- to 5-hour neurological examination coupled with imaging fully supports and verifies the clinical diagnosis made by her treating physicians.

Defendant argues that this portion of the differential diagnosis should be denied to the jury. Such a denial is a drastic action as noted in numerous Court opinions interpreting the *Daubert* standards, and the defendant asks this Court to be the first one in the United States to deny the jury this information based on the affidavits of two medical doctors who did not interpret these images.

DIFFERENTIAL DIAGNOSIS OF TRAUMATIC BRAIN INJURY

Differential Diagnosis as defined in Dorland's Medical Dictionary for Health Consumers:

1. The determination of which one of several diseases may be producing the symptoms.

Diagnosis as defined in The American Heritage Dictionary:

1. The act or process of identifying or determining the nature and cause of a disease or injury through evaluation of patient history, examination and review of laboratory data.
2. The opinion derived from such an evaluation.

Diagnosis as defined in Mosby's Medical Dictionary:

1. Identification of a disease or condition by a scientific evaluation of physical signs, symptoms, history, laboratory test results, and procedure.
2. The art of naming a disease or condition.

Medical Diagnosis – Diagnosis based on information from sources such as findings from a physical examination, interview with the patient or family or both, medical history of the patient and family, and clinical findings as reported by laboratory tests and radiological studies.

In this matter, the plaintiff's counsel will ask the treaters and retained experts if they have reached a diagnosis with reference to the plaintiff's disease or injury and, if so, have they used as their methodology the process of differential diagnosis. When

they testify they have used this accepted methodology, plaintiff will ask them:

1. To explain in detail the methodology they used in exact, precise steps,
2. the reason for each part of the information obtained (i.e., why this information was necessary to properly reach a diagnosis within medical certainty,
3. what information was obtained,
4. the significance of each piece of information,
5. how other potential "diagnoses" were eliminated within reasonable medical certainty; and
6. why a final diagnostic decision was made as to the etiology of plaintiff's problems.

Plaintiff will then ask what is the differential diagnosis within reasonable medical certainty.

Standards for expert medical testimony require that the opinions rendered be reached by a scientific medical method which is accepted as appropriate within the medical field and which is reached by a methodology that is accepted within the medical community. The use of differential diagnosis to come to the decision of etiology is the basis of all medical decisions as to treatment and prognosis.

The use of DTI is accepted within the medical community as a diagnostic component of the opinion being medically rendered. The use of DTI for causation is acceptable in conjunction with the other components of a differential diagnosis. No single component of a diagnosis can stand on its own, but rather each element makes a contribution to causation and/or is CONFIRMATORY of the condition that has been diagnosed by signs and symptoms.

This can be analogized to a medical diagnosis of a condition and its cause. For

example, damage to the pituitary gland is the likely cause of the problems the patient has and the imaging of the pituitary gland shows it has atrophied. The cause of the atrophy can be disease or trauma, so the medical professional looks to the onset of the symptoms, the premorbid function of the pituitary gland, the incident that is consistent with injury to the gland, the ongoing problems, and the time which the signs and symptoms first manifested themselves. Thus, the abnormal finding on the imaging combined with the clinical signs and symptoms and their onset lead to the final diagnosis of injury to the pituitary gland rather than disease. Barbara Sworin has a pituitary gland injury.

In this matter, axon water diffusion is a component that stands as one element of the causation opinion or can stand as a confirmatory diagnostic tool. The treating doctors in this matter have already made a diagnosis of traumatic brain injury and the imaging results did confirm the diagnosis that the brain did suffer injury when her head was slammed against a metal pole at 26 mph.

Barbara Sworin was a guest aboard a boat driven by Larry Harris at an excessive speed in an area known to have underwater hazards such as sandbars. The evidence in this case will show that the speed at which her head slammed against a metal pole was approximately 26 mph. The forces, as testified to by one of her treating doctors, were the equivalent of being kicked in the head by a horse or being slammed in the head with a baseball bat.

She was not examined by anyone with any training for almost 30 minutes. As has been testified to by experts in this matter, the evidence in this case will show that one cannot make a final determination as to the degree of brain injury based solely on the

condition of the survivor at the acute stage of the injury. This is particularly true when the survivor has sustained serious other injuries which cause severe pain. The evidence in this case as provided by Dr. Gregory O'Shanick and others will show that mild to moderate and occasionally even severe TBI is missed if the patient has suffered other severe injuries which will be addressed first and that the final diagnosis as to the degree of TBI often comes later after the seriously painful injuries have been successfully addressed. Dr. O'Shanick will explain that serious painful injuries are addressed first and conditions depicting brain injury are often ignored or attributed to confusion arising from pain and pain medications and not recognized as TBI symptoms until the painful injuries are resolved that the pain medications are diminished or discontinued.

Although the defendant (and others) relies upon the Glasgow Coma Scale at the time of injury to define the degree of brain injury, their reliance is misplaced. The information scale which was designed to assist in serial evaluations and to provide an easy-to-use assessment tool for relatively inexperienced care providers, has mistakenly been utilized to "diagnose the degree of brain injury in the acute stage".

Annals of Emergency Medicine

"Clinical policy: Neuroimaging and decisionmaking in adult mild traumatic brain injury in the acute setting****"

Authors: Andy S. Jagoda, MD, Stephen V. Cantrill, MD, Robert L. Wears, MD, MS, Alex Valadka, MD, E. John Gallagher, MD, Steven H. Gottesfeld, DO, Michael P. Pietzak, MD, Jason Bolden, MD, John J. Bruns Jr., MD, Robert Zimmerman, MD.

"Historically, the system most often used for grading severity of brain injury is the GCS score. The phrase "MTBI" is usually applied to patients with a score of 13 or greater. Some authors have suggested that patients with a GCS score of 13 be excluded from the "mild" category and placed

into the "moderate" risk group because of their high incidence of lesions requiring neurosurgical intervention.¹² Lesions requiring neurosurgical intervention may not be the only injuries that require identification. In a prospective study, patients with a GCS score of 13 or greater were grouped according to the presence or absence of head abnormalities.¹³ Despite having the same GCS score, those patients with intraparenchymal lesions performed on neuropsychological testing similar to those patients categorized as having moderate TBI by GCS criteria.

Created by Teasdale and Jennett¹⁴ in 1974, the GCS was developed as a standardized clinical scale to facilitate reliable interobserver neurologic assessments of comatose patients with head injury. The original studies applying the GCS score as a tool for assessing outcome required that coma be present for at least 6 hours.^{15 16} The scale was not designed to diagnose patients with mild or even moderate TBI nor was it intended to supplant a neurologic examination. Instead, the GCS was designed to provide an easy-to-use assessment tool for serial evaluations by relatively inexperienced care providers and to facilitate communication between care providers on rotating shifts.¹⁴ This need was especially great because CT scanning was not yet available. Since its introduction, however, the GCS has become quite useful for diagnosing severe and moderate TBI and for prioritizing interventions in these patients. Nevertheless, for MTBI, a single GCS score is of limited prognostic value and is insufficient to determine the degree of parenchymal injury after trauma.¹⁴ On the other hand, serial GCS scores are quite valuable in patients with MTBI. A low GCS score that remains low or a high GCS that decreases predicts a poorer outcome than a high GCS score that remains high or a low GCS score that progressively improves.^{13 16 17} To illustrate this, in their original paper, Teasdale and Jennett¹⁴ presented a patient who was admitted to the neurosurgical intensive care unit (NICU) with a GCS score of 14. The NICU chart reflected hourly scores of 14 for 3 hours, followed by a decline to 13 and then to 4, at which point the patient was taken to the operating room for evacuation of a subdural hematoma."

¹²Stein SC, Ross SE. The value of computed tomographic scans in patients with low risk head injuries. *Neurosurgery*. 1990;26:638-640.

¹³Williams DH, Levin HS, Eisenberg HM. Mild head injury classification. *Neurosurgery*. 1990;27:422-428.

¹⁴Teasdale G, Jennett B. Assessment of coma and impaired consciousness: a practical scale. *Lancet*. 1974;2:81-84.

¹⁵Teasdale G, Jennett B. Assessment and prognosis of coma after head injury. *Acta Neurachir (Wien)*. 1976;34:45-55.

¹⁶Jennett B, Teasdale G, Galbraith S, et al. Severe head injuries in three countries. *J Neurol Neurosurg Psychiatry*. 1977;40:291-298.

¹⁷Shackford SA, Wald SL, Ross SE, et al. The clinical utility of computed tomographic scanning and neurologic examination in the management of patients with minor head injuries. *J Trauma*, 1992;33:385-394.

It is interesting to note that **one of the** experts chosen by the defendant to label this a MTBI, in part by relying on the Glasgow Coma Scale, is Dr. Robert D. Zimmerman who is an author of the above scientific explanation of Glasgow Coma Scale. Plaintiff will later, in this memorandum, identify other articles by Dr. Zimmerman which deal with the opinions set forth in his affidavit and contradict same. **See Exhibit #5 attached hereto.**

To understand the clinical diagnosis of moderate TBI which has been rendered after many years of evaluating Mrs. Sworin's deficits, it is important to track the path of the medical records as it became apparent that her problems in functioning were not arising from the severe pain and multiple surgeries which occurred for the first 14 months following this insult to her brain. It is important to note how cursory and inaccurate the evaluations at the scene and in the hospital were in addressing her injuries.

The EMS does not respond until 30 minutes after the accident. In addition to saying the Glasgow Coma Scale is 15, the EMS goes on to note "slight edema to face, no crepatus, full range of motion to jaw and no loose teeth". All of the above notations are inaccurate. We attach hereto a picture of Barbara after the injury and note the medical records show she had a complete blow out fracture of the orbit, a massive fracture of the zygomatic bone which is the strongest bone in the face, significant injury

to her jaw and multiple injuries to her teeth. **See Exhibit #6 attached hereto.** The EMS also fails to note the severe pain. The EMS findings are a quick snapshot of time and cannot be relied upon to evaluate the degree of injury. Dr. O'Shanick will explain that a finding of no confusion 30 minutes after the accident is not diagnostic of the degree of head injury and general knowledge of sporting concussions has shown the player up and alert and waving to the crowd in much less than 30 minutes. Upon arrival at the Emergency Department, it was noted that Barbara had a GCS of 15 but visible deformity was also noted and she had a pain level of 10/10. A 10/10 range is a pain level of 10 in a scale with 10 being the worst pain possible.

In the peer-reviewed article, "Accuracy of Mild Traumatic Brain Injury Diagnosis", the authors and investigators found that 56% of the time MTBI is missed in the Emergency Departments. **See Exhibit #7 attached hereto.** In this case, with Barbara reporting a pain level of 10 out of 10 and with the CT scan of her face showing extensive and massive fractures, it led to a quick decision to discharge her and send her home for surgery in Kentucky. The Emergency Department recognized the degree of injury would require lengthy and extensive surgery and medical care. The evidence will show that when someone is in very severe pain, it is all but impossible to ferret out whether their behavior is related to the pain or if there is an additional component. After a lengthy evaluation at Dr. O'Shanick's rehabilitation center, Dr. O'Shanick diagnosed Barbara's brain injury as MODERATE and not mild. **See Exhibit #8 attached hereto.** The diagnosis of MTBI in the initial stages of the insult can readily be wrong as the diagnosis is not based on a full differential evaluation but rather on Emergency Department standards of determining whether there is a hemorrhage or swelling. The

Emergency Department's determination that extensive surgery and medical care would be needed for Barbara's injuries was accurate.

When returning home, Barbara received a continuing and in-depth evaluation. Her treatment included surgery to stabilize numerous fractures, jaw braces and extensive dental procedures to address the teeth that were moved by the blow and were dying. **See above Exhibit #6 attached hereto.**

Between June of 2007 and early July of 2008, Barbara was seen by multiple physicians and had multiple trips to the hospital in an attempt to get her severe pain under control. **See Exhibit #9 attached hereto.** The medical records show approximately 60 different visits to doctors and hospitals as they tried to address her numerous serious injuries and severe pain. The records further note that, during this time, she was repeatedly prescribed narcotic pain medication.

Finally in July of 2008, her numerous facial doctors began to see a light at the end of the tunnel and some resolution of the multiple injuries and, thus, some lessening of the severe pain. When those were better resolved, they noticed that the behavior and cognitive problems which they had attributed to pain and multiple procedures were still present and were significant. Her treating doctors thereafter referred her to a neuropsychologist as they suspected a possible brain injury.

Barbara underwent three days of testing to evaluate her brain function. The tests revealed very significant cognitive dysfunction, a substantial loss of IQ (Barbara had obtained a Master's Degree with a 3.9 average) with her full scale IQ being only 85. Her performance IQ is only 73 which is just above impaired. In contrast, her verbal IQ was 97 which was consistent with her grade average. The 24-point difference between

PIQ and VIQ is a classic sign of brain injury. The comparison of verbal and performance IQ in a non-compromised brain is normally within 5 to 10 points. **See Exhibit 10 attached hereto.**

During this time, Barbara also experienced visual disturbance that is consistent with brain injury, loss of taste and smell, and balance problems. She was diagnosed as having a brain injury with significant impact of function in 2008. Between this first diagnosis of brain injury and the examination by Dr. Benson, no less than 19 different doctors diagnosed Barbara with traumatic brain injury.

In July of 2011, Barbara went to a well-known neuro-rehabilitation center in Richmond, Virginia. At that time, she underwent an extensive examination by the Center's head, Dr. Gregory O'Shanick, and he ordered additional testing by other specialists. He issued a prescription for testing of neuro-optometry for post trauma vision syndrome, convergence insufficiency and midline shift syndrome (midline shift syndrome is a condition arising from a severe shift of the brain from one side to the other). He further ordered testing by a speech and language pathologist for cognitive, linguistic and pragmatic deficits and testing for thyroid and pituitary damage. He also ordered an MRI which demonstrated right frontal changes and left posterior temporal changes consistent with his diagnosis of traumatic brain injury. His differential diagnosis upon receiving all of the evaluation and testing is as follows:

1. Status post Boating accident – 6/23/07
2. Traumatic Brain Injury secondary to # 1
3. Post-traumatic Hypopituitarism secondary to # 2
4. Neurolinguistic changes secondary to # 2
5. Attention Deficit Disorder secondary to # 2
6. Post-traumatic Vision Syndrome, Convergence Insufficiency, Midline Shift Syndrome secondary to # 2
7. Orbitofrontal changes secondary to # 2

8. Post-Traumatic Headaches secondary to # 2
9. Disorder of initiating and maintaining sleep
10. Balance Disorder (Visual dependency) secondary to # 2
11. Dysexecutive Syndrome secondary to #2
12. Pseudobulbar Affect secondary to # 2
13. Depression (pre-existing), increased secondary to #2
14. Fatigue secondary to # 2, #3, #9 and #13
15. Decreased Cranial Nerve I on the left, secondary to # 1

See Exhibit #11 attached hereto.

In evaluating the defendant's position that plaintiff's pre-existing depression and anxiety is responsible for her current problems, it is important to note the testimony of Dr. Chris Peters. Dr. Peters is a Board Certified Psychiatrist who has been treating Barbara since the Fall of 2004. Barbara underwent his care to seek help for the severe depression and anxiety she was experiencing in response to a severe disability that had developed in her child. Barbara's son suffered a rare autoimmune condition where the brain tissue was attacking itself. As a result, he was totally disabled as a young child, suffered seizures and his future included institutionalization when his parents ceased being able to care for him. Barbara's response to this devastating news about her child included deep depression and anxiety. Dr. Peters saw Barbara regularly and has in-depth knowledge of her functioning before this brain injury. He believes she suffered a traumatic brain injury in the June, 2007 boating crash. He noted that pre-existing depression and anxiety can be exacerbated by brain injury. He testified that, in the time he treated her before the accident, the following conditions DID NOT EXIST:

1. Barbara never complained of left eye problems with ocular dandruff.
2. Barbara did not complain at all about visual disturbance.
3. He did not hear or come to the conclusion that Barbara had temporal visual field deficits.

4. He never came to the conclusion or noted that Barbara had a loss of taste.
5. He never came to the conclusion or heard Barbara complain of a loss of smell.
6. He never came to the conclusion or sent her to a doctor or noted any problems that he would believe come from adrenal insufficiency.
7. He never treated her for hypertension followed by hypotension.
8. He never felt the need to refer Barbara to someone because Barbara was suffering from pituitary dysfunction.
9. He never had anything in his records to note that he was concerned about pituitary dysfunction and did not want her to see a physician with reference to that; he made no referral for that reason.

The defendant in this matter argues that the Court should take the drastic step of precluding the introduction of all of Barbara's medical information on the basis that a DTI imaging study cannot, by itself, diagnose traumatic brain injury. They are right. No imaging study standing by itself can diagnose the cause of an abnormality. This is why at the bottom of imaging reports one sees the notation that clinical correlation is suggested or required. An imaging study is only one part of the tools used to reach a differential diagnosis. In this case, the diagnosis of traumatic brain injury opined by treating doctors is a result of clinical signs and the addition of the DTI study is confirmatory as to degree and confirms anatomically the location of the white matter injuries.

Copies of certain images of Barbara's brain are attached. **See above Exhibit #6 attached hereto.** The images show widespread white matter injury consistent with clinical signs. To date, the plaintiff has been able to obtain information on at least 13 cases where a challenge to the admissibility of DTI was denied. We are still gathering

additional copies of orders and will submit them to the Court as exhibits for the hearing.

See Exhibit #12 attached hereto.

The description of Diffusion Tensor Imaging in defendant's motion suggests that it is highly speculative and a very unusual test. This is not true. In order to address the specifics of this imaging technique, the description of DTI as set forth in a deposition of Dr. Andrew Walker is a good beginning. Dr. Walker is a neuroradiologist who practices in Palm Beach, Florida and regularly performs DTI imaging in a clinical setting to rule in or rule out traumatic brain injury. A copy of his affidavit is attached. The following excerpts briefly outline his educational background and explain Diffusion Tensor Imaging:

**Excerpts of Deposition of Dr. Andrew Walker taken
on December 20, 2012 in Palm Beach Gardens, Florida
in Menard v. The Travelers Indemnity Company of America, et al**

Page 3/Line 20 to Page 4/Line 10

A: Sure. I went to medical school at Yale University in New Haven, Connecticut. After graduating from Yale Medical School, went on to do an internship in both medicine and surgery at Yale University. After completing my internship, I went to a four-year residency in diagnostic radiology at Harvard University Brigham and Women's Hospital. After finishing my four-year radiology residency and becoming Board certified in radiology, I went on to an additional two years of specialized training in brain and spine imaging called neuroradiology –

Q: Okay.

A: -- and did a fellowship in neuroradiology at Yale University.

Q: So you would be a neuroradiologist?

A: I am, yes, a two-year fellowship-trained neuroradiologist.

Page 5/Line 16 to Page 13/Line 11

Q: Would you give us a layman's explanation between the difference between ordinary MRI and DTI?

A: Sure. It's a great question. And we do, as part of our examination, a normal brain MRI or what we would call a standard brain MRI. Every MRI, whether it be the brain or one of the joints, is made up multiple sequences; and what a sequence means is we tell the computer some very specific instructions on how to introduce energy into the patient and we take that energy back out as it's reflected back out and we create a picture. By telling the computer to use different parameters, we get different information and different coloration of those pictures and different orientation from the front, from the side, those things.

When we do Diffusion Tensor Imaging, it's one sequence of the entire brain MRI examination. In Diffusion Tensor Imaging we're asking the computer to take a series of very rapid pictures that are sensitive to the movement of water; and by doing that over and over and over we can actually calculate the movement of water. It's eigenvector, if you will. But really it's speed and direction is what we're looking for, the vector movement of that water. And by doing that, it helps us evaluate specifically areas of the brain that are highly organized, like the white matter tracts. So we look at the direction and the speed of the water movement within the entire brain, but it very much highlights the white matter tracts and gives us an idea of how well those white matter tracts are functioning.

Q: So you can see the white matter tracts on the DTI MRI?

A: Correct.

Q: But not on the regular MRI?

A: We can see the tracts structurally on the MRI, but we don't get an idea of how they're working. Let me give you a real simple analogy. If you were in a helicopter and you took a very high resolution picture of a highway, I-10, from above, you'd have a beautiful picture that has very high resolution. That's what a brain MRI is. And you'd see the cars on the highway, but you actually can't tell whether those cars are moving or not from that one picture. You can't even tell whether the cars are on from that one picture.

The next real movement in MRI, to add some functionality, was called Diffusion Weighted Imaging or DWI. Literally what we did is take two pictures very quickly from that helicopter and then subtracted and you can tell what car is moving and what car isn't moving.

Q: Right.

A: But the definition of that movement is very weak. It's hard to tell whether that car was changing lanes or not. We just get two very rapid pictures.

Really what DTI is, we go back up in that helicopter and we take a series of very rapid pictures, anywhere between six and 24, 30. Some people will even use more. By doing that, we can precisely calculate the speed of the car, the direction of the car, whether it's changing lanes or not and everything else that's surrounding it. So we now have functional information. We still are looking at the same white matter tracts we did with the original picture, the same cars if you will, but now we really see whether they're moving correctly or not.

Q: So it's like a moving picture, as opposed to a solitary photograph?

A: It's conceptually very similar. It is like the development of early still pictures -- early moving pictures from a still picture. We're sort of back in that time where just to take one picture still takes three or four minutes and to get multiple pictures, it's really dramatically difficult for the machine to do. We have some tradeoffs there, but that's exactly what we're doing. With respect to water, we're getting that motion now.

Q: And the water is in the brain or surrounding the brain?

A: The water is in every cell in our body, actually. And we look at more than just water, I should say, but that's what's moving in the brain. So I kind of distilled it simplistically.

But what the MR looks at and what it gets signal from is hydrogen and water has a lot of hydrogen, H₂O. Most of the other structures that contain hydrogen, some fats and lipids and things, don't really move that much in the brain. So when we're sensitizing that image to movement, what we're really seeing is the movement of water which, with respect to the white matter, is a good look at the movement of information in that white matter or the movement of, you know, how the brain functions.

Q: I'm not understanding the correlation between the white matter and the water.

A: Sure, sure. The brain is really basically made up of two substances. The outside of the brain is called the gray matter and that's really the cell bodies of the nerve cells or the neurons. All of those bodies are connected to each other with very long cylindrical connections called axons. Where those axons come together and because it's like wiring, it has insulation, we call those white matter tracts. The axons is the white matter and where they get into these dominant like wiring harnesses and things like that, that's a white matter tract.

Q: Okay.

A: The brain talks to other areas of the brain by sending signals. Those signals move along the axons. The water movement is reflective of that signal movement.

Q: Okay.

A: The brain actually moves by moving sodium and things like that, calcium and sodium.

Q: So the water moves along the white matter tracts?

A: Correct. Correct. It's that insulation that I alluded to is what makes the water movement in the white matter tract so organized, so predictable, because that insulation doesn't let it go a lot of different directions. It moves right along the orientation of the axon.

Q: What does the DTI MRI tell you that the regular MRI does not?

A: Sure. It's that functionality: Are the cars on the highway moving? You know, if you just took that picture of I-10, I can't tell you whether that road is working correctly or not. I have a beautiful picture. Maybe I see a little ice or rain on the road, but I can't tell you are the cars moving at eighty or are they moving at twenty.

Once we turn on DTI, I can tell you wow, that highway is working fine, all the cars are moving sixty to eighty miles an hour or we've got a real problem, the cars are only going twenty to forty miles an hour.

Q: And that's the problems you may diagnose in a patient?

A: Exactly.

Q: You'll see a problem with the white matter?

A: Exactly. When there's damage to the white matter, the speed of that water transfer, that information transfer slows down.

Q: Okay.

A: Just like when there's damage to the highway, you get a traffic jam.

Q: So this water is moving along the white matter tracts and it could be moving slowly, it could be moving normally --

A: Right.

Q: -- and if you look at that, because of your training and experience, you can tell whether the highway is operating as it should or if there's a problem?

A: You got it. I mean, really what we do to analyze DTI is we take a very specific location like an exit ramp on the highway. I'm going to go to Exit 10 every day that's a clear day, there's no problems and I'm going to measure the speed of the cars as they're going by. Well, I plot them out. They all go sixty to eighty on a normal day.

Now, we've got a horrible day, snow storm, the whole works. Let's go see if that highway is working. I go up there with my radar gun. That's what DTI is, a radar gun. And I take my speed measurements and the speed, if the highway isn't working correctly, if there's damage or a car accident or too much ice and snow, we'll see that in the range of speeds slows down: Twenty, forty, sixty miles an hour.

Q: So you know there's a problem?

A: So we have to have a group of normals to compare it to and we have a large group of normals. We have to measure the speed at the exact same location. I don't want to go where there's a bend in the road and compare it to where there isn't a bend. That would cause --

Q: Right.

A: -- an inequality. So we go to the same location in normals, measure it over and over and over in different normals and we have that range. Then we take our test patient and we compare it to that range.

Q Your normals -- Let's use Miss Menard as an example. The normals don't come from her, you have normals --

A: Correct.

Q: -- from other people?

A: Other people.

Q: And that gives you a baseline saying --

A: Sure.

Q: -- a normal brain is going to operate like these normals --

A: Right.

Q: -- I have. And in Miss Menard's case, if something is not normal, that tells you X, Y, Z?

A: Right. And the speed of the highway is really a good example, because DTI is also proportional to the damage to the brain. If we know the speed should be sixty to eighty and we go up there and we measure the speed at fifty, it's not normal, but it gives us an idea it's not a devastating abnormality. If we go up and measure the speed's forty, we know it's worse; if the speed's thirty, we know it's worse. God forbid the speed is zero, we know there's no functioning at all.

DTI has that same proportionality. Not only does it detect that there's an abnormality, a structural abnormality, that white matter is not working correctly, but it gives us an idea of how severe it's proportional to, how bad the cognitive effects will be, how bad the outcome will be.

* * *

Page 13/Lines 17 to 21

A: Sure. We've been using it at this location since 2007 when it became available on the system. I was lucky enough to be around in '94 through '96 when DTI was being developed at Yale University and used it extensively there as a research tool --

* * *

Page 13/Lines 23 to 24

A: -- and have also used it at another site that we no longer read for from about 2003 to 2005.

When asked in the same deposition if DTI is commonly used in clinical settings, he said, "I think almost every county in Florida offers DTI services at multiple locations." **See Exhibit #13 attached hereto.**

Again, plaintiff notes that standards for expert medical testimony require that the opinions rendered be reached by a scientific medical method which is accepted as appropriate within the medical field and which is reached by a methodology that is accepted within the medical community. The use of differential diagnosis to come to the decision of etiology is the basis of all medical decisions as to treatment and prognosis.

The use of DTI is widely accepted within the medical community as a diagnostic component of the opinion being medically rendered. **See their affidavits attached hereto as Exhibit #14-A and their curriculum vitae attached hereto as Exhibit 14-B.** The use of DTI for causation is acceptable in conjunction with the other components of a differential diagnosis. No single component of a diagnosis can stand on its own, but rather each element makes a contribution to causation and/or is CONFIRMATORY of the condition that has been diagnosed by signs and symptoms.

In this matter, the element of axon water diffusion is a component that stands as one element of the causation opinion or can stand as a confirmatory diagnostic tool. The treating doctors in this matter have already made a diagnosis of traumatic brain injury and the imaging results did confirm the diagnosis that the brain did suffer injury when her head was slammed against a metal pole at 26 mph.

Plaintiff presents affidavits from Dr. Nicholas Suite, a Board Certified neurologist in Florida, from Dr. Gary Weiss, a Board Certified neurologist in Florida and Dr. Manley W. Kilgore, II, a Board Certified neurologist in Florida in which all three Board Certified Florida neurologists state that DTI is scientifically appropriate for clinical use in traumatic brain injury. Plaintiff further presents affidavits from Dr. William Orrison from Nevada (signed copy of affidavit is being forwarded) and Dr. Joseph Wu, a neuro

professor at University of California at Irvine, setting forth the scientific validity of DTI as a diagnostic tool in brain injury. **See above Exhibit #14-A attached hereto.** Dr. Andrew Walker's affidavit and curriculum vitae are also included and **attached hereto as Exhibit #15.**

Numerous cases across the country admitting DTI over *Frye* or *Daubert* challenges include the following: **See above Exhibit #12 attached hereto.**

In Zawaski v. Gigs, LLC., a Massachusetts plaintiff sought to admit results of DTI testing that showed white matter damage. The defense hired an expert who argued that DTI is not sufficiently reliable to support a clinical diagnosis of a MTBI. The plaintiff cited to numerous peer-reviewed articles establishing that DTI was reliable for detecting axonal damage. Plaintiff also pointed out to the Court that every court in the country had rejected either *Daubert* or *Frye* challenges to DTI testimony. In November, 2010, Judge Connolly specifically admitted the DTI testimony.

In Ruppel v. Kucanin, the defendant sought to preclude evidence of a diffuse axonal brain injury under Federal Rule of Evidence 702. The defendant specifically argued that Dr. Benson's opinion that the plaintiff suffered a MTBI was not reliable because he used DTI to reach his conclusion. The court issued a ruling denying defendant's motion to exclude DTI evidence complete with a lengthy discussion of DTI. Under a *Daubert* analysis, the court stated that "DTI and FA quantification based on comparative scans appear to be reliable methods for plaintiff's expert to arrive at his expert opinion of both Ruppel's diagnosis of diffuse axonal injury and the cause of that injury." The Court made the following statements regarding DTI's general acceptance in the medical community:

"There have been numerous validation studies, published in peer-reviewed journals, on the use of DTI to detect diffuse axonal injuries."

"DTI is regularly used as a diagnostic tool at the Detroit Medical Center and at other locations throughout the country."

"the United States Army Telemedicine and Advanced Technology Research Command ("TATRC") sponsored a "Diffusion MRI TBI Roadmap Development Workshop" at which it was acknowledged: "DTI has detected abnormalities associated with brain trauma at several single centers.""

"approval for marketing by the FDA indicates that its effectiveness was determined pursuant to 21 U.S.C. §360c(a)(3)(A)."

"DTI has been accepted within the medical community." Importantly, as discussed below, there are many articles published in peer-reviewed publications that cover the effectiveness of DTI in detecting mild TBI."

"the evidence shows that DTI and analysis of white matter in DTI images are generally accepted methods of determining mild TBI."

The Court further found that DTI was demonstrably reliable through the remaining *Daubert* factors, independent of its general acceptance in the medical community. The Court denied the defendant's motion and allowed testimony regarding DTI and MTBI.

In Rye v. Kia Motors America, Inc., a defendant filed a Motion in Limine to exclude DTI. After reviewing briefs from both sides, the Court denied the defendant's motion and allowed the testimony and evidence concerning DTI testing. The court indicated that it had heard oral arguments and considered itself "fully advised" on the issue.

In Lamasa v. Bachman, the Supreme Court, Appellate Division, First Department, New York, considered whether a trial court properly admitted evidence of mild traumatic brain injury that had been obtained through DTI. The court held that DTI evidence was properly admitted because it could not be characterized as novel science and that the defendant's concerns went to the weight of the evidence, not its admissibility. The court reasoned that "plaintiff's" experts **relying on objective medical tests**, testified to brain damage and other injuries that they attributed to trauma, and **the conflicting medical evidence and opinions of defendant's experts concerning the permanence and significance of plaintiff's injuries simply raised issue of fact for the jury.**" In denying defendant's motion for relief, the lower court explained that:

DTI is an imaging technique used to study the random motion of hydrogen atoms within water molecules in biological tissue (e.g., brain white matter) and spatially map this diffusion of water molecules, *in vivo*. DTI provides anatomical information about tissue structure and composition. Changes in these tissue properties can often be correlated with processes that occur, among other causes, as a result of disease and trauma.

The lower court further held that, as to the issues of causation and the precise physical injuries the plaintiff suffered as a result of the collision, "the parties had numerous expert witnesses testifying and in considering the conflicting testimony of the parties' respective expert witnesses, the jury was not required to accept one expert's testimony over that of another, but was entitled to accept or reject either expert's position in whole or in part." On appeal, the New York Supreme Court, Appellate Division, upheld the trial court's admission of the challenged expert testimony.

In Booth v. Kit, the U.S. District Court for the District of New Mexico denied defendant's motion to strike, limit or exclude expert testimony that, in part, relied on DTI

testing. The court held that the expert's testimony was admissible under Rule 702 because the reasoning and methodology underlying the testimony was scientifically valid and therefore sufficiently reliable. The court made clear that "any perceived weakness in Dr. Orrison's conclusions **may be attacked on cross examination or by contradictory opinions by one or more other qualified experts.**"

In LeBoeuf v. B & K Contractors, Inc., a Louisiana trial court judge properly allowed experts from both sides to testify regarding plaintiff's brain damage and the various tests performed on him (including DTI) in a bench trial restricted to damages. The trial court judge found that the plaintiff did have a brain injury and awarded him damages. In affirming the plaintiff's award, the appeals court noted that the "expert medical testimony regarding the nature and degree of injuries [the plaintiff] sustained was conflicting "and the trial court judge found "that the evidence established [the plaintiff] suffered a mild brain injury.'" The appeals court decline[d] to disturb the trial court's award of general damages.

In Hammar v. Sentinel Insurance Company, Ltd., the defense raised a *Frye* challenge to the admissibility of DTI. In denying the defense challenge, Judge Barton wrote in September, 2010:

3. DTI of the brain is proven and well-established imaging modality in the evaluation and assessment of normal and abnormal conditions of the brain. DTI demonstrates evidence of traumatic brain injury pathology and can reveal abnormalities that are not visible on standard MRIs...

4. DTI is generally accepted by the medical community, FDA approved, peer-reviewed and approved, and a commercially marketed imaging modality which has been in clinical use for the evaluation of suspected head traumas including mild traumatic brain injury.

Judge Barton's Order specifically denying defendant's *Frye* challenge for the admissibility of an MRI with DTI is attached as an exhibit. In that Order, the Honorable James M. Barton, II concisely and logically lays out all of the reasons that DTI is not novel but is a proven, well-established imaging modality that is widely used in the medical community for which standards have been developed in the American College of Radiology and is simply one of the advanced imaging techniques available for evaluation of brain injury. The Order notes that DTI is admissible and both sides will have the opportunity to argue the weight to be given to the testing. However, the judge as gatekeeper of the evidence to go before the trier of fact should not withhold this imaging that is widely accepted in the medical community.

The science behind DTI is the main reason why every court in the country has admitted DTI over objection. DTI has been tested and meets the requirements of both *Daubert* and *Frye*.

Plaintiff has recently learned that two additional challenges to DTI (one in New Mexico and one in Minnesota) have been denied as the trial court, acting as a gatekeeper, found that the evidence meets admissibility standards. We are seeking copies of these orders and will present them as exhibits at the hearing.

Prior publications on the use of DTI number more than 700 and uniformly support the validity of Diffusion Tensor Imaging. Plaintiff attaches hereto a bibliography of 56 different peer-review papers confirming the scientific validity of using DTI as one of the diagnostic tools to evaluate the existence, extent and/or anatomical location of damage to the white matter. **See Exhibit #16 attached hereto.**

In this case, Barbara Sworin was referred for neurological evaluation and DTI imaging by counsel after they entered the case in 2013 and noted that this diagnostic tool had not been added to multiple clinical findings of traumatic brain injury. Dr. Randall Benson was chosen because he is recognized as one of the leading neuro-scientists in the world in traumatic brain injury. He is a behavioral neurologist and a neuro-imaging scientist. **See Dr. Randall Benson's curriculum vitae attached hereto as Exhibit #17.**

Dr. Benson examined Barbara for almost five hours. As a result of that examination, he reached the conclusion that she had suffered a traumatic brain injury and wrote a Neurobehavioral Evaluation and a Report of Findings for TBI Protocol. **Dr. Benson's evaluation and report are attached hereto as Exhibit #18.** Dr. Benson's records include his report containing 13 pages of detailed history, a questionnaire filled out by her husband detailing his experiences and observations, neurocognitive testing and an expanded neurological exam. As a result of this 5-hour clinical evaluation, Dr. Benson concluded (as had her treating doctors) that Barbara Sworin had suffered a traumatic brain injury and that the brain injury was consistent with the criteria for moderate brain injury rather than mild. **See Exhibit #19 attached hereto.** Again, it should be noted that the early description of mild traumatic brain injury was based on the cursory evaluation by EMS and in the Emergency Department in Florida.

It is now recognized that moderate brain injury can occur with no loss of consciousness and a GCS score of 13 to 15, particularly when the GCS is noted as much as 30 minutes after the insult as was the case in this incident. Another criteria for moderate traumatic brain injury that is recognized by numerous authorities, including

the Center for Disease Control and the National Institute of Health, is amnesia following an insult which lasts 24 hours or more. **See Exhibit #20 attached hereto.** Amnesia is defined in medical settings as a failure to lay down a COMPLETE memory. Amnesia occurring following an insult to the brain can be retrograde (before) or anterograde.

This definition is so universally accepted that it can be found in Wikipedia (online) which provides in pertinent part as follows:

“Amnesia... is a deficit in memory caused by brain damage, disease or psychological trauma... essentially, amnesia is the loss of memory. The memory can be either wholly or partially – IN OR OUT lost due to the extent of the damage that was caused” **See Exhibit #21 attached hereto.**

Both Dr. Gregory O'Shanick and Dr. Randall Benson inquired in depth as to Barbara Sworin's memory following the brain trauma. Their examinations confirmed that Barbara's anterograde amnesia was fragmented and vague for an extended period of time following the insult. **See above Exhibit #18 attached hereto.** This extension of memory loss places Barbara's degree of injury in the moderate category. Further, the extent of deficits in functioning as noted by all treating doctors is consistent with a moderate rather than a mild traumatic brain injury.

After the 5-hour clinical evaluation, Dr. Benson ordered a specific traumatic brain injury protocol to determine whether the deficits in functioning were consistent and correlated anatomically with the clinical findings of brain injury. The imaging found “Global WM (white matter) FA (Fractional Anisotropy) was at the 2nd percentile relative to the normal range and Voxel-wise quantitative analysis revealed significantly low FA in multiple white matter fiber pathways”. **See above Exhibit #18 attached hereto.**

Again, Dr. Andrew Walker in his deposition of December 20, 2012 in the case of Menard v. The Travelers Indemnity Company of America, et al, explained Fractional Anisotropy as follows:

Page 34/Lines 2 – 11:

Q: Your first finding was an abnormal decrease in white matter FA. And I'm going to let you tell me about what's FA?

A: Sure. Fractional anisotropy is that property that is analogous to speed of the water movement. It is both the speed and directionality of that water, the cohesive movement of that water in the white matter tract. For whatever reason, we've called it fractional anisotropy. It would have been nice if we called it speed, personally but.

Page 34/Line 18 through Page 35/Line 2:

A: You bet. So this is what the DTI images look like and these are two representations of the same level of the brain. This is called a fractional anisotropy magnitude image, FA magnitude image. The computer takes all of those rapidly acquired sequences and looks at every point in that picture and says what the speed of the water movement is. What that enables us to do is go into that picture and draw a region of interest in the white matter tract at that right location, right at that exit, the same exit, and just like that radar gun, I get a speed reading.

See above Exhibit #13 attached hereto.

The damage to the axons as reflected in the significantly "low speed" of the water movement is anatomically consistent with the deficits in functioning found in the clinical portion of the differential diagnosis of brain injury. The significant damage found was:

1. Corticospinal Tract in the Midbrain in both the left and right hemispheres;
2. The left side of the Cingulum;
3. The right side of the Inferior Frontoccipital Fasciculus;

4. Both hemispheres of the Uncinate Fasciculus;
5. Both hemispheres of the Posterior Limb of the Internal Capsule;
6. Both hemispheres of the Anterior Thalamic Radiations;
7. Both hemispheres of the Anterior Corona Radiata;
8. Both hemispheres of the Posterior Corona Radiata;
9. Both hemispheres of the Genu of the corpus Callosum;
10. The left hemisphere of the Splenium of the Corpus Callosum; and
11. Both hemispheres of the Superior Corona Radiata.

The regions were found abnormal with a 99% confidence interval using BOTH voxel-based analysis and anatomical localization of the affected fiber tracts utilizing a tract-based atlas. Kou, et al. J. of Head Trauma Rehabil. 2010. 25:267-82; Smith, et al. NeuroImage, 31:1487-1505;2006; and Wakana, et al. Radiology, 230:77-87;2004. Abnormal DTI images are attached. **See Exhibit #22 attached hereto.**

It is again interesting to note that when the defendant asked for two additional experts to contradict Dr. Benson's imaging opinions, they chose two experts who did not actually interpret DTI images and neither of the experts reviewed the images to state whether the findings in the white matter were abnormal and consistent with the various neuro-deficits noted by clinical findings of over 15 different doctors.

For the most part, the memorandum and the affidavits of the defendant cite as authoritative Dr. Hal Wortzel and a "Consensus Conference" from a December of 2012 meeting.

With reference to Dr. Wortzel, it is notable that he is not a neuroradiologist and not even able to interpret DTI findings to determine whether the images correlate with

the clinical findings. An in-depth review of the "authoritative article" defendant cites shows that it is not medical research but rather an "opinion" based on "cherry picking" articles to support his advocacy to deny plaintiff the right to present the jury with imaging evidence that correlates and is supportive of the clinical diagnosis of traumatic brain injury. He cites very limited scientific literature and a close reading of his criticisms shows he only argues that abnormal white matter findings can occur for several different reasons. Dr. Wortzel's "scientific" opinion is cited no less than six times in defendant's motion. The other articles cited minority opinions and are appropriate for cross examination but do not support the drastic remedy of preventing the introduction of this information by a highly qualified doctor/scientist.

Dr. Benson's findings are that the abnormalities within medical probability are consistent with and correlate anatomically with the clinical deficits he found in a 5-hour evaluation. Defendant is free to cross-examine him as to whether other things can cause white matter abnormalities. They can challenge him in cross-examination as to why the particular pattern of white matter abnormality is diagnostically consistent with the neuroabnormalities noted clinically.

While Dr. Zimmerman does not think DTI is ready for clinical use, he is at odds with the clinical community as demonstrated by numerous affidavits attached to this memorandum. Dr. Andrew Walker is aware of numerous facilities in Florida that use DTI for clinical diagnosis and has testified that almost every county in the state provides such a diagnostic tool. **See above Exhibit #13 attached hereto.**

The undersigned is personally aware of six different facilities that provide DTI imaging in Florida as one of the diagnostic tools available for medical diagnosis of traumatic brain injury.

As noted earlier, it is not practical to address all of the scientific articles that support the use of DTI in analyzing the degree and location of brain injury, however, plaintiff attaches a summary of a number of the articles that find DTI useful in evaluating the white matter (axons) in a human brain. **See above Exhibit #3-B and Exhibit #16 attached hereto.**

It is important to note that defendant cited Dr. Erin Bigler as supporting his position that DTI is not acceptable as a diagnostic tool to assist and confirm a differential diagnosis. This is not true. Dr. Bigler is 100% supportive of DTI being an appropriate tool to diagnose the degree of axon injury from trauma. Attached hereto is a sworn statement by Dr. Bigler confirming his agreement with DTI in clinical settings. **See Dr. Erin Bigler's sworn statement attached hereto Exhibit #23-A and two sample articles are attached hereto as Exhibit 23-B.** Another quoted, alleged source of "scientific opposition" is the "Guidelines for the Ethical Use of NeuroImages in Medical Testimony: Report of a Multi-disciplinary Consensus Conference". Dr. Benson did attend such conference and the conference did not result in an agreement. In fact, another invited attendee has written a lengthy affidavit which is attached hereto. It clearly demonstrates that there was disagreement at the conference; there was no voted consensus. The hypothetical "Guidelines" do not preclude the introduction of Diffusion Tensor Imaging but rather address the need to have such testimony appropriately offered. **See the Affidavit of William Jungbauer regarding the Emory**

meeting attached hereto as Exhibit #24-A and the statement of Dr. Randall Benson regarding the Emory meeting attached hereto as Exhibit #24-B. While defendant offers general disagreement with DTI, he did not evaluate this DTI or even look at it.

Dr. Benson is preparing a detailed response to each of the "allegations" raised but due to his year-end formal research schedule furthering an understanding of TBI, he is unable to address it before December 15, 2013. A full written rebuttal will be provided to the Court and to defendant no later than January 6, 2014 which is the date by which the Court has ordered all materials be in the Court's possession for review. Dr. Benson's methodology has always been approved in his research papers and peer-review articles. In this case and as is accepted in the scientific community, his methodology validates the conclusions he has reached with reference to the white matter abnormalities found on the Sworin images which correlate with the clinical findings.

The defendant argues that the findings of other Courts with reference to the *Daubert* standards are not relevant. They seek to argue the Orders are not relevant because 100% of the time the *Daubert* and the *Frye* challenges have failed (the undersigned knows of two challenges that were granted due to the failure of plaintiff's counsel to submit scientific evidence in opposition to those challenges). As noted earlier, we attach hereto some of the Orders the plaintiff has found. Plaintiff has requested copies of two additional Court Orders which were just entered in New Mexico and Minnesota which will be provided upon receipt.

Plaintiff concludes as she began in this response. The test is not whether the defendant has found any article that disputes the use of DTI but rather whether the defendant has proven that its use as a part of a differential diagnosis is not scientifically sound. The plaintiff would also show that defendant's opposition to the use of DTI is its use as a "stand alone" diagnosis. We agree Diffusion Tensor Imaging by itself is not appropriate as a stand alone diagnosis but rather is for use as part of the puzzle using the differential diagnosis method to reach a conclusion as to the causation of a problem. Dr. Benson's opinions are based upon sufficient fact and data. In addition to objective neuropsychological testing he performed testing which demonstrated brain dysfunction, he has clinical diagnosis by at least 15 doctors, he has testing done by Dr. O'Shanick, an endocrinologist, a speech pathologist, a neuro-ophthalmologist, a list of deficits as set forth by plaintiff and her husband, a list of new deficits as noted by doctors who treated her before the brain injury and a 5-hour neurological examination performed by Dr. Benson himself.

The opinion is based on reliable principles and methods as supported by hundreds of articles on Diffusion Tensor Imaging and the principles and methods are reliably consistent with the facts of the case.

In conclusion, Plaintiff will quote the findings of a trial judge, the Honorable James M. Barton, II in the matter of Hammar v. Sentinel Insurance Company, Ltd., Case No. 08-019984, pending in the Circuit Court of the Thirteenth Judicial Circuit in and for Hillsborough County, Florida:

1. Diffusion Tensor Imaging (DTI) is not new or novel science.

2. Plaintiffs have demonstrated that the basic underlying principles of DTI have been sufficiently tested and accepted by the relevant scientific and medical communities.

3. DTI of the brain is a proven and well-established imaging modality in the evaluation and assessment of normal and abnormal conditions of the brain. DTI demonstrates evidence of traumatic brain injury pathology and can reveal abnormalities that are not visible on standard MRIs. According to Dr. David Herbst, a Board Certified Radiologist, DTI studies are definitely accepted by practicing radiologists and are depended upon by physicians who order them to assist in diagnosing and treating brain injuries.

4. DTI is generally accepted by the medical community, FDA approved, peer-reviewed and approved, and a commercially marketed imaging modality which has been in clinical use for the evaluation of suspected head traumas including mild traumatic brain injury.

5. This Court's findings are further buttressed by the position of the American College of Radiology (ACR), who defines practice guidelines and technical standards for radiologic practice on the Performance and Interpretation of Magnetic Resonance Imaging (MRI) of the Brain, which clearly provides that indications for MRI of the brain with diffusion imaging, if available, is helpful in many indications, including but are not limited to, acute and chronic neurological deficits, headache, mental status change, suspicion of non-accidental trauma, suspicion of acute intracranial hemorrhage or evaluation of chronic hemorrhage, functional imaging, brain mapping, blood flow and brain perfusion study, post-traumatic conditions.

6. The ACR explains that advanced imaging techniques such as diffusion weighed imaging, diffusion tensor imaging, susceptibility weighted imaging, functional imaging, perfusion imaging, parallel imaging and volumetric, morphometric, and other quantitative applications provide added utility for MRI of the brain.

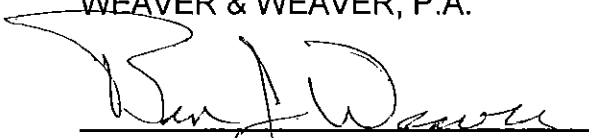
7. The weight to be given to stated scientific theories, and the resolution of legitimate but competing scientific views, are mates appropriately entrusted to the trier of fact.

Although the findings were made in conjunction with a *Frye* challenge to Diffusion Tensor Imaging, they track the basic criteria for *Daubert*. In addition to meeting the criteria set forth by Judge James M. Barton, II, the plaintiff also showed, in detail, that this diagnostic tool was used in conjunction with many other diagnostic tests and opinions and the DTI of Barbara Sworin is to be looked at as correlating with, consistent with and confirmatory of the prior clinical findings.

In reviewing all of the cases, the evidence, the literature, the affidavits and the specifics of this case, it is more than conclusive to support a finding that the *Daubert* challenge cannot and does not support the drastic ruling of withholding evidence from the jury.

Respectfully submitted on this 13th day of December, 2013.

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CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a true and correct copy of the foregoing was sent by email on this 16th day of December, 2013, to the following counsel:

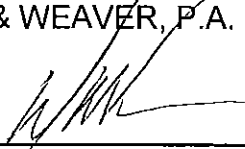
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SEE *43 FOR A DISCUSSION ON ADMITTING DTI UNDER FRYE.

2008 WL 5949015 (N.Y.A.D. 1 Dept.) (Appellate Brief)
For opinion see [869 N.Y.S.2d 17](#)

[Briefs and Other Related Documents](#)

Supreme Court, Appellate Division, First Department, New York.
Salvatore LAMASA and Ana Lamasa, Plaintiffs-Respondents,
v.
John K. BACHMAN, Defendant-Appellant.
No. 2008-04608.
September 2, 2008.

Brief and Appendix for Plaintiffs-Respondents

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***1 PRELIMINARY STATEMENT**

Salvatore Lamasa exists in a living hell. He can't think anymore, he can't sleep, he can't work, and he is totally dependent on his wife, Ana. His neck and back pain is unrelenting. His headaches are constant, his thinking and sleep disrupted and disjointed. He is prone to emotional surges, crying spells, even violence. He remains psychologically frozen in time, with no present or future, held captive in a perpetual state of fear.

These conditions are all because of a collision on November 25, 1992, which occurred while Sal was stopped at a red light. This was no 5 mph fender-bender: the Lamasas' accident reconstructionist put the collision conservatively at anywhere between 20-32 mph and even Defendant John Bachman admitted that this wasn't a bump, but a **crash**.

As Sal's treating physicians and experts explained, this collision caused [traumatic brain injury](#), which works in diabolical synergy with associated [post-traumatic stress disorder](#), depression, chronic pain syndromes, and multiple sleep disorders, such that none of the conditions have any prospect for cure. At trial the evidence as to the nature, extent, permanence, and progression of these injuries was overwhelming, despite the fact that the jury never heard about ***2** confirmatory EEG, PET, or QEEG testing results.

In fact, Plaintiffs had to fight to present just about every type of evidence. Beginning in March 2004, the team of three defense attorneys bombarded Plaintiffs' counsel with various motions to preclude, which continued through the four-week trial in May and June. The trial judge, Justice Martin Schulman, was vigilant to ensure that the defense team had every bit of information they were entitled to as well as ample time to prepare their case.

The trial was bitterly fought, as was the posttrial motion, but Ana and Sal Lamasa prevailed. Now Defendant continues his campaign to avoid owning responsibility for his negligence and the Lamasas face what is hopefully the final battle in their quest for justice.

QUESTIONS PRESENTED

Question: Where Defendant's only explanation for crashing into the rear of Plaintiff's stopped vehicle was a wet roadway, was Plaintiff entitled to a directed verdict as to liability?

Answer: Yes. See Point I.

Question: Where Defendant's **Frye** challenges were based on ***3** conclusory and/or incorrect statements of general acceptance, but Plaintiffs nonetheless proved that their experts' opinions

were based on generally accepted scientific knowledge, procedures, and methodology, did Plaintiffs' experts properly testify ?

Answer: Yes. See Points II and IV.

Question: Where the defense team had every bit of pertinent information necessary to mount a defense, is there any reason for a new trial?

Answer: No. See Points II, III, IV, V, and VI.

Question: Having presented overwhelming evidence that Sal Lamasa sustained [traumatic brain injury](#), severe PTSD, chronic pain syndromes, neck and back injury, and multiple sleep disorders, all of which are permanent and causally connected to the November 1992 collision, did Plaintiffs satisfy the "serious injury" threshold of [Insurance Law § 5102](#)?

Answer: Yes. See Point VIII.

***4** COUNTERSTATEMENT OF FACTS

Plaintiffs' evidence at trial demonstrated that before November 1992, Sal Lamasa was an independent, hard-working family man.

After emigrating from Italy when he was 17, Sal learned English and Spanish, completed his GED, and earned college credits. [2649.^[FN1]] He loved to work and was proud of his work history, which included becoming a certified automobile mechanic, years of experience as a garment machinist, and construction work. In November 1992 he was a night-shift porter at Ogden Allied, and had just passed an exam that would allow him to take on a second job at Con Edison. [1710-26; 1750-51; 1993-96; 2782-83.]

FN1. Numbers in brackets refer to pages in the Appellant's Appendix. Numbers following "RA" referred to Respondents' Appendix.

Sal's family described him as sociable, sweet, and devoted to family. [2781-82.] He was head of household in every sense: he paid the bills; shopped; did chores; cooked; helped with his sons' **homework; and "tended to whatever was lacking."** He even did his own carpentry, plumbing, and building renovations. [1717-29; 2776-81; 2817-18; 2829.]

On his way home from work at about 6:30 am on November 25, 1992, Sal sat in his Chevrolet Celebrity, stopped at a red light on Delancey ***5** Street. Suddenly, a Ford F-250 pickup crashed into the rear of his vehicle, taking him utterly by surprise. [1730-35.]

Sal jolted back and forth and hit his head on something. [1734-35; 2040-44.] Immediately **afterward, he felt "dazed," "scared," "completely blank," and he was in pain.** [1734-38; 1742; 1745; 2009.] He didn't want to go to the hospital because he was afraid they would keep him there and he wanted to get back to work. [1739; 1742-43; 2099-3000.] But knowing that he couldn't drive, Sal called home. [2786; 1744-45.] Ana recalled Sal's voice trembling on the phone. [2784-86.] When Sal's brother-in-law, Leonardo came to pick him up, Sal didn't speak-- he just held his head in his hands all the way home. [4190-94.] And when they arrived, Ana noticed right away that her husband was walking very slowly, and Leonardo was holding him. He had one hand on his brow and the other on his neck: he looked scared and he was he was very, very pale. [2079; 2787-89.]

Sal and Ana knew there was a doctor's office about a block from the house. They walked there when it opened. [1746-48; 2048; 2789-90.] It would be the first time Sal ever visited a chiropractor.

The chiropractor, William Remling, recalled that first visit. Sal was visibly shaken [1627-28], and complained of dizziness, pain in his neck *6 and back, and feeling dazed just after the accident. [1624-29.] Dr. Remling diagnosed, among other injuries, cervical whiplash, and felt that the C-2 and C-6 vertebrae had subluxated due to the accident. [1634; 1640-44.] He also noted a congenital abnormality in Sal's neck, in that the C-2 and C-3 vertebrae were joined. [1645.] None of Sal's acute symptoms could be attributed to that abnormality, but as Dr. Remling explained, given the lack of space between the bones, that area would be more susceptible to trauma, especially a whiplash. [1645-1648.] Dr. Remling treated Sal regularly from the date of the accident until his retirement in 1994 when his partner, Dr. Riker, took over Sal's treatment. In all, Sal's chiropractic treatment consisted of over 260 visits. [1615; 4061-4148.]

Ana recalled the first week or two after the accident: Sal seemed afraid, sad, withdrawn, and **very much in pain. He had trouble sleeping, and, as Ana tells it, would "jump" in the bed several times during the night. Sometimes he would tremble, and in conversation he was "always floating around."** She had never seen him like this before. [2796-99; 2001-02.]

Meanwhile, Sal's case seemed remarkable to Dr. Remling. He would have expected Sal's physical condition to improve, yet for weeks it *7 persisted unabated. [1652-53; 1656-59; 1673-76.] Sal couldn't sleep and was having night twitches, he was nervous and agitated, and continued to be obsessed by thoughts of the accident. It was as if Sal's life had stopped at the moment of impact. [1627-28; 1657; 1663-64; 1672-74.] Suspecting a neurological problem [1659-60], Dr. Remling referred Sal to Lewis Weiner, the Chief of Neurology at New York Methodist Hospital. [1661; 2274-75.]

Dr. Weiner diagnosed [post-concussion syndrome](#), as well as [cervical sprain](#) and [lumbar radiculopathy](#) [2278-79; 2283-85; 2289-90; 2292; 2314-18], all of which he attributed to the collision. [2281-85; 2314.] Dr. Weiner followed Sal from January 1993 through March 1994. His diagnosis never changed.

Dr. Stephen Stein is a board-certified neuropsychologist and clinical psychologist [2638, 2643] who first saw Sal on April 5, 1993. Dr. Stein administered comprehensive neuropsychological testing, which he described in detail. [2639-41; 2650-86.] His diagnosis was [post-concussion syndrome](#) with severe [cognitive deficits](#), and trauma-induced [depressive disorder](#) with [post-traumatic stress disorder](#) features. [2686-89.] He also noted sleep difficulties, hypervigilance [2687-88], crying spells [2648; 2699-2700] and avoidance behaviors. [2697]. As Dr. Stein *8 explained, some parts of the neuropsychological testing showed that Sal's pre-accident cognitive functioning had been average to above average. [1667-68; 2667-68; 2746-57.] The fact that English was a second language was also indicative of Sal's high pre-accident level of functioning. [2655-57; 2749-51.]

Dr. Stein treated Sal through June 14, 1993 using neurotraining, cognitive rehabilitation, and relaxation training, but Sal didn't progress. [2639; 2691-96]. He referred Sal to Daniel Kuhn, a board-certified psychiatrist specializing in neuropsychiatric disorders from [head injuries](#). [2563-64; 2488.] Sal would see Dr. Kuhn over 175 times, and was still a regular patient at the time of trial. [2490-91; 2523-24.]

Dr. Kuhn also diagnosed [post-concussion syndrome](#) (or [traumatic brain injury](#)) [2514; 2529] as well as "clear-cut PTSD." [2513; 2509-10; 4379.2.] His diagnoses were based on "clinical observation, the symptoms, the history and the change in ability and performance" [2544-45]

and were further supported by EEG and evoked potential testing [2538; 2541-48; 2576-89; 2617-19].

Dr. Kuhn related Sal's depression to [brain trauma](#) [2502; 2529], as well as a constellation of other symptoms: intense agitation; trance-like states; speaking endlessly and obsessively; crying spells; compulsiveness; *9 severe anxiety; epileptic-type seizures; attention and memory dysfunction; disorganization; dizziness; migraine-type headaches [2498-2502; 2509; 2511; 2514-17; 2522-23; 2527; 2539-40]; disassociation; [panic disorder](#); jerking movements; inability to focus, to make decisions, to plan, or to experience pleasure [2528]; and uncontrollable emotional surges, including violent outbursts [2550; 2697; 2700; 2704-05]. No wonder Dr. Kuhn described Sal as one of the most difficult incapacitated patients he has ever treated. [2491-92; 2527-2528.]

Neuroradiologist Michael Lipton provided objective proof of brain damage through MRI and DTI studies. The MRI images showed frontal lobe atrophy [1902-05]; hippocampal atrophy [1905-10; 1914-18]; parahippocampal atrophy [1915-1917]; and hemosiderin residue (a breakdown product of blood), consistent with an old hemorrhage in the frontal lobe [1861; 1880-86]. According to Dr. Lipton's measurements, Sal's brain structure is almost a third smaller on the left (injured side) than the right. [1916.] But as he explained, because [brain injury](#) must reach a certain threshold to be seen,^[FN2] the presence of *visible* atrophy strongly supported the inference that much more damage occurred than what the MRI could capture [1922-1923] and in Sal's case represented *10 only the "tip of his iceberg." [1975].

FN2. As Plaintiffs' medical witnesses explained, many brain injuries are beyond detection of regular MRI, CAT or EEG, [1839-40; 2928; 2932-33.]

The DTI studies revealed extensive white-matter (axonal) damage [1898-1899], which significantly impairs Sal's brain function and is permanent. [1925-27.]

Dr. Lipton explained that the findings on MRI and DTI are classic manifestations of acceleration/deceleration (whiplash) [brain injury](#). [1891-92; 1923-24.] He also correlated Sal's cognitive and emotional functioning to the specific regions of damage [1925-27], with which Dr. Wiener concurred [2282-83; 2319-20].

Drs. Remling, Wiener, Stein, and Kuhn all chronicled Sal's complaints of sleeplessness and waking up with startled, jerking movements. [1657; 1660; 1673; 2278-79; 2497; 2504-05; 2648; 2703-04.] In February 2004, Sal submitted to a sleep study at the Center for Sleep Medicine at Mount Sinai Medical Center. [4379.131 *et seq.*] Stasia Wieber is board-certified in sleep medicine and the Director at the Center. [3182-84.]

Dr. Wieber testified that Sal suffers from not one, but several sleep disorders [3203; 3235], all causally related to the collision [3206]: [obstructive sleep apnea](#) [3197]; [sleep state misperception](#) [3203-4]; and fragmented sleep architecture [3204]. Asked if there was yet any other *11 diagnosis, Dr. Wieber answered:

"Yes, there was one more. Mr. Lamasa has the classic sleep abnormality associated with [traumatic brain injury](#)... He had trouble initiating sleep. He had trouble maintaining sleep. He had difficulty with the stages of sleep and he had [sleep disordered breathing](#). All of that is a classical finding of [traumatic brain injury](#)." [3205.]

Sal's sleep profile was "probably one of the most severe" Dr. Wieber had ever seen, in that Sal has absolutely no stage three, four, or REM sleep. [3195; 3199; 3217; 3216; 3235-36.] Whereas

most people sleep about 80% of the time they are in bed, Sal's sleep percentage is a mere 31.1%. [3196.]

Rachel Yehuda is the Director of the Traumatic Stress Division at the Mount Sinai School of Medicine. [2337-39.] She has worked with war veterans, Holocaust and 9/11 victims, and has written more than a hundred peer-reviewed publications. [2339-41.]

Dr. Yehuda evaluated Sal in June 2002. Although, given the obviousness of Sal's condition, testing was hardly **necessary**, Dr. Yehuda utilized "structured psychiatric interviews that are well validated ...state-of-the-art instruments in the psychiatric field" to evaluate Sal. [2380-81; 2343.] Her diagnosis was three-pronged: (1) severe [major depression](#) with melancholic features; (2) [panic disorder](#); and (3) very severe ***12** [posttraumatic stress disorder](#), all of which she concluded resulted from the collision. [2344.] She explained how a mundane rear-end collision could cause a severe PTSD:

"A. [Post-traumatic stress disorder](#) is thought to be caused primarily by overwhelming fear at the time of the traumatic event.

"Q. Does it matter how hard the collision was that prompted that fear?

"A. No. It only matters how afraid he was subjectively." [2378.]

She noted that Sal's being frightened and feeling blank right after the collision is consistent with the dissociation he exhibits, further indicative of PTSD and [brain injury](#). [2463-65.] She also discussed the various indications of malingering, and explained why Sal didn't exhibit any of them. [2387-92; 2438-47.]

In terms of severity, Dr. Yehuda rated Sal's PTSD in the top 10% of patients she has evaluated in the past 12 years. [2346; 2371.] As a result of the immense psychological barriers inflicted by PTSD, Sal is so obsessed with the collision that he has become frozen in traumatic memory. [2372-73; 2375-76.] His fear has condemned him to increasing isolation [2273; 2276-77], leaving him largely confined to home [2374]. That he also suffers from [major depression](#) and panic disorder **compounds the problem** [2371], "[s]o it's really a miserable life for him." ***13** [2274.]

Nils Varney is a board-certified clinical neuropsychologist [2918-2919] and the author of many publications on [traumatic brain injury](#) and the kinematics of [brain injury](#). He provided updated neuropsychological testing, the results of which showed that Sal's condition had worsened over the years. [2933; 2953-2963.] He also discussed certain hallmarks of closed [head injury](#) -- logorrhea [2934-39], psychomotor spells [2939-45], indifferent depression [2942-45], and splitting headaches [2963; 2976-77] -- all of which Sal prominently exhibits.

Dr. Varney explained the mechanisms of closed-head injury and micro-shearing in a rear-end collision, detailing specifically what occurs in the brain during a [whiplash injury](#). [2926-2929; 2953; 2960; 3052.] He then correlated Dr. Lipton's findings of damage to Sal's functioning. [2934-44; 2953-57; 2961-63.]

Drs. Kuhn and Yehuda explained that the severity of Sal's PTSD is very much determined because of the [head trauma](#) [2349-50; 2435; 2468; 2511-14; 2349-51]. Due to brain damage, Sal doesn't have the cognitive and emotional resources that therapeutic interventions require, so his PTSD isn't amenable to treatment. [2346-47; 2513-14; 2969-71.]

Dr. Kuhn catalogued the many medications Sal's doctors have ***14** prescribed over the years, only some of which were for pain. [2530-33; 2561-63; 2614-16.] He said that he can see that Sal is in pain by the way he walks and holds his head [2527-28; 2530-31; 2608-09], but pain management specialist Joshua Greenspan, who saw Sal in May 2003 [3111; 3114], expounded on the subject. Dr. Greenspan diagnosed cervical and [lumbar radiculopathy](#), facet syndromes, [fibromyalgia](#), and myofascial pain [3123-24; 3125-26; 3145-46; 3149; 3153] all of which he attributed to the collision [3137; 3153]. He explained that the chronic nature of Sal's neck and back pain has had altering effects on his central nervous system in general and his spinal cord in particular, in that it has caused a change (for the worse) in the way pain is encoded, processed and transmitted. [3123-24; 3125-26; 3153.] Thus Sal's neck and back pain is permanent, severe, and irremediable. [3131; 3145-46; 3149.] Unfortunately, narcotics aren't appropriate for Sal and other medications are costly. [3146-48.] Dr. Greenspan expressed his frustration in trying to treat Sal, and his regret in having to discharge him due to violent outbursts. [3127-28, 3133-35.]

Sal's brain damage and psychiatric conditions are permanent [2519-20; 2554-55; 2974-75; 3151-52; 3206] and in fact, Sal's condition is deteriorating as the TBI, PTSD, pain, depression, and sleep deprivation ***15** continue to feed off each other. [2346-47; 2511-14; 2351; 2558-60; 2494; 2696; 2969-75]. He will never again be able to work. [2621-22; 2558; 2970; 3200.] As **Dr. Yehuda observed, Sal's condition is deteriorating, and "it doesn't look good."** [2391-2; 2372.] He will need psychiatric care for the foreseeable future. [2560-61.] As Dr. Varney opined, it will take a team of people in neuropsychiatry, neuropsychology, neurology, headaches, pain, and sleep **"to get all of Sal's problems sorted out."** Even then, **"he may get a third to maybe 50% better in some spots."** [2969.] Dr. Greenspan described Sal as **"a shattered man" who can't move forward with his life, and is probably condemned to a future of pain without alleviation.**" [3151-52.]

This is just a summary of the evidence that Defendant argues was insufficient to prove that Sal Lamasa sustained a serious injury in the November 25, 1992 collision. There would have been more, but due to the defense team's efforts, the jury never heard about Dr. Wiener's positive EEGs [401-403], confirmatory PET [371] and QEEG [364] testing, or Dr. Varney's opinions as to kinematics [3041-51].

Further facts will be subsumed in the points that follow.

***16** POINT I

THE TRIAL COURT CORRECTLY DIRECTED A VERDICT AS TO LIABILITY

As Justice Schulman noted in his post trial decision, "the facts of the Collision are essentially undisputed, i.e., a rear-end collision of a stationary vehicle waiting for a light change which occurred on a wet roadway." [25.]

Indeed, Sal Lamasa testified that he had been stopped at the red light on Delancey Street "a little while" - unsure whether it had been 15 or 30 seconds. [1733.] He had brought the Celebrity to a stop without any problem [1732-33], and was waiting for the light to change when suddenly he was hit from behind by Defendant's Ford F-250 truck. [1730.]

On direct examination, Defendant testified that he had been traveling on Delancey Street for about 10 blocks before the accident occurred. [3250-51.] Asked what happened, he said:

"I was coming east on Delancey and I saw the light turned and Mr. Lamasa's car stopped. I put on my brakes and it wasn't reacting properly. It started to skid. So I put them on hard, put it in lower gear, and I hit the rear of his car." [3254.]

The salient details, however, were elicited on cross-examination. ***17** Defendant admitted that during those 10 blocks on Delancey, visibility was "fine", "clear" for at least 1000 feet -- as many as five city blocks. [3270-71.] In fact he testified:

"Q. You can see at least five blocks, can't you?

"A. You can if you're paying attention." [3271.]

Yet despite the excellent visibility, Defendant didn't see Sal's Celebrity until he was only 60 to 80 feet away. [3276-77.] He was forced to "clarify" that he never saw Sal's car *come to a* stop, nor did he see the light change. [3276.] The first time he first saw the Celebrity, it was already stopped under an already red light:

"Q. -- was it the redness of the light which caused you to put your foot on the brakes?

"A. No. That was almost because I saw his car underneath the red light and I put my foot on the brakes, so simultaneously.

"Q. So you saw Mr. Lamasa's car. You looked at the light and you saw it was red?

"A. Right.

"Q. You never saw the light yellow, did you?

"A. Not that I can remember.

"Q. You never saw Mr. Lamasa slow down for yellow light, did you?

"A. Not that I can remember." [3277.]

* * *

"Q. You mean -- isn't it true that at the time you first saw Mr. Lamasa, Mr. Lamasa was already stopped for a red light?

"A. That could well be." [3279.] ***18** Defendant also admitted that he knew the roadway was wet [3280] and that the first time he applied his brakes was when he was just 40-60 feet away from Sal's Celebrity. [3281-82.]

Even assuming that he was traveling at 20 mph (29.33 feet per second) to 25 mph (36.66 feet per second), 40-60 feet on a wet roadway was simply not enough distance for this truck to stop in time to avoid crashing into Sal's stopped car, and Defendant knew it. He testified:

"Q. You were forty to sixty feet away. You see this car, this car stopped and you're worried that you weren't going to be able to stop in time, weren't you?

"A. Yes, I was.

"Q. You're worried that you weren't going to be able to stop because you knew, oh my g-d, I'm pretty close to this guy, I better press hard otherwise I'm not going to be able to stop in time, correct?

"A. Correct.

"Q. Now, the impact with Mr. Lamasa's car, it wasn't a tap, was it?

"A. No, it was not.

"Q. It wasn't a bump, was it?

"A. No, it was not.

"Q. It was a crash, wasn't it?

"A. Yes, it was." [3284.]

The law is clear and the decisions are myriad: A rear-end collision with a stopped vehicle creates a prima facie case of negligence on the part of the operator of the moving vehicle unless ?? operator presents evidence sufficient to rebut the inference of negligence. **19 Garcia v Bakemark Ingredients (East)*, 19 AD3d 224 [2005]^[FN3]; *De La Cruz v Leong*, 16 AD3d 199 [2005]; *Mullen v Rigor*, 8 AD3d 104 [2004]; *Agramonte v City of New York*, 288 AD2d 75 [2001]. "A driver is expected to drive at a sufficiently safe speed and to maintain enough distance between himself and cars ahead of him so as to avoid collisions with stopped vehicles, taking into account the weather and road conditions." *Malone v Morillo*, 6 AD3d 324 [2004], quoting *Mitchell v Gonzalez*, 269 AD2d 250, 251 [2000]. It doesn't matter that a the vehicle was traveling within the speed limit, if that speed exceeds what the road conditions warrant. See, e.g. *Yu Guo Hu v Dahlia Travel & Tours*, 13 AD3d 99 [2004].

FN3. Unless otherwise indicated, all Appellate Division citations are to First Department decisions.

It has also been repeatedly held that the "explanation" of skidding on wet pavement is insufficient to rebut the inference of negligence in a rear-end collision case. *Mitchell v Gonzalez*, 269 AD2d 250 [2000]; *Warren v Donovan*, 254 AD2d 201 [1998]; *Pinkow v Herfield*, 264 AD2d 356 [1999]; *Kosinski v Sayers*, 294 AD2d 407 [2d Dept 2002]; *Sabbagh v Shalom*, 289 AD2d 469 [2d Dept 2001]; *Benyarko v Avis Rent A Car System, Inc.*, 162 AD2d 572 [2d Dept 1990].

This is so because, in inclement weather, a slippery road is an **20* entirely foreseeable condition and a driver should reasonably anticipate and be prepared to deal with it. *Pincus v Cohen*, 198 AD2d 405 [2d Dept 1993]. As this Court noted in *Pinkow*, 264 AD2d at 357-358:

"[T]he slickness of a wet roadway and the loss of traction resulting from an accumulation of water are obvious motoring hazards requiring a driver to exercise caution. It is unavailing to raise the ambient conditions by way of defense when the negligence charged is the driver's lack of due care in response to such conditions."

For a driver to admit awareness of the rain yet claim that he could not have reasonably anticipated slippery road conditions seems factually and legally unsupportable. Indeed, in *Warren*, 254 AD2d 201, this Court found a defendant's claim that his vehicle "hydroplaned" in foggy and rainy weather conditions "show[ed] nothing more than that the accident was caused by known adverse road conditions that should have been compensated for." *[Id.]*

Here, just as in [Benyarko, 162 AD2d 572](#), Defendant asserts that he saw a car waiting for a red light half a block ahead, applied his brakes, but slid into the stopped vehicle due to the wet roadway. And just as in [Mitchell, 269 AD2d 250](#), there was no explanation as to why Sal's car was able to stop safely while Defendant's vehicle was not.

The sole proximate cause of this collision was Defendant's failure to ***21** observe traffic conditions (specifically, Sal's stopped car) and to maintain a safe stopping distance on a wet roadway. There was no evidence to suggest otherwise: negligence was established as a matter of law.

Justice Schulman thus correctly directed a verdict for Plaintiffs on the issue of liability, and was entitled to do so notwithstanding the prior denial of summary judgment. [Sorrentino v Ronbet, 244 AD2d 262 \[1997\]](#); [Miraglia v H. & L. Holding Corp., 36 AD3d 456 \[2007\]](#).

POINT II

ACCIDENT RECONSTRUCTIONIST GRAHME FISCHER'S TESTIMONY WAS IN ALL RESPECTS PROPER

(A.)

Defendant's Complaints of Untimeliness and Prejudice are Unfounded and Unauthentic

The nature and degree of injury-causing forces is an issue in every rear-end collision case. Of course it would be an issue in this case involving traumatic [brain injury](#).

Defendant knew in 2000 that Plaintiffs would be calling an ***22** accident reconstruction expert and were informed that the expert - then designated as Mariusz Ziejewski-would testify that the **overall** velocity differential between the vehicles was "**at least 10 mph.**" [272-73; 275-276.]

In March 2004 Plaintiffs retained a new accident reconstructionist, Grahme Fischer. [2149.] The case had just been assigned to Justice Schulman, who noted that there was ample time to resolve several matters before jury selection. [96; 352.] Thus Plaintiffs' expert disclosure wasn't "**late**" and to the extent it could be so considered, it was well within Justice Schulman's discretion to allow it and to take appropriate measures to obviate potential prejudice. [Cela v Goodyear Tire & Rubber Company, 286 AD2d 640 \[2001\]](#); [Gilbert v Luvin, 286 AD2d 600 \[2001\]](#).

While Plaintiffs' initial March 9th disclosure advised generally that Fischer would testify as to the severity of the collision and probable speed of Defendant's vehicle at impact [330-331], an April 9th supplemental disclosure supplied the details. It set forth Fischer's conclusions that the "**maximum compression between the vehicles**" was 19 mph, and the "**longitudinal velocity change (delta-V) of the Lamasa vehicle**" was at least 22 mph. [334-35.] Defendant would have this Court believe that ***23** Plaintiffs went from a 10 mph crash to a 45 mph crash [see Defendant-Appellant's Brief at pp 20; 23] but that's patently untrue. Forty-five miles per hour was Fischer's conclusion as to the speed the F-250 was traveling when Defendant applied his brakes, a dynamic that was never mentioned in the Ziejewski disclosures.

As Plaintiffs' counsel stated, the supplemental disclosure was served in a good-faith effort to comply with decisional law addressing the adequacy of 3101(d) disclosures. [404-405.] See e.g.,

[Cocca v Conway, 283 AD2d 787](#) [3d Dept 2001]. Instead of acknowledging this (or reciprocating), Defendant moved to preclude, claiming surprise and untimeliness [258-270]. In his brief to this Court, Defendant fails to mention that this motion was successful in procuring not only Fischer's entire file [RA-15; RA-33-38; 39-45; 46-50; 51-52], but also an eight-hour pretrial deposition [4912-21; RA-26]. That deposition was followed two days later by another assault on Fischer as an expert, this time on *Frye* grounds, which prompted the submission of two affidavits by Fischer to defend his methodology. [4922-27; 4936-37.]

As a general rule, absent showing of substantial need or other special circumstances, a party is *not* entitled to depose his adversary's expert or to disclosure of the expert's complete file. ***24** [Martinez v KSM Holding Ltd., 294 AD2d 111](#) [2002]; [Padro v Pfizer, Inc., 269 AD2d 129](#) [2000]; [Ruthman, Mercadante & Hadjis, P.C. v Nardiello, 288 AD2d 593](#) [3d Dept 2001]. Supplementing the 3101(d) disclosure could hardly be seen as "special circumstances," yet here served as grounds for Defendant to obtain both expert materials and a deposition.

Fischer was retained and noticed in March; more precise opinions were provided on April 9th; his entire file was produced by April 27th; he was deposed on May 3rd; and he submitted affidavits on May 10th and 12th. It was impossible for Defendant to have extracted any more information from Fischer before he took the stand on May 13 [2147 *et seq.*]. The notion that the defense team of Rudge, Petrocinelli, and Murphy weren't fully prepared for every syllable of Fischer's testimony is inconceivable. Defendant's expert likewise profited, having almost seven weeks to digest the 3101(d) disclosures, a full month to study Fischer's deposition and expert materials, three weeks to study his affidavits, and more than two weeks to review Fischer's trial testimony before he took the stand on June 2nd.

Defendant's complaint that he was surprised because Fischer's conclusions were different from Ziejewski's, or that he never learned of Fischer's methodologies until deposition [4905], are disingenuous ***25** considering that Defendant *never* set forth one iota of any similar information in his 3101(d) disclosures. Lest Plaintiffs' conduct be judged in a vacuum, this Court should note that Defendant's January 2004 3101(d) disclosure lacked even a single scientific assertion, indicating only that accident reconstruction expert Richard Hermance or David King (or both) would testify regarding accident reconstruction. [253-255.] Plaintiff's counsel repeatedly requested more information [RA 3; 29; 31] only to be refused [405-406; 1509].

And when Plaintiffs' entreaties [RA 29-30; 31-32] finally prompted Justice Shulman to direct reciprocal discovery [2484-85], Defendant still held back. His production of 398 photos on April 30th indicated that his experts had previously conducted four crash tests, yet withheld any findings or conclusions from the 3101(d) disclosure. [RA 30; 32.] The videotapes of the crash tests were never provided, nor were the field notes, and apparently defense counsel instructed her experts not to write any reports. [RA 27.] Mysteriously, Defendant's expert professed ignorance to the graphs produced to Plaintiffs, and the spreadsheets produced--consisting of hundreds of pages of numerical data--were virtual data dumps. [RA 26-28.] The one-hour telephone conversation (held the night before Fischer's trial testimony) yielded nothing, as ***26** defense counsel repeatedly obstructed questions, often with the quip that it was "none of [Plaintiffs' counsel's] business," and suggested that he crunch the spreadsheet numbers to figure it out for himself. [RA-27-28.] For Defendant to complain to this Court that *Plaintiffs'* behavior was willful and contumacious, while concealing his own discovery abuses, is itself contumacious.

Similarly, the accusation that Plaintiffs chose to use a different expert merely to avoid providing discovery is completely unsubstantiated and patently untrue. Had Justice Shulman required an explanation for why Plaintiffs changed experts, it would have been furnished. Since he did not, the reason is outside the record and it's inappropriate for Plaintiffs to proffer an explanation on appeal, just as it's inappropriate for Defendant to now engage in wild speculation. And it should be noted that although the 2002 court order allowed for *reciprocal expert* depositions [1228; RA-

29] the record lacks any evidence of Defendant's pursuit of the deposition or of Plaintiffs' resistance to it.

In the end however, Defendant got he wanted - a full eight-hour deposition of Plaintiffs' expert and the production of every bit of the expert file. The defense team then promptly took full advantage of that disclosure by using it to launch another round of assault, this time in the ***27** guise of a *Frye* challenge.

(B.)

The Court Properly Denied Defendant's *Frye* Motion

Defendants *Frye* application [4905-4908] was based on the affidavit of their expert, David King [4909-4911], who asserted that Fischer's use of static analysis was not generally accepted in the field of accident reconstruction and that, "A well-regarded book on the issue by Norman Jones, titled 'Structural Impact'... strictly cautions against the use of static methods to assess dynamic buckling." King claimed a second "flaw in Mr. Fischer's methodology" was that he added the forces required to cause several buckles in the bumper to compute overall delta-V. [4910.]

Initially, it should be noted that King's affidavit consisted really of nothing more than disagreement with Fischer's analysis and conclusory assertions that Fischer's methodology wasn't generally accepted. The "well-regarded" text King cited to was neither discussed nor produced [see 1509]. Justice Schulman should have found that Defendant's initial showing was insufficient to trigger a *Frye* inquiry. [People v Hayes, 33 AD3d 403 \[2006\]](#). *Frye* is not invoked merely because experts disagree. [Gayle v Port Authority of New York & New Jersey, 6 AD3d 183 \[2004\]](#); ***28** [Lustenring v AC&S, Inc., 13 AD3d 69 \[2004\]](#). As the Second Department wrote in [Alston v Sunharbor Manor, LLC, 48 AD3d 600 \[2008\]](#): "The main purpose of a *Frye* inquiry is ... not, as the defendants would have it used here, to verify the soundness of a scientific conclusion."

Nevertheless, the soundness of Fischer's scientific conclusions **was** verified, as was his methodology, and by the very authority that Defendant himself had invoked: Norman Jones, Fellow of England's Royal Academy of Engineering, Editor-in-Chief of the International Journal of Impact Engineering, former Professor at MIT and Brown University, current Professor of Mechanical Engineering at the University of Liverpool, and the author of "Structural Impact." [4820-21.]

As Fischer explained in his opposing affidavit [4922-27], he communicated with Prof. Jones via e-mail, relayed King's criticisms, and inquired as to the validity of his own analysis. Fischer's affidavit addressed virtually every sentence of King's criticisms, with reference to Prof. Jones's opinion as to each, and demonstrated that Prof. Jones found Fischer's analysis scientifically valid. [4922-27.] Prof. Jones's emails were attached to Fischer's affidavit [4928-4935], and at Justice Schulman's request [2107-09], were later (due to time constraints [2257- ***29** 58]) embodied in a sworn affidavit [4820-25]. The affidavit, replete with copious citations to the very text Defendant had proclaimed was authoritative, averred that (1) Fischer *appropriately* employed quasi-static analysis; (2) that quasi-static methods are *well-established* for low velocity impact problems such as the subject accident; and (3) it was proper and "scientifically reasonable" to take the sum of the effects of individual events to arrive at delta-V. [4820-23.] Professor Jones concluded that:

"In short, the methodologies used by Grahme Fischer are sound under principles of structural engineering, dynamics, and Newtonian physics to yield an estimate for the change in velocity experienced by Lamasa's vehicle." [4824.]

In fact, Jones felt that Fischer's analysis, if anything, was conservative [4937; 4824]. Thus, to the extent Fischer's calculations could be perceived as "flawed," they reduced the severity of the collision, and favored Defendant.

Ironically, Prof. Jones described some of King's statements as "scientifically incorrect," "patently untrue," and "scientifically unsound." [4823-24.] Now Defendant, espousing King's assertions as gospel and refuting the authority he invoked, argues that Prof. Jones's opinions were flawed, and Justice Schulman's reliance on them inapt. But as the record *30 is devoid of any formal challenges to Jones's opinions, that argument cannot be advanced now on appeal. [John v City of New York](#), 235 AD2d 210 [1997]; [Laniado v New York Hospital](#), 168 AD2d 341 [1990]. Had they been advanced at trial, it seems unlikely that Justice Schulman would have entertained them. There is only so much second guessing of scientific information a court is required engage in: "[T]he trial court's role as gatekeeper is not intended to serve as a replacement for the adversary system." [United States v 14.38 Acres of Land Situated in Leflore County, Mississippi](#), 80 F 3d 1074, 1078 [5th Cir 1996]. Moreover, as it was Defendant who proclaimed Jones as an authority, (see [Lenzini v Kessler](#), 48 AD3d 220 [2008]), he is hardly in the position to (belatedly) impugn him.

In any event, Justice Schulman did *not* base his decision to allow Fischer to testify on Jones's opinions alone. He read Fischer's deposition excerpt, noted that Fischer utilized Newtonian physics [1503-04; 2256; 4922], considered Fischer's reference to Fricke ("the Bible of accident reconstruction") and performed some limited research. [1503-05.] But to the extent Justice Schulman did consider Jones's opinions, what better way (especially given the time constraints) to confirm or dispel King's assertion that Jones's text "strictly cautions against the use of static *31 methods to assess dynamic buckling": it was certainly preferable to analyzing this highly technical material himself and hardly an abuse of discretion.

Justice Schulman correctly concluded that there was no reason to preclude Fischer ([Parker v Crown Equipment Corp.](#), 39 AD3d 347 [2007]; [Nonnon v City of New York](#), 32 AD3d 91 [2006]) and that whatever flaws Defendant perceived in Fischer's calculations went to the weight of the evidence, not its admissibility [2257; 2108; 1504] ([Altamirano v Door Automation Corp.](#), 48 AD3d 308 [2008]; [Thorne v Grubman](#), 40 AD3d 375 [2007]; [Hayes](#), 33 AD3d 403; [People v Wesley](#), 83 NY2d 417 [1994]).

(C.)

Defendant's Other Foundational Objections are Unpreserved and/or Meritless

Grahme Fischer holds an MS degree in Mechanical Engineering from Columbia University [2150], has taught engineering at SUNY Stony Brook [2155], has been doing collision reconstruction for 12 to 14 years, and has analyzed hundreds of automobile collisions. [2151.]

Fischer visited the accident scene and was familiar with it himself. [2213.] He used an exemplar quarter panel and bumper for his analysis. *32 [2179.] Like Defendant's expert [see 254-255], he used the repair estimate and photographs of the Celebrity [2159-60], as well as the applicable Federal Motor Vehicle Safety Standard [2192]. He took into account the weight ratio of the two vehicles [2174-78] and assumed the truth of Defendant's testimony as to when he

applied the brakes and for what distance he experienced hard braking. [2198-2200.] This constituted ample basis for Fischer's opinions. [Tarlowe v Metropolitan Ski Slopes](#), 28 NY2d 410 [1971]; [Gayle](#), 6 AD3d 183; [McKeon v Sears Roebuck & Co.](#), 242 AD2d 503 [1997].

A review of the Appellant's Appendix reveals that none of the foundational objections advanced now - that Fischer assumed facts not in evidence, failed to measure the relative heights of the bumpers, and failed to perform crash testing - were made during trial. As such, these objections may not be reviewed on appeal. [Inwood Security Alarm Inc. v 606 Restaurant, Inc.](#), 35 AD3d 194 [2006]; [Gayle](#), 6 AD3d 183; [Weinstein v New York Hosp.](#), 280 AD2d 333 [2001].

Even if such objections had been lodged, they would have been overruled. These matters go to the weight, not the admissibility, of Fischer's testimony ([Altamirano](#), 48 AD3d 308; [Pember v Carlson](#), 45 AD3d 1092 [3d Dept 2007]) and are properly exploited through cross-examination. ??PLR § 4515; [Uss v Tow??f Oyster Bay](#), 37 NY2d 639 [1975]; [Thor??](#) 40 AD3d 375]. Indee?? Mr. Rudge was allowed unfettered cros??amination with virtually n?? ection. [2209 *et seq.*]

In any ev?? the assertion that Fisch??erely assumed "that Bachman's bump??ruck Lamasa's vehicle, c?? though Bachman's vehicle had no visible damage and Lamasa's bum??er was only collapsed on the passenger side Defendant-Appellant's Brief at 27-28] is simply not true. Evidence of ?? bumper to bumper con ??t was supplied by Bachman's deposition ??imony, which was read the jury. [2248.] And using an exemplar quarter panel and fender fo??ustration [2179], Fischer explained how the impact could occur without ??nificant damage to the F-250, how the amount of damage to the F-2?? was consistent with a 26 mph crash [2237-38], and why the Ce??rity's bumper collapsed only on the passenger side. [2221-23.] Fisch?? disputed the assumption that it would be necessary to measure the r e heights of the bumpers, specifically addressed the overriding of the F-250's bumper over the smaller, shorter Celebrity, and asserted that it wouldn't undermine his conclusion that there was a bumper to bumper collision. [2226-29.]

As for crash testing, Fischer explained that accident reconstruction *34 can be accomplished either through analysis or testing, that testing is costly and riskier because it may not yield reliable results, and that he chose the analytical method. [2236-37; 2167-68.]

As to Defendant's argument that Fischer supplied the only competent testimony of the force Sal experienced during the accident [Defendant-Appellant's Brief at 31], note that Sal himself testified that the impact was "very hard" [1734] causing him to feel "very lost and scared."

It was the jury's prerogative to believe Fischer or King. See [Sullivan v Goksan](#), 49 AD3d 344 [2008]; [Mejia v JMM Audubon, Inc.](#), 1 AD3d 261 [2003]; [Seay v Greenridge](#), 292 AD2d 173 [2002]. They chose to believe Fischer.

POINT III

THERE WAS NO LACK OF DISCLOSURE: DEFENSE COUNSEL HAD ALL THE DISCLOSURE THEY NEEDED

(A.)

Plaintiffs Complied in Full with Their Discovery Obligations

This Court might first note the unusual nature of the discovery of a nonparty physician's raw data. Dr. Weiner averred: "I cannot remember ***35** a circumstance where my EEG tracings were sought in addition to my reports" noting "in my experience in processing authorizations numbering in the thousands, it would have been extraordinary for an attorney to make such a request." [931.] Dr. Kuhn affirmed that he had "*never* produced the entire raw EEG data for anyone, including for [his] own analysis." [1363.] Two neurometricians at the NYU Neurometric Evaluation Service advised that in all its 25 years of existence, they had *never* had a request for a complete EEG record to be printed out. [934; 1363.]

Martinez v KSM Holding Ltd., 294 AD2d 111 [2002] seems to be the only appellate court decision addressing the discoverability of medical raw data, there from a plaintiff's psychologist and neuropsychiatrist. This Court held that unless the defendants could show (1) substantial need and (2) the inability to obtain the substantial equivalent by other means, there would be no such discovery, stating:

"While the 'raw data' that defendants claim to need may be open to interpretation, the substantial equivalent thereof can be obtained by means other than turning over plaintiffs' experts' files. Indeed, defendants failed to take advantage of a preliminary conference order giving them the right to conduct neuro-psychological testing, and then, while attempting to compel disclosure of the files, declined plaintiffs' offer to submit to examinations by a neuro psychologist, who, it appears, could have conducted tests equivalent to those performed by ***36** plaintiffs' experts." [I d. at 111-12.]

In this case, Defendant likewise had the opportunity to conduct his own testing, and according to *Martinez*, didn't need and wasn't entitled to discovery of the raw data.

Nevertheless, at a January 22, 2002 compliance conference, Plaintiff's counsel stipulated "to provide Defendant with copies of records in Plaintiff's possession specifically: EEG raw data...and other records..." That and another stipulation dated nine days later -- which again refers to records "in plaintiff's possession" -- were so-ordered. [1228; 1230-1231.]

But Plaintiffs' counsel never had any raw data in their possession, and so advised defense counsel at least twice. [1296; 1304-05.] Thus the assertion that Plaintiffs violated court orders is patently untrue. A party may not be compelled to produce, or sanctioned for failing to produce, information that it doesn't possess. Romeo v City of New York, 261 AD2d 379, 380 [2d Dept 1999]; Gray v Wallman & Kramer, 225 AD2d 362 [1996]; Samello v Intershoe, Inc., 78 AD2d 796 [1980].

Plaintiffs provided authorizations for Dr. Wiener's records in March 1994, October 1998, and February 2002 [1283], and for Dr. Kuhn's records in March 1994, October 1998, November 1998, June ***37** 1999, and November 2001. [1256-67.] Having done so, Plaintiffs fully complied with their discovery obligation. Serpe v Eyriss Productions, Inc., 243 AD2d 375 [1997]; Dowling v 257 Associates, 235 AD2d 293 [1997]; Ryan v City of New York, 269 AD2d 170 [2000]; Lombardi v Wlazlo, 170 AD2d 653 [2d Dept 1991]. It was then up to defense counsel, armed with their authorization, to request and pursue the data they sought.

(B.)

Dr. Weiner

Dr. Wiener, a neurologist, first saw Sal on January 14, 1993 -- 2 months postaccident. He performed EEGs in January and February 1993, both of which were abnormal and consistent with findings of [traumatic brain injury](#). [1387-88.] As Dr. Wiener explained, EEG tracings were seldom if ever requested, even by treating physicians. It was his practice to store them separately and discard the data after three years. [1284.] Whether raw data **constitutes a "patient record"** and whether Dr. Wiener's practice violates the Education Law mandate that patient records to be kept for six years, is debatable. If it did, Plaintiffs certainly had nothing to do with it.

Defendant first received an authorization for Dr. Wiener's records in March 1994. So when Dr. Wiener first supplied defense counsel with ***38** record that didn't include the EEG data, defense counsel had two years to follow up on its raw data requests before it was discarded. [1283-84.] Yet it wasn't until November 1998 (two years after the data was discarded) that defense counsel **wrote Dr. Wiener asking for "photocopies of EEGs and all records relating thereto"** -- without specific reference to raw data. [1274-75.] Notices to produce the data weren't served on Plaintiffs' counsel until 1999. [1199; 1214-17; 1245-53.]

Justice Schulman acknowledged that destruction of the data was unintentional. [401.] Nevertheless, because Dr. Wiener had written a letter report to Jacoby and Meyers in November 1993 [1415], Justice Schulman ruled that Dr. Wiener should have anticipated that raw EEG data -- which had never been requested before in his career -- would be needed some time in the future for litigation.

Justice Schulman thus imposed the drastic sanction of precluding Dr. Wiener from testifying about the positive EEGs [401-403], punishing Plaintiffs for Dr. Wiener's admittedly unintentional act. It was an abuse of discretion to have done so, particularly where counsel had Dr. Wiener's records, the EEG report, and Dr. Wiener to cross examine. See [Schozer v William Penn Life Ins. Co.](#), 84 NY2d 639 [1994]. Even in the context of spoliation, preclusion is a harsh remedy that this Court has ***39** found necessary only when the spoliation was willful. [Tawedros v St. Vincent's Hospital of New York](#), 281 AD2d 184 [2001]; [Myers v Sadlor](#), 16 AD3d 257 [2005]; [Melcher v Apollo Medical Fund Management L.L.C.](#), 52 AD3d 244 [2008]. Even the circumstances of *Tawedros* -- where a *party defendant* had lost a portion of the plaintiff's medical record -- didn't warrant preclusion. It was for the jury to weigh the credibility of the defendant's explanation for losing the record. Here it was a third party who had destroyed data never shown to be crucial to the defense, and which technically, Defendant wasn't entitled to.

Still Defendant wasn't satisfied with this overly harsh preclusion, and even now insists that it should have extended to the entirety of Dr. Wiener's testimony. But contrary to Defendant's contention, Dr. Wiener didn't base his diagnosis of [cerebral concussion](#) on the positive EEGs alone. As the November 1993 report indicates, the test was undertaken to confirm his clinical findings. [1415-16.] At trial, he testified that myoclonic jerks (noted at first visit) were consistent with [brain irritation](#) from trauma. [2278.] He further testified that his February 16, 1993 diagnosis of [cerebral concussion](#) was:

"Based on the history of the auto accident...the symptoms that followed it including the headaches, the personality changes, including the panic attacks and the bodily jerks, all of which added up to the impression of *40** the concussion."** [2283.]

Dr. Wiener should have been permitted to testify to the abnormal EEGs. Barring that, it was entirely proper for him to testify as to his diagnosis. [Lopez v Consolidated Edison Company of New York, Inc.](#), 40 AD3d 221 [2007].

(C.)

Dr. Kuhn

During Sal's course of treatment, Dr. Kuhn performed several EEGs, which were interpreted **using both standard procedure as well as quantitative EEG (or "QEEG") procedure (which utilizes computer analysis)**. Defendant demanded the entirety of the raw data from each of them.

As Plaintiffs' counsel explained, this demand was highly unusual for these medical care providers and extraordinarily burdensome and expensive. [1281-90; 925-926.] The invoice from the NYU Neurometric lab [RA-4-5; 951] conveys some sense of the enormity of the task: it reflects 25 hours of labor, at a cost of \$1075, to prepare a computer disk covering 1857 epochs (each epoch being approximately 50 pages [see e.g. 1309-1356]). This disk was provided to defense counsel on April 12th, [948; RA-4] and when defense counsel didn't have the program to view the data, Plaintiffs counsel made alternate arrangements. [378-80.]

***41** In any event, the defense team had full copies of the tracings in plenty of time before Dr. Kuhn testified on May 18th. [2488.] As Justice Schulman noted in the posttrial decision, Defendant was able to have his own expert witness, Marc Nuwer, testify concerning Dr. Kuhn's data and offer a contrary interpretation of it. [27.] Dr. Nuwer never complained that he didn't have enough time or data upon which to base his opinions. There was no prejudice to Defendant.

We presume that Defendant's contention that Dr. Kuhn testified to "new injuries," refers to testimony regarding epileptic behavior. Dr. Kuhn testified that one of the manifestations of brain damage is epileptic behavior - such as Sal's tendency to rant in a trance-like state. [2537-2541.] Thus, Dr. Kuhn treats Sal as if he has [epilepsy](#), since the medication also helps to treat anxiety. [2548-50.]

Epileptic behavior was not a new injury. Plaintiffs claimed "[epileptic disorder](#)" in their March 6, 1996 Supplemental Bill of Particulars. [69.]

(D.)

Dr. Shea

Through Plaintiffs' counsel's efforts, all raw data collected by treating neuropsychologist Leo Shea was provided on March 15, 2004. [381; ***42** 1281.] However, Dr. Shea never testified,^[FN4] so **revisiting the issue, as Justice Schulman noted, "seems pointless."** [28.]

FN4. As Drs. Stein and Varney are both neuropsychologists, Dr. Shea's testimony would have been cumulative.

(E.)

The There was Not One Iota of "Willful or Contumacious" Conduct

The harsh sanction of preclusion is warranted only where the adversary makes a clear showing that noncompliance with a discovery order was intentional and prejudicial. [Jordan v Doyle, 24](#)

[AD3d 107 \[2005\]: *Anagnostaros v 81st St Residence Corp.*, 269 AD2d 150 \[2000\]: *Dexter v Horowitz Management*, 267 AD2d 21 \[1999\].](#)

Plaintiffs never violated court order. Acting beyond his legal duty of discovery, Plaintiffs' counsel contacted Sal's treating physicians himself, provided explanations [925; 1293-1294; 1358; 1360-63], and made every effort to ensure that the monumental task of providing every bit of medical information -- be it record, image, or raw data - was accomplished. It stretches the imagination to categorize this as "willful or contumacious" conduct deserving of preclusion.

***43 POINT IV**

NEURORADIOLOGIST MICHAEL LIPTON'S TESTIMONY WAS IN ALL RESPECTS PROPER

(A.)

The Court Properly Denied Defendant's *Frye* Motion

Plaintiffs proffered objective evidence of [traumatic brain injury](#) through the testimony of neuroradiologist Michael Lipton, who utilized both MRI and an MRI modality known as [diffusion tensor imaging](#) and fractional anisotropy ("DTI") to assess Sal Lamasa's brain damage. [4163-64.] Defendant had been on notice that Dr. Lipton would testify since October 2003. [1775^[FN5]]

FN5. Mr. Flomenhaft said 1993 but it is clear that he meant October 2003, as Dr. Lipton's report is dated September 2003 [see 4163-64; 1840-41].

Minutes before Dr. Lipton was to take the stand, defense counsel issued a *Frye* challenge as to the DTI/FA technique, asserting that it was "new and experimental and not definitive to determine whether a patient has traumatic [brain injury](#)." [1773-74.] Once again, Defendant submitted an expert affidavit rife with conclusory assertions that Plaintiffs' scientific evidence was not generally accepted. This time the affidavit was accompanied by the expert's CV, an excerpt from the 2002 *44 ACR Practice Guidelines, [4636-39]; and an article written by a group at Massachusetts General Hospital. [4632-35; 4643-49.1 As Plaintiffs' counsel noted, Defendant's expert -- Mark Mishkin -- was retired from the practice of medicine and had no experience or training in DTI or any of its applications. [1776; 3350-51.] Nevertheless, Justice Schulman indulged Defendant and held a "mini-hearing" as to the general acceptance of DTI. [1774-1827.]

In contrast to Dr. Mishkin, Dr. Lipton's board certifications in both radiology and neuroradiology are current. [1777; 1805.] He practices at Montefiore Medical Center, where he is the Medical Director of [Magnetic Resonance Imaging](#) [1783-1784], as well as at Jacobi Medical Center and North Central Bronx Hospital. [1783.] He is an Assistant Professor of Neuroradiology at the Albert Einstein College of Medicine [1778; 1781] and is a member of a research group of neuroscientists at the Nathan Klein Institute, part of the New York State Office of Mental Health. [1781-82.]

Dr. Lipton explained that traditional MRI shows brain structure [1797] but that DTI is more sensitive, and can reveal abnormalities that aren't visible on standard MRIs.

[1803; 1807; 1823-254.] DTI is approved by the FDA [1789-1790]; had been widely used, including at *45 Montefiore Medical Center, as a clinical diagnostic tool for more than a year [1789-1791]; and was one of the most used diagnostic methods by the group at the Nathan Klein Institute [1805; 1820]. Dr. Lipton was familiar with DTI literature, and advised that the evidence that DTI is a strong marker for the presence of axonal injury is both substantial and increasing. [180??-1803; 1820.] Further, DTI is a reliable method for determining the *presence* of [brain injury](#) in the brain's white matter. He testified:

"Among the benefits of use and study of diffusion tensor imaging, at this point it is fair to say that it is an accepted fact, or given, that DTI indexes [brain injury](#)." [1804.]

He added that there may be questions regarding DTI treatment applications and other diseases, "but there is no question that it indicates the presence of injury." [1804; 1820.] Moreover, its reliability doesn't change depending on whether the [brain injury](#) is mild, moderate, or severe. [1821.]

Dr. Lipton reviewed the article submitted by defense counsel, and explained that the question it addressed was *not* whether DTI evidences the *presence* of [brain injury](#), but whether it could determine the *severity* of tissue injury and *prognosis* (concluding that it could). [1792-93; 1801-02; 1808; 1813.] He disagreed with the notion that the article in any way *46 indicated that DTI was a novel application. Rather, he saw it as very positive, describing the use of DTI as a further extension of the authoring group's previous success. [1792; 1800.] Asked by the court if he had read any peer-reviewed articles that adopt his opinion and "recognizes DTI/FA as a diagnostic tool in terms of its reliability and revealing the presence of TBI," Dr. Lipton answered that Defendant's article *was* such an article, and that it referenced other articles that also support that point. [1806.] As for the 2002 ACR Guidelines, Dr. Lipton explained that although DTI/FA is not specifically mentioned, it is clearly alluded to in the language, and that the ACR criteria are meant to be non-restrictive. [1815-16.]

Justice Schulman denied Defendant's application to preclude on the ground that there was insufficient basis to characterize DTI as a novel science. [1827.] Once again, Justice Schulman correctly determined that Defendant's concerns went to the weight, and not the admissibility of the opinion testimony. [1827.]

Under the *Frye* standard, the burden of proving general acceptance ultimately rests on the party offering the disputed expert testimony (see [Lara v New York City Health & Hosps. Corp.](#), 305 AD2d 106 [2003]), but that's *only after* the party challenging the evidence satisfies his initial *47 burden of showing *prima facie* that the evidence is novel and hasn't been generally accepted. ([Oppenheim v United Charities of New York](#), 266 AD2d 116 [1999]). Defendant here failed to meet that burden. It was the second time he invoked an authority to support his position, only to be proven wrong as to what the authority actually represented.

Still insisting that DTI is not generally accepted, Defendant seizes upon one answer Dr. Lipton gave at the on-the-spot *Frye* hearing, in which he stated that he didn't know of any study where DTI was utilized that specifically concerned mild (as opposed to moderate or severe) [traumatic brain injury](#).

But the lack of such a study would not be dispositive on the issue of scientific reliability. DTI as it applies to diagnosing Sal Lamasa's brain damage, doesn't "fail" the *Frye* test merely because there might not be a study expressly reporting on DTI and mild [traumatic brain injury](#). See [Zito v Zabarsky](#), 28 AD3d 42 [2d Dept 2006]. As

Justice Saxe, concurring in *Marsh v Smyth*, 12 AD3d 307 [2004] wrote, it's not necessary that underlying support

"consist of cases or studies considering circumstances exactly parallel to those under consideration in the litigation. It is sufficient if a synthesis of various studies or cases reasonably permits the conclusion reached by the plaintiff's expert." [*Id.* at 312-313.]

***48** Publication is but one aspect of general acceptance. Study or no study, the fact remains that, unlike for example, the "spinoscope" (see [Castrichini v Rivera](#), 175 Misc 2d 530 [Sup Ct Monroe County 1997, Fisher, J.]) DTI has been approved by the FDA and (at the time of trial) had been utilized case after case for more than a year by at least two major hospitals in major metropolitan areas (Montefiore and Massachusetts General). That Dr. Lipton didn't know offhand what other hospitals employ the technology indicates nothing more than a lack of preparedness for the "pop-quiz" he was subjected to.

The burden should never have shifted to Plaintiffs to prove DTI was generally accepted, but Dr. Lipton's testimony amply sustained that burden nonetheless. The jury properly considered Dr. Lipton's testimony regarding DTI.

(B.)

Defendant had Access to Every Film Dr. Lipton Testified To

During Dr. Lipton's testimony, various MRI images housed on a computer disk were projected on a screen for use as demonstrative evidence. Dr. Lipton explained that all MRIs originate in electronic form. [1842-43.] Defense counsel objected, claiming they had never been provided with *computerized* images, only films. [1843.] Plaintiffs' ***49** counsel's response was twofold: (1) Plaintiffs had provided an authorization for defense to obtain all medical information from Dr. Lipton (a statement that defense counsel never refuted); and (2) it's common knowledge among radiologists that MRIs are originally generated in digital form, and if defense counsel wanted the images on a CD, it was theirs for the asking. [1845-46.] During a brief voir dire [1848-49], it was established that the images on the CD and the films were the same, and that the images could be digitalized and put on CD, or burned directly to a CD, but either way, they were the same images. [1849-51.] Satisfied, Justice Schulman allowed Dr. Lipton's testimony to continue, during which the CD containing the images was marked in evidence. [1851.]

At the break, Plaintiffs' counsel noted that defense counsel could burn a copy of the CD that had been marked in evidence if they wished [1868], and that's apparently what defense counsel did.

Later defense counsel alleged that, having reviewed their own copy of the disk, they hadn't *previously* received some images (out of many), and that *one* of those images was an image Dr. Lipton had referred to. Based on this they moved that Plaintiff's Exhibit 2A and 2B be stricken from the record. [2363-64.]

***50** Defense counsel *never substantiated the claim of missing images*. Nor did they ever state how the non-receipt of these images -- only one which was actually used at trial -- would make any difference to their expert's opinion or their defense. They simply posited then (and now) that they hadn't received some images, *ergo* they were prejudiced.

But Justice Schulman didn't see any prejudice. Defendant's well-credentialed neuroradiologist now had all the images and plenty of time - almost three weeks until he was to testify - to review them. [2364-65.]

Indeed, the claimed missing images had no effect on Defendant's expert's opinion. For no matter how many images there were or how many abnormalities Dr. Lipton would highlight, the defense expert's opinion remained the same: that all images were completely normal.

Defendant never disputed having received authorizations to obtain Dr. Lipton's entire file, including the MRI images. [2366.] If any images were missing from whatever Dr. Lipton's office had sent in response to that authorization, that was beyond Plaintiffs' knowledge or control. Nor was there any basis to accuse Dr. Lipton's facility of any intentional omissions. There was no willful conduct by either Plaintiffs' counsel or Dr. Lipton, no prejudice to Defendant, and no reason to strike the testimony or the exhibit. [People v Sullivan, 261 AD2d 652](#) [3d Dept *51 1999].

There is likewise no reason to disturb Justice Schulman's ruling, which, in an abundance of caution, allowed Defendant to recall Dr. Lipton for a continued **and "open-ended" cross-examination** [1878-80] after his own neuroradiologist enjoyed ample opportunity to review Dr. Lipton's testimony and the films.

(C.)

Dr. Lipton Properly Testified to What He Saw on the Images

Referred by Dr. Greenspan for the purpose of diagnosing the precise nature of Sal's [brain injury](#), Dr. Lipton was a treating physician (see [Wylie v Consol. Rail Corp., 229 AD2d 966](#) [4th Dept 1996]). Defendant had his report and his records. As such, no 310 1(d) was required to be served regarding his testimony. [Breen v Laric Entertainment Corp., 2 AD3d 298](#) [2003]; [Finger v Brande, 306 AD2d 104](#) [2003]; [Ryan v City of New York, 269 AD2d 170](#) [2000].

Sometime before testifying, Dr. Lipton reviewed the September/October 2003 MRI and DTI images, and made some measurements, which quantified Sal's [brain atrophy](#). Those measurements, which merely quantified damage that was there to be ***52** seen on the images provided, were for demonstrative purposes and needn't have been disclosed to defense counsel. They were disclosed nonetheless. [1874-76.]

Dr. Lipton's September 2003 report noted, *inter alia*, hippocampal damage. However, before taking the stand, he noticed that there was also damage to the parahippocampal area - a small area just next to the hippocampus. This area of damage was insignificant compared to the massive extent of damage previously reported. Allowing Dr. Lipton to testify to it, Justice Schulman likened the situation to cases where a physician who examined a plaintiff a week before trial was permitted to relate the findings. See [Frank v Iasello, 257 AD2d 362](#) [1999]; [Taylor v Daniels, 244 AD2d 176](#) [1997]. This was an apt analogy. Instead of a person, the physician re-examined a film. The parahippocampal damage wasn't a "new" abnormality -- it had always been there to be seen. It was not so far afield of the information set forth in the report to be prejudicial. [Moreno v Fabre, 46 AD3d 254](#) [2007]; [Reed v City of New York, 304 AD2d 1](#) [2003]. Truly, it made no difference in the end, as Defendant's expert would *still* testify that the images were in all respects normal.

***53** POINT V

THE ENTIRETY OF DR. WIEBER'S TESTIMONY WAS PROPERLY CONSIDERED

(A.)

Dr. Wieber's Report was Timely Served

Defendant knew from the service of the original Bill of Particulars that Plaintiffs' claims included sleep disorder. In fact, insomnia was listed second in the injury paragraph [53], which also **included "restlessness," "wakes several times a night" [54], and "sudden bodily jerks in sleep" [57].** In addition, Drs. Remling [1657, 1660, 1673], Weiner [2278-79; 2497], Kuhn [2504-05; 2493; 2497; 4379.6], Greenspan [3132; 3134], and Stein [2648; 2703-04] all noted Sal's sleep difficulties.

It could hardly have come as a surprise then, when Plaintiffs served the report of a sleep study done on February 18, 2004. [4379.131 et seq.] The report was served on March 15th, the day it was received [1505-1506], and Plaintiffs also furnished an authorization to defense counsel, who subpoenaed the records. [1507-08.] Once again, having furnished a report and authorization, Plaintiffs satisfied their discovery obligation.

Defendant didn't object to the timeliness of Dr. Wieber's sleep study report until orally moving to preclude on May 7th -- just after jury selection. [1507-08.] Justice Schulman properly denied the motion. The ***54** report was served timely, 53 days before trial (see [22 NYCRR § 202.17](#)), and 77 days before Dr. Wieber testified on June 1st [3181]. The defense team made use of that time: they retained their own sleep expert, Mare Raphaelson. Again, as for the underlying data, once Plaintiff's counsel was made aware of Defendant's difficulty obtaining it, he endeavored to ensure its proper production before Dr. Wieber testified. [2636-37.] Notably, at trial defense counsel never asked for a continuance or otherwise claimed to need more time to analyze this data.

(B.)

Since Both Dr. Wieber and Dr. Raphaelson Linked Sal's Sleep Problems to the Accident,
Defendant's Arguments are Academic

Given the Bill of Particulars, and the fact that every treating physician noted Sal's inability to sleep, it's difficult to believe that the defense team could not have anticipated that an expert would opine as to a causal link between [brain injury](#) and Sal's sleep problems.

In fact, Dr. Kuhn testified without objection that sleep disturbance is not only consistent with a history of motor-vehicle accident and TBI, but is one of the first and most common symptoms. [2504-05.] Dr. Stein similarly testified, without objection, that awakening in the middle of the **night with a jumping sensation is "the type of pattern that we see when *55 posttraumatic stress is a secondary diagnosis and the principal diagnosis is the concussion."** [2703-04.] Most importantly, Dr. Wieber, without objection, identified Sal's several sleep disorders [3203-06;

3235; 3197] and asserted that Sal has the classic sleep abnormality associated with [traumatic brain injury](#). [3205.]

Now Defendant complains that Dr. Wieber failed to establish the reliability of her testimony that **one** of those several disorders, [obstructive sleep apnea](#) (or "[sleep disordered breathing](#)") was linked to [brain injury](#). [3214-15.] To support his argument, he seizes on her language that there is "a thought out there that [traumatic brain injury](#) is associated with [sleep disordered breathing](#)" and her mention of a study where 10 subjects with traumatic [brain injury](#) all suffered from this disorder. [3198-3199.] However that testimony was received with neither a *Frye* nor a hearsay objection, and is not reviewable on appeal. [People v Angelo](#), 88 NY2d 217 [1996]; [Andrew v Hurh](#), 34 AD3d 1331 [4th Dept 2006]; [People v Gallup](#), 302 AD2d 681 [3d Dept 2003]. Moreover, it was the subject of rather intense disagreement by Dr. Raphaelson: virtually his entire testimony was dedicated to refuting Dr. Wieber's opinion as to [sleep apnea/sleep disordered breathing](#). [3633 *et seq.*] That Dr. Raphaelson asserted that [central sleep apnea](#) could be ***56** caused by brain-related problems, but [obstructive sleep apnea](#) could not [3670-72], was something for the jury to consider.

But whether [obstructive sleep apnea](#), or any of the various sleep disorders were due to [brain-injury](#) seems beside the point: the applicable link was **to the accident**. Dr. Wieber furnished that link [3206], as did Dr. Raphaelson, who **agreed that the crash, as well as the "physical, emotional and mental consequences of the crash" was a substantial factor in producing the insomnia** Sal experienced. [3681-82; 3676-78.]

(C.)

Dr. Wieber's Report was Not Misleading: The Issue of CPAP Therapy was Purely Collateral

There was very little testimony concerning the CPAP mask - other than that Sal probably wouldn't be able to tolerate it [3206-07], and Plaintiffs made no claim to the jury that Sal would need CPAP therapy. The purpose of Dr. Wieber's testimony was to establish the nature and scope of Sal's sleep disorders. Any discrepancy between her report and her testimony regarding whether Sal was a good candidate for CPAP therapy was minor and pertained to the purely collateral issue of treatment.

***57** POINT VI

DR. VARNEY'S TESTIMONY WAS IN ALL RESPECTS PROPER

(A.)

The Court Specifically Allowed Plaintiffs to Retain Dr. Varney as a Replacement for Dr. Welti

When Justice Schulman precluded forensic pathologist Charles Welti (who would have testified as to the medical mechanisms of [brain injury](#)) on April 1st, he advised Plaintiffs' counsel "You're going to have to find someone else" [92], noting later "I'm giving you an option...I'd like all parties to take advantage of the time" [96]. Revisiting the issue on April 14th, Justice Schulman

reiterated that Plaintiffs' counsel was free -- **"particularly because there is no current must go date for trial" to retain a substitute expert on causation.** [352-53.] Plaintiffs had already taken that advice, having served a disclosure noticing Dr. Varney that morning. [352; 4835-55.]

Dr. Varney examined Sal on April 24th and his report and records were provided to defense counsel by hand three days later. [AR 15.] As Dr. Varney didn't testify until May 24th [2912; 3108], the defense team had a full month to prepare for cross-examination, which ?? extensive [3052-3098]. Plaintiffs' disclosure, sanctioned by the ??rt, was ***58** decidedly *not* untimely.

(B.)

Dr. Varney Didn't Testify as to Any "New Injuries," Nor did Defendant Lodge an Objection on this Ground

Defendant moved to preclude Dr. Varney on the grounds that the disclosure was untimely, that his testimony would be cumulative to Dr. Shea, and that he was incompetent to testify as to kinematics. [4826-33.] Defendant was successful on the kinematics issue [3041-51], and Dr. Shea never testified, vitiating the claim of cumulativeness.

But the trial transcript is devoid of any objection to Dr. Varney on the grounds that he would be **testifying as to what Defendant now claims were "new and significantly more serious injuries"** [Defendant-Appellant's Brief at 20], referring to lack of taste and smell, epileptic seizures, and moderate to severe [brain injury](#). Indeed, the time to have objected was at trial when Justice Schulman, if necessary, could've put a stop to any questioning on subjects he felt were beyond the scope of Plaintiffs' claims or disclosures. Instead, defense counsel forged on with vigorous cross-examined as to both these aspects of Dr. Varney's testimony. [3092-97; 3062-68.]

But to be clear, Dr. Varney did *not* testify to any "new injuries."

***59** As already discussed, Dr. Kuhn had been treating Sal for epileptic-type seizures for years, and epilepsy had been claimed in the 1996 Supplemental Bill of Particulars. [2548-50; 69.]

Loss of taste and smell were never proffered as an injury. Dr. Varney merely noted this finding, which is a *sign* of closed [head injury](#). [3101-02; 2963-66.] As Dr. Varney explained, there are only three things that can cause a loss of taste and smell at the same time: closed [head injury](#), [encephalitis](#), and [meningitis](#) [2966], and clearly Mr. Lamasa did not suffer from either of the latter two. It was certainly permissible for Dr. Varney to justify his opinion by reference to clinical signs.

Similarly, Plaintiffs never sought to add a "new injury" of "moderate to severe TBI." In fact, the bills of particulars never categorized Sal's [brain injury](#) at all. The March 10, 1994 bill simply lists "[post-concussion syndrome](#) with severe cognitive defects [*sic*]" [53], "closed [head injury](#)" [54], "[cerebral concussion](#)" [57], and a litany of manifestations, including severe headaches, extreme posttraumatic anxiety, and various deficits ranging from mild to severe [54-57], virtually all of which were established at trial. That Defendant may have interpreted this list as indicating "[mild traumatic brain injury](#)" is not binding on Plaintiffs.

***60** In any event, as Dr. Varney explained, one index of the severity of [head injury](#) is how long "you're knocked out," and another index is how long one's memory is "knocked out." [2946.] Dr. Varney explained that using this second index, Sal's history (as given to him by Ana) of a month-long [posttraumatic amnesia](#) would indicate "somewhere between moderate and severe [[head](#)

[injury](#)] by the conventional classifications.” [2947.] It was up to the jury to determine whether this index was even applicable to Sal Lamasa. Dr. Varney then testified to the same severe cognitive deficits that Dr. Stein and Dr. Kuhn related and that were set forth at length in Plaintiffs’ Bill of Particulars. [2950-60.] He added only that with the passage of time, these deficits had worsened [2954; 2974; 3083-84], and would continue to worsen [2974-75], establishing the allegation of permanence, also claimed in the initial bill. [59.]

POINT VII

DR. LEIKEN’S TESTIMONY AS TO MEDICAL INSURANCE AND SOCIAL SECURITY BENEFITS WAS IN ALL RESPECTS PROPER

(A.)

Loss of Medical Insurance

The award for lost medical insurance is **not** duplicative of the award for medical expenses.

***61** As Dr. Leiken explained, medical insurance coverage is a component of income. It’s part of the benefits package that Sal could have continued to expect to receive had he continued working. [2871-72; 2878; 2880-86.] Although union workers such as Sal usually enjoy a health insurance plan that covers the worker’s entire family, Dr. Leiken conservatively confined his calculations to an individual plan. [2885-86.]

Medical insurance benefits would cover any type of medical care that Sal might need - be it for routine medical check-ups, the flu, or treatment relating to the injuries he sustained in the November 1992 accident. In contrast, an award for medical expenses pertains to reimbursement of medical bills **only** for the medical care for the injuries and [sequelae](#) caused by the 1992 collision.

Thus, the cost for obtaining medical insurance coverage and unreimbursed medical expenses are not the same. We note that future loss of medical insurance benefits was awarded in [McKee v Sithe Energy Co., No. 216/95, 1999 WL 33483598](#) [Sup Ct, Oswego County, Nicholson, J.] It is a proper element of economic damage.

The extent to which the medical insurance award relates to future medical expenses is an issue to be addressed at a collateral-source hearing. [CPLR § 4545](#) (c).

***62** (B.)

Future Loss of Social Security

Dr. Leiken calculated and testified to Sal’s future loss of Social Security **retirement** benefits. [2886-2889.] Future loss of Social Security retirement benefits were awarded in [Bove v Cherney, No. 30116/94, 2001 WL 1818987](#) [Sup Ct, Suffolk County, Tannenbaum, J.], [Malloy v Stellar Management, No. 109054/05, 2008 WL 2246591](#) [Sup Ct, New York County, Rakower, J.] and

[*Louissaint v Hudson Waterways Corp.*, 111 M 2d 122, 123](#) [Sup Ct New York County, Greenfield, J. 1981] and is a proper element of economic damage.

As he advised during voir dire, Dr. Leiken knows how Social Security competes retirement benefits [2865], and fact that Sal was already receiving Social Security *disability* benefits was not relevant to his analysis. [2862.]

However defense counsel (apparently utilizing his own economic formula) essentially argued with Dr. Leiken that his calculations for future Social Security retirement benefits should be reduced by the amount Sal will receive for Social Security disability benefits. [2862-69.] However, Dr. Leiken and Justice Schulman agreed [2866; 2870], and it is Plaintiffs' position on appeal, that to whatever extent social security *disability* payments may work to reduce Social Security *retirement* *63 benefits is a matter for a collateral source hearing. [CPLR § 4545\(c\)](#).

POINT VIII

PLAINTIFF'S PROOF WAS MORE THAN SUFFICIENT TO ESTABLISH SERIOUS INJURY

Proof of [post-concussion syndrome](#), [post-traumatic stress disorder](#), and [cognitive deficits](#) is proof of "serious injury" under [Insurance Law § 5102](#) (d). This Court so held in [Jackson v Mungo One, Inc.](#), 6 AD3d 236 [2004]. See also [Jordan v Goldstein](#), 129 AD2d 616 [1987]; [Wyman by Wyman v J. Giarnella & Son, Inc.](#), 170 AD2d 229 [1991]; [Chapman v Capoccia](#), 283 AD2d 798 [3d Dept 2001]; [Bissonette v Campo](#), 307 AD2d 673 [3d Dept 2003].

As set forth at length in the Counterstatement of Facts, the evidence here was overwhelming that Sal Lamasa suffered debilitating [post-concussion syndrome](#), [cognitive deficits](#), and severe [post-traumatic stress disorder](#). Defendant's evidence barely refuted it.

Equally conclusive was the evidence that these injuries were the result of the November 1992 collision. Before then, Sal was a healthy and hard-working porter at Ogden Allied with a 40-hour plus work week. [1993-94.] He was a stranger to neck and back pain. [1724.] In fact, he *64 had no physical complaints, and hadn't been to a doctor in two years except for a work physical and a stomach ache. [1747.] Like a substantial portion of the population, Sal had a mild case of lumbar [scoliosis](#) and the early stages of disc thinning at the last lumbar vertebra. But these conditions were asymptomatic, and as Dr. Remling explained, would not, by themselves, have been a source of pain. [1648-51.]. As already set forth, before November 1992, Sal's mental functioning was average or above, and he had no problems sleeping, even though he was a shift worker.

It was at the moment of the November 1992 collision that Sal's physical and mental status changed and his odyssey in pain and cognitive breakdown began. The jury heard evidence as to what Sal felt at the moment of impact, and in the minutes, hours, and weeks that followed. They heard from him, his family, and the medical witnesses who chronicled Sal's condition over the course of more than 450 office visits.^[FN6] There was no question that Sal's problems started the day of that collision. See [Feliciano v Ford Motor Credit Company](#), 28 AD3d 221 [2006].

FN6. Not including the clinicians whose records were not presented at trial.

Defense counsel cross-examined each medical witness as to *65 possibility that Sal's various injuries were caused by anything but the November 1992 collision, yet none of them opined as to any other cause. Neither mild [scoliosis](#) nor the onset of degenerative disease could account for

the acute onset of Sal's neck and back pain. And if anything, Sal's congenital abnormality at C2-C3 made him *more* susceptible to trauma [1645-48], a factor that serves only to exemplify the well-established principle of tort law that the defendant must take the plaintiff as he finds him. [*Bartolone v Jeckovich*, 103 AD2d 632](#) [4th Dept 1984]; [*Stanton v Hexam Gardens Const. Co., Inc.*, 144 AD2d 132](#) [3d Dept 1988].

There was absolutely no evidence that a car accident in 1991 had any effect on Sal's physical or mental condition. Just the opposite. Unlike the plaintiffs in [*Becerril v Sol Cab Corp.*, 50 AD3d 261](#) [2008] and [*Wadford v Gruz*, 35 AD3d 258](#) [2006], Sal hadn't been injured in the 1991 accident at all, never had pain or any need to see a doctor, and never missed a day of work (including the day *of* the accident). [1740-42.] **That the car had been designated "totaled," without more, has** no bearing on whether Sal was injured. And there isn't one iota of evidence, or any scientific basis whatsoever to presume (as Defendant does on page 39 of his brief), that Sal experienced any acceleration/deceleration injury. As a ***66** matter of fact, given Sal's brief description of the accident (which involved an impact to the side of the car's front end as opposed to a rear-end collision), it's clear that the mechanism for an acceleration/deceleration injury was *absent*.

By all accounts, the 1991 accident was a non-injurious event, and it is pure speculation to argue otherwise. Given the absence of complaints or any medical record, it was not incumbent upon Sal's doctors to address the issue of any prior accident. [*Bray v Rosas*, 29 AD3d 422](#) [2006]; [*Offman v Singh*, 27 AD3d 284](#) [2006].

By establishing that any one of several injuries sustained in an accident is a serious injury within the meaning of [*Insurance Law § 5102*](#)(d), a plaintiff is entitled to seek recovery for all injuries incurred as a result of that accident. [*Obdulio v Fabian*, 33 AD3d 418](#) [2006]. The Court may note that Defendant offers no argument as to the 90/180 day category of damages.

Having submitted persuasive proof of [brain injury](#), resultant [cognitive deficits](#), emotional problems, and PTSD, it hardly matters how much evidence of orthopedic or neurological treatment Plaintiffs adduced. The criteria for assessing serious injury applicable to cases involving only neck and back injuries are simply not dispositive here. ***67** Sal's cervical and lumbar conditions, although extremely painful, were not the focus of this trial, and seem almost beside the point.

Defendant cites no authority for the proposition that a finding of serious injury is contingent on the continuous treatment of any particular specialty. But Sal never suffered from lack of neurological treatment -- he's been treated for [brain injury](#) since he was diagnosed. And the argument that Sal's orthopedic treatment was limited seems almost desperate, as there was no basis to presume that the nature of Sal's injuries either required, or are even amenable to treatment by an orthopedist. The chiropractic records in evidence [4061-4151] demonstrate that S??I continuously received chiropractic treatment from the day of the accident through at least December 1998 -- over 260 treatments. The findings of Dr. Gordon, who examined Sal once in December 1993, was explored during the cross-examination of Dr. Wiener. [2305-2308.] It was for the jury to determine what impact, if any, this would have on the rest of the medical testimony.

The assertion that Sal suffered from untreated [obstructive sleep apnea](#) before the accident is utterly without basis and the contention that Sal's emotional and [cognitive deficits](#) could have been caused by [sleep apnea](#) rather than the accident borders on the ridiculous.

***68** Defense counsel cross-examined Dr. Wieber at length as to the several alternative causes of [obstructive sleep apnea](#), including a low-lying palate, age, weight gain, medications, and a phenomenon known as "first night effect" [3209-12; 3221-23]. Dr. Wieber eliminated each from being a factor in Sal's case, explaining that if his sleep disorders were due merely to anatomical

problems, they would have manifested before the accident or gradually over time [3226-35.] She also noted that **"It's very rare for one abnormality in the airway to cause the whole spectrum of sleep disorders."** [3229.]

Dr. Wieber did admit that [obstructive sleep apnea](#) and severely fragmented sleep could result in irritability, loss of concentration, confusion, and memory problems. And the jury was free to find (1) that this only compounds Sal's condition, or (2) that this-and not traumatic brain injury-was the root of all Sal's suffering. However, given the overwhelming evidence of TBI, the jury could (and apparently did) realize that the latter hypothesis was ludicrous.

The defense team's efforts to eviscerate Plaintiffs' proof notwithstanding, the jury heard more than enough evidence to find for Plaintiffs on three categories of serious injury. Defendant presents no viable grounds to disturb the verdict.

***69** CONCLUSION

The judgment should be affirmed.

INTRODUCTION

The Plaintiff opposes the defense's Motion to exclude the results of Diffusion Tensor Imaging ("DTI"). In support of this Opposition, Plaintiff states as follows:

- 1. 20 different courts from all over the country have denied defense Motions to exclude DTI in similar circumstances; and**
- 2. The overwhelming consensus in the peer reviewed medical literature is that DTI is a valuable tool to detect the white matter damage associated with mTBI.**

OVERVIEW OF THE ARGUMENT

DTI is a hot topic among the practitioners in traumatic brain injury litigation, especially those involved in the handling of mild Traumatic Brain Injury Claims ("mTBI"). As will be shown below, the overwhelming consensus in the peer reviewed medical literature is that DTI is highly effective in demonstrating damage to the white matter of the brain associated with mTBI. DTI is an objective test; the claimant can do nothing to manipulate or trick the scanner into thinking the white matter is damaged when in fact it is healthy.

DTI does not diagnose the etiology of the damage to the white matter; no radiological test does. Rather, like X-Rays, CT Scans or MRIs, DTI provides objective evidence of damage; it is left to the clinician to infer etiology. In the instant matter, DTI is part, albeit an important part, of the diagnostic puzzle. Further, DTI is relevant because the white matter damage clearly shown by the DTI refutes the malingering and somatoform claims made by the defense.

Since DTI presents the jury with objective evidence of damage to important structures of the brain, the defense industry has repeatedly tried to undermine DTI. Before DTI, the defense industry relied upon the fact that 85% of mTBI patients will have "normal" CT Scans and MRIs. In the absence of "objective" evidence of damage to the brain, the defense industry has been highly effective in claiming that mTBI patients were either malingering or suffering from psychological diseases such as somatoform disorder or anxiety or depression that accounted for their post incident decline. Objective evidence of brain injury puts a serious damper in these claims.

Starting in 2005 and continuing through 2014, the defense industry has tried to exclude DTI results in mTBI cases and other claims of brain damage. At least **20 times** the defense has argued that DTI is unreliable and should be stricken. Courts employing Frye and Daubert

standards have unanimously rejected such claims. As will be shown below, Courts have not only found DTI to be reliable and generally accepted within the relevant scientific community, one Court has actually credited the DTI results in a bench trial. The **defense has not pointed to one successful challenge** to the science of DTI and its use as a clinical tool to mTBI. Undeterred, the defense asks this Court to be the sole Court in the country to exclude DTI in mTBI proffered by the appropriate expert and supported by the appropriate peer reviewed literature.

A. Brief Medical History of your Client

B. Diffusion Tensor Imaging is a Widely Accepted and Reliable Methodology Used Across the Country and the World to Evaluate Post Concussive Syndrome

1. How DTI Works¹.

DTI is a sequence of an MR examination that examines the microstructure of the white matter (axons) of the brain.² As a large majority of mild traumatic brain injury is not detectable on CT scans or standard MR scans, a major drive behind the development of DTI software was to detect white matter abnormalities.³

DTI works by measuring the distribution of water through portions of the brain.⁴ DTI is based upon the known physics of the flow of water.⁵ On a purely smooth surface, water will flow equally in all directions in a manner called an isotropic distribution. If, however, there are barriers to flow (such as found in the white matter of the brain), water will move unequally in all directions, in a manner called anisotropic distribution.⁶

¹ There are multiple modes of DTI (e.g. Tractography, Mean Diffusivity, etc). Dr. Benson employs the most commonly accepted method of voxel based analysis and Tract Based Spatial Statistics ("TBSS"). Both of these methods are peer reviewed and acceptable DTI methodologies.

² See, Affidavit of Randall Benson, M.D., dated September 2, 2010 and attached as Exhibit 1, at p. 3, paragraph 6.

³ *Id.* at p. 3, paragraph 7.

⁴ *Id.* at p. 3, paragraph 8.

⁵ *Id.*

⁶ *Id.*

Water distribution in healthy, intact white matter tends to be anisotropic.⁷ But as white matter is damaged, the outer membranes are broken down causing the water to diffuse in a more isotropic distribution.⁸

DTI divides the brain into thousands of voxels. Voxels are like pixels of a digital camera, except they are three dimensional. DTI measures the distribution of water through each voxel in the brain and provides a score between 0 and 1.⁹ In the medical literature, that score is referred to as FA (fractional anisotropy). A lower score means that the distribution of water is more isotropic (equal in all directions), with a score of 0 representing pure isotropic distribution. A higher score means the distribution is more anisotropic, with a score of 1 being close to a straight line. It is well known that axonal injury will result in decreased FA scores.¹⁰ Dr. Benson has a mean FA score derived from 87 healthy volunteers ages 19 to 81. The patient's FA score for each voxel is compared to the mean score for each voxel from the normative database. Dr. Benson uses well accepted software that makes sure the brain of the patient at issue is properly aligned with the normal brain; each voxel is properly compared to the corresponding voxel in the brain. The software will inform Dr. Benson what percentage of voxels are properly aligned with the normal database. If 95% or greater are properly aligned then Dr. Benson has a valid voxel based analysis. As age is known to cause changes in a person's FA, Dr. Benson programs the software to correct for both factors as the effect of age and sex on FA are easily accounted for.

The DTI software then counts the FA score on a voxel-by-voxel basis and compares it to normal population. The DTI software highlights voxels that are 2 standard deviations below the mean. 2SD below the mean ensures that the voxels found are well below random variation.

In addition to searching for voxels that are extremely abnormal, the DTI software looked to see if the voxels were clustered in greater amounts than the normal.¹¹ A cluster is defined as more than 50 abnormal voxels together. The odds of having such an abnormal cluster of voxels

⁷ See Exhibit 1, at p. 3, paragraph 11.

⁸ *Id.*

⁹ *Id.* at p. 3, paragraph 10.

¹⁰ *Id.* at p. 3, paragraph 11.

¹¹ *Id.* at p. 4, paragraph 20.

are astronomical. The Plaintiff has _____ clusters. The odds of having _____ clusters without white matter injury are essentially impossible.¹²

Further, if the clusters of abnormal voxels are in areas that are known to be susceptible to axonal injury through trauma, then the odds of those clusters happening there by chance are astronomical. In plaintiff's case, her clusters are in the areas of the brain that are consistent with her symptoms.

Aside from the voxel based analysis, Dr. Benson performs Tract Based Spatial Statistics ("TBSS"), a more conservative look at the flow of water through the white matter. TBSS eliminates any partial volume effect because it only looks at the center of the white matter tracts, not at the edges. Further, TBSS eliminates any misregistration issues because it has the ability to search directly for white matter tracts. In this way, TBSS is much more conservative than voxel based analysis, it is programmed to find less abnormal voxels. The TBSS sequence validates the voxel based analysis.

2. DTI's Acceptance and Reliability.

a. **LEGAL STANDARD**

"The role of expert testimony is to assist jurors in interpreting evidence that lies outside their common experience." Commonwealth v. Shanley, 455 Mass. 752, 761 (2010). "Expert testimony is sufficiently reliable [for this purpose] if the underlying theory or methodology is *either* (1) generally accepted in the relevant scientific community, *or* (2) satisfies the alternative requirements adopted in Lanigan. *Id.* at 761-762 (emphasis added). *See* Commonwealth v. Lanigan, 419 Mass. 15, 26 (1994) ("proponent of scientific opinion evidence may demonstrate the reliability or validity of the underlying scientific theory or process by some other means, that is, without establishing general acceptance"); Commonwealth v. Sands, 424 Mass. 184, 185-186 (1997) ("party seeking to introduce scientific evidence may lay a foundation either by showing that the underlying scientific theory is generally accepted within the relevant scientific community, or by showing that the theory is reliable or valid through other means") *See Also*

¹² *Id.* at p. 5, paragraph 21.

Federico v. Ford Motor Co., 67 Mass. App. Ct. 454 (2006); Com. v. Zimmerman, 70 Mass. App. Ct. 357 (2007); Smith v. Bell Atlantic, 63 Mass. App. Ct. 702 (2005).

Among the factors for a court to consider regarding admissibility under the new more flexible Daubert/Lanigan test are whether the theory or methodology: (1) has been or can be tested; (2) has been subject to peer review and publication; (3) has an unacceptably high known or potential rate of error; (4) has been developed outside of litigation; and (5) has been generally accepted in the relevant scientific community. Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579, 593-595 (1993); Commonwealth v. Lanigan, 419 Mass. 15 (1994); Commonwealth v. Powell, 450 Mass. 229 (2007).

A review of the caselaw after Daubert shows that the rejection of expert testimony is the exception rather than the rule. Fed. R. Evid. 702 advisory committee's note. *See Also In re: Gadolinium-Based Contrast Agents Products Liability Litigation*, 2010 WL 1924476 (N.D. Ohio 2010) (stating rejection of expert testimony is exception rather than rule). The Second Circuit has noted that "Daubert reinforces the idea that there should be a presumption of admissibility of evidence," and the Circuit has interpreted Daubert as having "advanced a bias in favor of admitting evidence short of that solidly and indisputably proven to be reliable." Borawick v. Shay, 68 F.3d 597, 610 (2d Cir. 1996). A trial court's role as gatekeeper is not meant to replace the adversary system. U.S. v. 14.38 Acres of Land Situated in Leflore County, Mississippi, 80 F.3d 1074, 1078 (5th Cir. 1996). Challenges to the methodology used by an expert witness are usually adequately addressed by cross-examination. U.S. v. Diaz, 300 F.3d 66, 76-77 (1st Cir. 2002). "If nothing else, Frye and Daubert stand for the proposition that only in the most extreme and thereby prejudicial circumstances should the trier of fact be prevented from hearing and weighing opinion of the expert." Stanley Tulchin Assoc. v. Grossman, 2002 NY Slip Op 50428U. The Supreme Court was careful to stress in Daubert that "[v]igorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof are the traditional and appropriate means of attacking shaky but admissible evidence." 509 U.S. at 595.

b. DTI IS GENERALLY ACCEPTED IN THE RELEVANT SCIENTIFIC COMMUNITY AS A CLINICAL TOOL TO DIAGNOSE BRAIN INJURY OF ALL SEVERITY LEVELS

Massachusetts law directs a court to look first to the “general acceptance” requirement and, if that is satisfied, to find the proffered evidence admissible. Lanigan, 419 Mass at 26 (“[G]eneral acceptance . . . will continue to be the significant, and often the only, issue.”) “Lanigan’s progeny make clear that general acceptance in the relevant community . . . continues to be sufficient to establish the requisite reliability for admission in Massachusetts courts regardless of other Daubert factors.” Powell, 450 Mass. at 238 *quoting* Commonwealth v. Patterson, 445 Mass. 626 at 640-641. **“General acceptance does not necessarily mean that a majority of the scientists involved subscribe to the conclusion. Rather, it means that those espousing the theory or opinion have followed generally accepted scientific principles and methodology in evaluating clinical data to reach their conclusions.”** Zito v. Zabarsky, 28 A.D.3d 42 (2006) *quoting* Beck v. Warner-Lambert Co. (2002 NY Slip Op 40431[u], *6-7). Therefore, the relevant community is comprised of “those espousing the theory” and the test is whether that community has “followed generally accepted scientific principles.” *Id.*

1. DTI is in clinical use right now to diagnose and treat mTBI

Contrary to the defense suggestion, DTI is in clinical use throughout the country. Right now, DTI is one of the core MRI techniques utilized to evaluate TBI and the Department of Defense elite brain injury institute at Walter Reed National Medical Center. The American College of Radiology¹³, the American Society of Functional Neuroradiology (ASDFNR)¹⁴, the Defense Centers of Excellence in Medical Multimedia (CEMM) all recognize and recommend DTI as a clinical tool to diagnose and treat mTBI.¹⁵ In short, not only is DTI reimbursable by insurance companies, it is used clinically throughout the country and the world.¹⁶ As Dr. Benson writes:

¹³ The ACR Guidelines are attached as Exhibit 2.

¹⁴ The ASDFNR Guidelines are attached as Exhibit 3.

¹⁵ See, letter from Dr. Benson dated January 2, 2014 and attached as Exhibit 4. The letter was submitted in Sworin v. Harris, (Case No. 08-05836-CA, Collier County, FL).

¹⁶ See the Affidavit of F. Reed Murtagh, M.D., attached as Exhibit 5, and submitted in Yang-Weissman v. S. Carolina Prestress Corp., United States District Court, District of South Carolina, Civil Action No. 4:07-CV-3643; *see also*, Videotaped Trial Testimony of Michael Lipton, M.D. in the Yang-Weissman case attached as Exhibit 6, at

“24. It is generally accepted in the scientific community throughout the peer reviewed literature that DTI is a reliable and accurate tool to detect microscopic damage done to the white matter of the brain. There have been numerous validation studies in the peer reviewed literature, including studies that the defendant in this case cites, that validate the use of DTI to detect axonal injury.

25. DTI is used clinically at the Detroit Medical Center and as a diagnostic tool. In fact, the entire sequence given to [the Plaintiff], including DTI, was the standard trauma protocol at the Detroit Medical Center. I understand that DTI is used clinically by a number of sites across the country and internationally.”¹⁷

In written testimony before the United States Congress House Judiciary Committee on January 4, 2010, Dr. Benson wrote as follows:

“DTI is able to ‘visualize’ diffuse axonal injury from TBI. In some cases location of lesions appear to correlate with specific symptoms but generally the severity of DAI as indicated by DTI is strongly predictive of general neurocognitive disability.”¹⁸

Dr. Benson’s opinion is hardly alone. In Yang-Weissman v. S. Carolina Prestress Corp., Dr. Michael Lipton¹⁹ testified as follows:

“Q. Is DTI in clinical use?
A. Yes, it is.
Q. Is it experimental?
A. No.
Q. All right. Is it used—
A. People are certainly investigating it and trying to make improvements. But it’s, you know, an FDA-approved technique that’s in clinical use...
Q. Can diffusion-tensor imaging be used to diagnose a particular patient
A. Yes, it can...
Q. Is DTI in use in other medical centers other than Einstein and Montefiore?
A. Yes, it is.
Q. And is it in use throughout the United States?
A. I believe it’s in use throughout the world...”

pp. 28, 53, 55-56; Affidavit of Dr. Lipton in the Yang-Weissman case, dated April 29, 2010 is attached as Exhibit 7. The defense in Yang attempted to exclude DTI evidence, but the Court did not rule as the case settled for \$3,000,000 while the Motions were pending.

¹⁷ See Exhibit 1 at p. 5.

¹⁸ See, Dr. Benson’s testimony to Congress attached as Exhibit 8 at p. 15.

¹⁹ Dr. Lipton is a neuroradiologist at the Albert Einstein College of Medicine and the Director of Research and Development as well as the Medical Director at the Montefiore Medical Center. He has over ten years of experience working with DTI and eight years specifically using DTI to diagnose brain injury.

- Q. Dr. Lipton, is there literature endorsing the assessment of individual subjects using DTI?
- A. Yes there is.
- Q. Can DTI be used to detect abnormalities due to traumatic brain injury?
- A. There are.
- Q. Are there studies of individuals or groups?
- A. Both
- Q. Are there papers which support the use of DTI to diagnose traumatic brain injury in individual subjects?
- A. Yes, there are”²⁰

Dr. Lipton created a list of articles that support the use of DTI in traumatic brain injury by its ability to diagnose axonal damage consistent with TBI.²¹

Dr. Benson and Dr. Lipton’s views are echoed by Dr. Murtagh. Dr. Murtagh is Board Certified in Radiology with an added Qualification in Neuroradiology.²² Dr. Murtagh submitted an affidavit that stated:

- “6. DTI improves the diagnosis and management of patients suffering from traumatic brain injury...
7. ...I have been actively involved in MR imaging since 1984 and in Diffusion Tensor Imaging since 2004.
10. DTI technology is currently being used to diagnose brain injury in individual patients using the methodology employed by Dr. Lipton. This methodology is set forth as the subject of peer-reviewed literature of which I am aware...
12. DTI studies are not experimental and may be used to diagnose brain injury in individual subjects.”²³

Additionally, in Martin v. Nike, Inc.,²⁴ Erin Bigler, Ph.D. submitted an affidavit stating the following:

- “4. It is my opinion that Diffusion Tensor Imaging is a scientifically valid assessment tool to assist in the diagnosis of mild traumatic brain injury.

²⁰ See, Exhibit 6, at pp. 28, 53-58, 96.

²¹ See, Exhibit 6, at pp. 58-59. The list is attached as Exhibit 9.

²² See, Exhibit 5, at para. 1.

²³ See, Exhibit 5, at pp. 6, 7, 10 and 12.

²⁴ Case No. OCN-L-3392-09, (NJ, Ocean County, 2013). A copy of Dr. Bigler’s affidavit is attached as Exhibit 10.

5. DTI is being used clinically and as a diagnostic tool.
6. While DTI cannot diagnose the cause of the white matter damage, it is an acceptable assessment tool to use in conjunction with history, review of medical records, and/or clinical examination to make a diagnosis of traumatic brain injury.”

Further, Gary M. Weiss, M.D. and Nicholas D. A. Suite, M.D. have both offered affidavits²⁵ which state:

2. I am thoroughly familiar with the use of DTI and DTI is accepted as a diagnostic tool in clinical practice.
3. I review the literature routinely and am not aware of any state in which the use of this imaging test is not accepted in clinical practice.
4. As a result of my background, I consistently update information concerning valid, recognized diagnostic tools in brain injury and DTI has been a valid diagnostic tool for clinical purposes for many years.
5. I am personally aware that DTI is used to aid in clinical diagnosis in several different locations in the State of Florida.
6. DTI is a valid clinical diagnostic tool for mild, moderate and severe traumatic brain injury.

Similarly, Manley W. Kilgore, II, M.D. has submitted an affidavit²⁶ stating:

3. I am thoroughly familiar with the use of PET and DTI and both tests are accepted as diagnostic tools in clinical practice.
4. I review the literature routinely and am not aware of any state in which the use of these imaging tests is not accepted in clinical practice.
5. As a result of my background, I consistently update information concerning valid, recognized diagnostic tools in brain injury and DTI has been a valid diagnostic tool for clinical purposes for many years.
6. I am personally aware that there are several private practices utilizing DTI on a clinical basis to diagnose brain injury and the same is true in Tampa, Orlando and Jacksonville has at least two private practices utilizing DTI.
7. DTI is a valid clinical diagnostic tool for brain injury including hypoxic brain injury.

²⁵ Dr. Weiss’ affidavit, dated November 1, 2013, is attached as Exhibit 11. Dr. Suite’s affidavit, dated October 31, 2013, is attached as Exhibit 12.

²⁶ Dr. Kilgore’s affidavit, dated March 14, 2013, is attached as Exhibit 13.

Additionally, William W. Orrison, Jr., M.D., has submitted an affidavit²⁷ stating:

3. ...As summarized below, DTI is a reliable and robust imaging modality that is widely accepted and used for the evaluation of traumatic brain injury.
6. ...I am intimately familiar with the clinical use of DTI as it relates to Traumatic Brain Injury...
8. ...I am unaware of any MRI technology, DTI or otherwise, that can by itself unequivocally determine etiology.

For example, an abnormal lung mass revealed on conventional MRI imaging of the chest can represent a benign mass, sarcoidosis, a cancerous tumor, tuberculosis, or other differential diagnosis. We do not ingest the imaging because it cannot “by itself” tell us the exact etiology....

11. **The DTI-sequence of MRI has been extensively tested;** Diffusion tensor imaging (DTI) has been developed and refined for almost two decades....
12. **DTI has been extensively peer reviewed;**...
13. ...The potential error rate for DTI in accurately identifying fiber track damage is well-known and described in the literature....There are numerous peer-reviewed and case-control studies in the medical literature allowing for individual evaluations of brain injured patients using DTI. The comparison of cases (patients with a history of traumatic brain injury) and controls (no history of traumatic brain injury) utilizing DTI is an accepted methodology and standard technique utilized in order to demonstrate the clinical utility of DTI in adding incremental diagnostic information to structural MRI, multimodal MR studies, other imaging modalities and the clinical condition....
14. ...I rely on the literature to form the basis of my use of DTI and DTI is not experimental in view of daily clinical use and more than 7,000 peer-reviewed publications on the topic dating to 1994.
16. ...DTI has been extensively reported in the peer-reviewed medical literature to make a diagnosis of traumatic brain injury in a “single-subject” who was involved in isolated trauma....

Finally, the following are quotes from the peer reviewed literature that show that DTI is scientifically valid and accepted within the community to assist in the diagnosis of mTBI

1. Fakhraan, Saeed, et al, *Symptomatic White Matter Changes in Mild Traumatic Brain Injury Resemble Pathologic Features of Early Alzheimer Dementia*, **Radiology** volume 269: Number 1 – October, 2013:

²⁷ Dr. Orrison’s affidavit, dated October 10, 2013, is attached as Exhibit 14.

“Recent studies of white matter abnormalities at diffusion-tensor imaging in patients with mild TBI have correlated findings with clinical assessment tools of cognitive function, showing complex or widespread patterns of reduced white matter integrity associated with cognitive dysfunction.”

“Quantitative comparison for tract-based spatial statistics analysis between patients with mild TBI and control subjects showed widespread significant differences in FA...”

“Total concussion symptom scores correlated positively with FA values at the gray matter-white matter junction, most prominently at regions of geometric inflection and in the primary and association auditory cortices. There were no regions where FA values negatively correlated with total concussion symptom scores.” (internal citations omitted).

“Post hoc analysis showed that patients with mild TBI and sleep and wake disturbances had significantly lower FA in this region than did patients with mild TBI and no sleep and wake disturbances and control subjects.” (internal citations omitted).

“Numerous prior studies have shown the important role of diffusion-tensor imaging in evaluating white matter integrity after mild TBI and white matter abnormalities in patients with mild TBI relative to control subjects.” (internal citation omitted).

2. Treble, Amery, et al, *Working Memory and Corpus Callosum Microstructural Integrity after Pediatric Traumatic Brain Injury: A Diffusion Tensor Tractography Study*, **Journal of Neurotrauma** 30:1609 – 1619 (October 1, 2013):

“Diffusion tensor imaging (DTI) and tractography are increasingly being utilized to quantify the effects of TBI *in vivo* through examination of the orientation and magnitude of water diffusion in the brain. Metrics provided by DTI include fractional anisotropy (FA) and mean diffusivity, which is separable into axial and radial diffusivities.”

“Although the correlates of changes in different DTI metrics remain under investigation, **recent studies suggest that FA and radial diffusivity, but not axial diffusivity, are significant predictors of post-traumatic changes in cognitive outcomes.**”

“DTI studies have shown lower FA and higher diffusivity metrics in all callosal subregions, relative to TC comparison groups, after TBI in both children and adults at subacute and chronic stages of recovery.”

“DTI metrics indexing microstructural organization and integrity of particular callosal subregions were associated with WM performance in both groups of children. Lower FA and higher radial diffusivity in callosal subregions connecting anterior and/or posterior parietal cortical regions predicted poorer verbal WM, with both FA and radial diffusivity in these subregions accounting for significant variance over and above remaining callosal subregions.”

“Our results are consistent with the building evidence suggesting that DTI of the [corpus callosum or “CC”] may serve as an effective biomarker for the degree of TAI and potential cognitive dysfunction after traumatic injury to the brain.”

“Reductions in processing speed have been associated with lower FA in the body and splenium of the CC after pediatric TBI. Impaired fine motor speed and bimanual coordination were associated with lower FA in splenial fibers, whereas impaired cognitive control of motor functions was associated with lower FA in callosal fibers connecting prefrontal, anterior parietal, and posterior parietal cortices in adults with TBI. Declarative memory impairment has been associated with posterior, but not anterior, callosal FA reductions in adult TBI. With regard to WM, in a case series of two pairs of twins discordant for sTBI sustained during childhood, poorer verbal WM was associated with lower mid-sagittal-area FA in the rostral mid-body, whereas visuospatial WM was unrelated to callosal FA in any subregion. Poorer verbal WM was also associated with lower mid-sagittal-area FA in the splenium in a group of children with TBI. In adults with sTBI, whole-brain FA analysis revealed positive correlations between anterior and posterior callosal subregions with visual WM performance and functional activation patterns.”

“As hypothesized, both FA and radial diffusivity in particular callosal subregions predicted WM performance, whereas axial diffusivity was not significantly predictive. **This pattern of relative sensitivity of DTI metrics in prediction of neuropsychological outcome after TBI is a somewhat consistent trend in the TBI literature**, although it remains poorly understood.”

“These results suggest that radial diffusivity may be the most sensitive DTI biomarker for predicting poor neuropsychological outcome after TBI.”

“DTI of the CC may serve as a neuroanatomical biomarker for predicting WM deficits in children sustaining TBI.”

3. Yeh, Ping-Hong, et al, *Postconcussional Disorder and PTSD Symptoms of Military-Related Traumatic Brain Injury Associated With Compromised Neurocircuitry*, **Human Brain Mapping** September 13, 2013:

DTI yields estimates of the main direction of axon fibers with reasonably good spatial resolution [Basser and Jones, 2002;

Basser et al., 1994; Pierpaoli et al., 1996]. DTI provides a unique insight into the microstructure of numerous tissues. Within the brain, DTI can be used to quantify an index of white matter integrity and extract white matter features for visualization, for example, tractography [Basser et al., 2000].”

“Several recent studies have investigated the role of diffusion MR and shown promising results in detecting microstructural changes in mild TBI [Kasahara et al., 2012; Matsushita et al., 2011; Mayer et al., 2010]. The brain structures that are vulnerable to this type of injury are mainly the brainstem and the corpus callosum (CC), both regions with highly anisotropically oriented axons [Cloodts et al., 2013]. The white matter tracts that tend to show abnormal DTI measures in TBI are long association fibers of fronto-parieto-temporal pathways such as superior and inferior longitudinal fasciculus, uncinate fasciculus, anterior corona radiata, projection fibers of the fronto-limbic network such as cingulum bundle and fornix, and the inter-hemispheric connection, i.e. genu and splenium of corpus callosum [Niogi and Mukherjee, 2010 for review].”

“Using high-dimensional tensor warping and tractspecific analyses, **we have revealed evidence of white matter injury in those with military-related TBI.** Indicated primarily by reduced FA and increased trace, the injuries were most prominent in the pathways within the frontostriatal and fronto-limbic circuits, and the fiber tracts in the midbrain and the brainstem regions. Moreover, the compromised fiber tracts (reduced FA) in the nodes of frontostriatal and fronto-limbic circuits were associated with greater post-concussion and PTSD symptoms.

“Several DTI studies have shown decreased FA and increased apparent diffusion coefficient (ADC) in acute TBI patients [Arfanakis et al., 2002; Benson et al., 2007; Huisman et al., 2004; Lipton et al., 2009; Miles et al., 2008], possibly explained by the disruption of membrane skeleton and/or vasogenic edema due to the increased axolemmal permeability.”

“The majority of our patients were in a subacute stage of injury, i.e. around 3 months or more post-injury. Our tract-specific analysis of the DTI diffusion metrics is consistent with the findings of recent reports [Bendlin et al., 2008; Singh et al., 2010], which found lower FA and higher trace in the pathways of fronto-striatal and fronto-limbic circuitry and brain stem fiber tracts.”

“**our findings of significant associations between FA and post-concussion symptoms were in the affected regions of the neural networks in which the cognitive (frontal fibers), affective (limbic fibers), and somatic sequelae (sensory/motor pathways) following brain injury can be explained.** The frequent comorbidity of PTSD and TBI is well described in military TBI patients [Belanger et al., 2009; Hoge et al., 2008; Ruff et al., 2010; Warden, 2006]. Compromised integrity of white matter fiber connections, such as mainly decreased FA in the frontal region, has also been reported in PTSD patients

[Schuff et al., 2011]. Therefore, the compromised integrity of white matter fiber connections of this study can be the combination of comorbid PTSD and TBI as these two separate and distinct diseases share common clinical symptoms.”

Recent DTI studies suggest that cognitive impairment following trauma may correlate with the severity of white matter injury [see Levin et al., 2010 for review].”

4. Zwany Metting, et al, *Pathophysiological Concepts in Mild Traumatic Brain Injury: Diffusion Tensor Imaging Related to Acute Perfusion CT Imaging*, PLOS ONE May 2013, Volume 8, Issue 5:

“Diffuse axonal injury (DAI), a major pathological substrate of TBI, can be visualized with diffusion tensor imaging (DTI), also in the mild TBI category.”

“In patients with mild TBI and normal convention imaging, a trend was observed towards DTI abnormalities in the chronic phase after injury. More importantly, **these DTI findings were found to be associated with hemodynamic abnormalities assessed with perfusion CT imaging in the acute phase of injury.**”

“Furthermore, several DTI studies identified subsequent white matter abnormalities in the chronic phase in patients with mild TBI. In general a decreased FA [fractional anisotropy] and an increased MD [mean diffusivity] is seen after injury in accordance with our study.”

5. Hulklower, et al., *A Decade of DTI in Traumatic Brain Injury: 10 Years and 100 Articles Later*, AJNR - Published January 10, 2013 as 10.3174/ajnr.A3395.

“Because of the highly uniform collinear structure of normal white matter, **DTI is uniquely able to probe its microscopic structure and is, therefore, particularly well-suited for the assessment of TAI.** Although gross abnormalities can be identified in some cases of TAI by using CT and conventional MR imaging, **DTI can both qualitatively and quantitatively demonstrate pathology not detected by other modalities and is, therefore, an important tool not only in the research setting but in the clinical setting as well.**”

“Numerous clinical studies have assessed TBI by using DTI.”

“The corpus callosum, frontal lobe, internal capsule, and cingulum are among the most commonly identified regions of abnormality in DTI studies of TBI, perhaps because these structures are particularly vulnerable to injury due to their anatomic relationship to the skull and other structures such as the falx cerebri.”

“DTI has been studied extensively as a tool for identification of brain abnormalities related to TBI and to understand the relationship of these brain abnormalities to other

clinical features of the disorder. During the past decade, the number of such studies has risen exponentially and continues to increase with no sign of abatement. A unifying theme can be deduced from this large body of research: **DTI is an extremely useful and robust tool for the detection of TBI-related brain abnormalities. The overwhelming consensus of these studies is that low white matter FA is characteristic of TBI. This finding is consistent across almost all the articles we reviewed**, despite significant variability in patient demographics, modest differences in data acquisition parameters, and a multiplicity of data analysis techniques. This consistency across studies attests to the robustness of DTI as a measure of brain injury in TBI.”

“We also found an overwhelming consensus that imaging abnormalities detected with DTI are associated with important clinical outcomes. This further validates DTI as a meaningful measure of clinically important brain injury.”

6. Editorial, Jonathan Silver, M.D., *Diffusion tensor imaging and mild traumatic brain injury in soldiers: abnormal findings, uncertain implications*, **Am J Psychiatry** 169:12, December 2012

Diffusion tensor imaging (DTI) is able to detect damage to axonal tracts by using a measure of directional water diffusion (fractional anisotropy).”

7. Aoki, et al, (**J Neurol Neurosurg Psychiatry**. 2012 Sep; 83(9):870-6:

A meta-analysis of 13 independent DTI studies on mTBI patients was performed and the authors concluded: “Our meta-analysis revealed the posterior part of the corpus callosum was more vulnerable to mTBI compared with the anterior part, and suggested the **potential utility of DTI to detect white matter damage...in mTBI patients.**

8. Dr. Toth, et al, (**J Neurotrauma**, 2012 Aug 20 E-published) report that “Advanced MRI methods were shown to be able to detect the subtle structural consequences of mild traumatic brain injury (mTBI). TBSS showed fractional anisotropy to be significantly lower... in the mTBI group in several white matter tracts compared to controls at 72 hours after injury and still one month later... **Our findings present dynamic micro- and macrostructural changes occurring in the acute to sub-acute phase in mTBI, in very mildly injured patients lacking micro hemorrhage detectable by SWI.**”
9. Wada, T., et al, *Decreased Fractional Anisotropy Evaluated Using Tract-Based Spatial Statistics and Correlated with Cognitive Dysfunction in Patients with Mild Traumatic Brain Injury in the Chronic Stage*, **Am J Neuroradiology**, published June 21, 2012 as 10.3174/ajnr.A3141:

“Diagnostic imaging of mTBI can increase our understanding of the clinical symptoms and help determine treatment strategies. In particular, **DTI** is sensitive to the diffusion characteristics of water (such as the principal diffusion direction and diffusion anisotropy) and **has been developed as a tool to investigate the**

integrity of brain tissues such as white matter tracts and to uncover discrete axonal injury.”

“Evaluation of FA values obtained from DTI images is another promising neuroradiologic technique for detecting minute brain lesions due to DAI. We have previously reported the significant relationship between white matter integrity and cognitive functions in certain areas of the brain following TBI.”

“This is the first study to evaluate white matter abnormalities by comparing DTI from patients with mTBI without any focal morphologic abnormality on conventional MR imaging and healthy control subjects by using TBSS analysis. The results indicated that there were some regions, the right superior longitudinal fasciculus, left superior frontal gyrus, right insula, and left fornix, with significantly decreased FA values compared with those in healthy controls, which might be attributed to a minute morphologic abnormality in the damaged brains of patients with mTBI. Additionally, the results showed that the location of these regions was mostly concordant with those in the previous neuropathologic studies.”

“Furthermore, our results showed a number of white matter regions that were significantly related to MMSE and FIQ in the brain, which suggests that cognitive function generally involves multiple white matter pathways—that is, these cognitive tests were not related to a single region in the brain.”

“In patients with mTBI, significantly decreased FA value clusters in the white matter compared with the healthy controls were found in the superior longitudinal fasciculus, superior frontal gyrus, insula, and fornix. Cognitive examination scores positively correlated with FA values in a number of regions in deep brain structures, which were anatomically close or physiologically intimate to the regions with significant FA value reduction, in patients with mTBI. Their conclusion: “Patients with mTBI in the chronic stage have certain regions with abnormally reduced white matter integrity in the brain (demonstrated by DTI). Although the clinical and pathologic-anatomic correlation of these findings remains to be elucidated, *these brain regions are strongly suggested to be related to chronic persistent cognitive impairments in these patients.*”

10. Lipton, et al., *Robust detection of traumatic axonal injury in individual mild traumatic brain injury patients: Intersubject variation, change over time and bidirectional changes in anisotropy*, **Brain Imaging and Behavior**, DOI 10.1007/s11682-012-9175-2. June, 2012

Diffusion tensor imaging (DTI) reveals evidence of TAI in animal models of TBI (e.g., (Mac Donald et al. 2007a, b; Wang et al. 2009)) and in patients, where brain abnormalities detected by DTI are associated with important clinical outcomes (e.g., (Kraus et al. 2007; Miles et al. 2008; Niogi et al. 2008a)). **Recent studies have used**

DTI to link specific functional impairment after mTBI to injury at specific brain regions (e.g.,(Niogi et al. 2008b; Geary et al. 2010; Little et al. 2010; Levin et al. 2010; Hartikainen et al. 2010; Lipton et al. 2009)). (See Shenton, et al. 2012)."

"In white matter, water diffuses more readily parallel to axons because its diffusion in other directions is restricted by subcellular structure including neurofilaments, microtubules, myelin and the axolemma. Intraaxonal microstructural disturbances and degradation of the myelin sheath have been demonstrated using DTI, in the absence of frank axotomy (Song et al. 2003). The shear forces exerted on an axon during even mild head trauma have been reported to cause axonal pathology, with or without ultimate axotomy (Povlishock and Katz 2005) (see Bigler and Maxwell 2012)."

"Individual subject assessments reveal unique spatial patterns of white matter abnormalities in each patient, attributable to inter-individual differences in anatomy, vulnerability to injury and mechanism of injury. **This paper shows the ability to delineate abnormalities in single patients.**"

11. Huang, Ming-Xiong, et al, *An Automatic MEG Low-Frequency Source Imaging Approach for Detecting Injuries in Mild and Moderate TBI Patients With Blast and Non-Blast Causes*, **NeuroImage**, 61 (April 20, 2012) 1067 – 1082:

"Recently, DTI has also been used to examine potential axonal injury in mTBI patients with promising results. **DTI has been successfully applied in mild, moderate, and severe TBI and the method has shown great potential in providing a better understanding and improved diagnosis of –traumatic axonal injury**]. DTI studies in TBI patients have reported reduced fractional anisotropy (FA) in major white-matter tracts in central areas of the brain and the FA abnormality correlates with the GCS and post-traumatic amnesia."

"The present study also revealed the diffuse nature of the neuronal injuries in TBI patients. On average, approximately 4 - 8 cortical gray-matter areas showed abnormal slow-wave generation in each TBI patient using our automated MEG low-frequency source imaging. Such findings are consistent with the mechanism of diffuse axonal injury in TBI due to a combination of linear and rotational acceleration and deceleration. The findings are also consistent with our previous MEG-DTI study in mTBI, in which we found that abnormal MEG slow-waves are generated from cortical gray-matter areas that connect to white-matter fibers with reduced DTI fractional anisotropy due to axonal injury in patients with mTBI. Specifically, the reduced DTI fractional anisotropy in local white-matter fiber tracts led to focal abnormal MEG slow-waves from neighboring gray matter in mTBI."

12. M.E. Shenton et al, *A Review Of Magnetic Resonance Imaging and Diffusion Tensor Imaging Findings in Mild Traumatic Brain Injury*, **Brain Imaging and Behavior J.** March 2012:

“DTI can depict multifocal and diffuse axonal injuries in individual cases of mTBI.”

“Here we present evidence for brain abnormalities in mTBI based on studies using advanced MRI/DTI neuroimaging techniques. Importantly, these advances make it possible to use more sensitive tools to investigate the more subtle brain alterations in mTBI.”

“Recent advances in neuroimaging techniques, such as DTI, make it possible to characterize better extant brain abnormalities in mTBI.”

“Taken together, **the findings presented below suggest that more sensitive neuroimaging tools improve the detection of brain injuries in mTBI** (i.e., diagnosis).”

“We concur and believe that we now have neuroimaging tools that are sufficiently sensitive to discern both more gross indicators of pathology, as well as microstructural changes in white matter, and microhemorrhages using newer imaging technologies.”

“[T]here is no one single imaging modality that is capable of characterizing the multifaceted nature of TBI. **Advances in neuroimaging are, nonetheless, unprecedented and we are now able to visualize and to quantify information about brain alterations in the living brain in a manner that has previously not been possible. These advances ...[include]...DTI; useful for measuring white matter integrity.**”

“DTI...provides information about white matter anatomy that is not available using any other method...”

“DTI differs from conventional MRI in that it is sensitive to *microstructural* changes, particularly in white matter, whereas CT and conventional MRI (including also FLAIR) reveal only *macroscopic* changes in the brain. Thus subtle changes using **DTI can reveal *microstructural* axonal injuries**...which are potentially responsible for persistent postconcussive symptoms” (emphasis in original)

“The concept underlying DTI is that the local profile of the diffusion in different directions provides important indirect information about the microstructure of the underlying tissue. It has been invaluable in investigations of white matter pathology in multiple sclerosis, stroke, normal aging, Alzheimer’s disease, schizophrenia and other psychiatric disorders, as well as in characterizing diffuse axonal injuries in mTBI.”

“[DTI] figures reflect important, recent advances in methodology that are sufficiently robust and sensitive that they can be used for visualizing and

quantifying white matter pathology *in vivo*, **for the assessment of mTBI clinically**. These tools are available now for this purpose...”

“DTI is a sensitive measure of axonal injury that is particularly important for evaluating small and subtle brain alterations that are characteristic of most mTBI.”

“DTI is by far the most sensitive *in vivo* method to detect subtle brain abnormalities in mTBI.”

13. Drs. Sharp and Ham from the Hammersmith in London (**Curr Opin Neurol**. 2011 Dec;24(6):558-63) state:

“Diffusion tensor imaging (DTI) provides a more flexible way of investigating white matter injury. Recent studies largely **confirm that DTI is sensitive to white matter damage after mTBI**. Distinct DTI abnormalities are observed in the acute and subacute/chronic stages. DTI measurements change dynamically after an injury, reflecting the evolving pathological processes. ***DTI abnormalities correlate with cognitive and neuropsychiatric impairments. Importantly, DTI can contribute to the prediction of clinical outcome and has begun to be applied to the study of sports and blast injury.***

14. Wang, J.Y., et al, *Longitudinal Changes of Structural Connectivity in Traumatic Axonal Injury*, **Neurology** 77, August 30, 2011:

“Diffusion tensor tractography is a valuable tool for identifying structural connectivity changes occurring between the acute and chronic stages of traumatic brain injury and for predicting patients’ long term outcome.”

15. Vos, Pieter; Bigler, Erin, *White Matter in Traumatic Brain Injury, Dis- or Dysconnection?*, **Neurology** 77, August 30, 2011:

“DTI detects decreases in the flow of water due to disturbed axonal transport and increased water diffusion due to myelin damage. Hence DTI measures the integrity of white matter.”

“DTI methods permit the study of how networks are functionally affected by traumatic lesions; this is in contrast to past TBI research focusing only on location or lesion size in relation to cognitive functions.”

16. Chu, Z, et al, *Voxel-based Analysis of Diffusion Tensor Imaging in Mild Traumatic Brain Injury in Adolescents*, **J Head Trauma Rehabil.**, 25(1): 31 – 42, January, 2010:

“Whole-brain WM DTI measures can detect abnormalities in acute mTBI associated with PCS symptoms in adolescents.”

17. Niogi, SN, et al, *Diffusion Tensor Imaging of Mild Traumatic Brain Injury*, **Neuropsychologia**, 48(5): 1472 – 82, April, 2010:

“Researchers have shown that frontal and temporal association white matter pathways are most frequently damaged in mTBI and that the microstructural integrity of these tracts correlates with behavioral and cognitive measures.”

18. Caeyenberghs, K, et al, *Brain-behavior Relationships in Young Traumatic Brain Injury Patients: Fractional Anisotropy Measures are Highly Correlated With Dynamic Visuomotor Tracking Performance*, **Neurology**, 74(*): 643 – 50, February 23, 2010:

“...the combined application of DTI and behavioral measures, was the most effective in distinguishing between TBI patients and controls.”

19. Wu, Trevor, *Evaluating the Relationship between Memory Functioning and Cingulum Bundles in Acute Mild Traumatic Brain Injury using Diffusion Tensor Imaging* – **Journal of Neurotrauma** 27:303-307 (February 2010):

“...and decreased FA and increased ADC in chronic TBI have been attributed to white matter injury and degeneration.”

20. Bigler, E.D. – *Voxel-Based Analysis of Diffusion Tensor Imaging in Mild Traumatic Brain Injury in Adolescents* – **AJNR Am J Neuroradiol** 31, Feb 2010:

“Whole brain WM DTI measures can detect abnormalities in acute mTBI associated with PCS symptoms in adolescents.”

“The present study revealed significant alteration in DTI metrics in a group of patients with mTBI in several brain regions, and these changes were highly correlated with PCS severity and emotional distress.”

“Voxel based DTI analysis is capable of identifying potentially diffuse axonal injury vulnerable regions invisible to CT and conventional MR imaging, which may assist in classification, early diagnosis, and treatment.”

21. Kumar, Raj – *Serial Changes in Diffusion Tensor Imaging Metrics of Corpus Callosum in Moderate Traumatic Brain Injury patients and Their Correlation with Neuropsychometric Tests: A 2-Year Follow Up Study* – **J Head Trauma Rehabil** Vol. 25, No 1, pp. 31-42 (February, 2010):

“...(DTI) has been shown to be a valuable technique for in vivo quantification of white matter microstructural alterations following TBI.”

“However, changes in DTI indices were observed, confirming that DTI appears to be a more sensitive measure than volume of injury in these patients.”

“In conclusion, our study suggests that FA and RD indices are surrogate markers of microstructural alterations in patients with TBI over time and correlate significantly with some NPT scores. The recovery in these indices in some regions of that CC²⁸ is associated with recovery in neurocognitive deficits, suggesting that these indices may be used as an objective marker for the residual injury in these patients.”

“FA and RD indices appear to be surrogate markers of microstructural alterations in patients over time and correlate significantly with some of the NPT scores. The recovery in these indices may be used as an objective marker for residual injury in these patients.”

22. Bigler, Eric, Ph.D. – *Diffusion tensor imaging: A Biomarker for Mild Traumatic Brain Injury?* – **Neurology** February 23, 2010;74:626-627:

“DTI is particularly sensitive in assessing white matter (WM) microstructure, even in parenchyma deemed normal. **The sensitivity of DTI for WM injury makes it especially important in understanding mTBI...**”

23. Mayer, A.R, Ph.D. – *A prospective diffusion tensor imaging study in mild traumatic brain injury* – **Neurology** January 20, 2010;74: 643-650:

“Current results also suggest that DTI results are more accurate in objectively classifying mTBI patients from carefully matched HC²⁹”.

“Diffusion tensor imaging may have utility for objectively classifying mTBI, and may serve as a potential biomarker for recovery.”

24. Sugiyama, K, et al, *Clinical Utility of Diffusion Tensor Imaging for Evaluating Patients with Diffuse Axonal Injury and Cognitive Disorders in the Chronic Stage*, **J Neurotrauma**, 26(11):1879-90, November, 2009:

“These results indicate that DTI is a useful technique not only for detecting DAI lesions but also for examining cognitive disorders in DAI patients.”

25. Lipton, Michael, M.D., Ph.D. – *Diffusion-Tensor Imaging Implicates Prefrontal Axonal Injury in Executive Function Impairment Following Very Mild Traumatic Brain Injury* – **Radiology**: Volume 252:Number 3-September 2009:

“Detection of ultrastructural damage by using DT imaging is a major advance in diagnostic imaging. **Several studies have supported the capability of FA to help identify white matter abnormalities in patients with traumatic brain injury including mTBI.** As confirmed by our findings, abnormal FA is detected even in the absence of other imaging abnormalities.”

²⁸ CC stands for Corpus Collosum.

²⁹ HC stands for Healthy Controls.

“Lower DLPFC FA was significantly correlated with worse executive function performance in patients) $P < .05$).”

26. Lo, Calvin – *Diffusion Tensor Imaging Abnormalities in Patients with Mild Traumatic Brain Injury and Neurocognitive Impairment* – **Comput Assist Tomogr**, Volume 33, Number 2, March/April 2009”

“Our results demonstrate a significant decrease in FA within the genu of the corpus callosum in patients with persistent cognitive impairment after mild TBI”.

“Our study shows that DTI can be used to detect differences between patients with cognitive impairment after mild TBI and controls.”

27. Wang, S, et al, *Longitudinal Diffusion Tensor Magnetic Resonance Imaging Study of Radiation-induced White Matter Damage in a Rat Model*, **Cancer Res**, 69(3): 1190-8, February 1, 2009:

“DTI indices reflected the histopathologic changes of WM damage and our results support the use of DTI as a biomarker.”

28. Lipton, Michael – *Multifocal White Matter Ultrastructural Abnormalities in mild Traumatic Brain Injury with Cognitive Disability: A Voxel-Wise Analysis of Diffusion Tensor Imaging* – **Journal of Neurotrauma** 25:1335-1342 (November, 2008):

“Diffuse tensor MRI (DTI) shows lower fractional anisotropy (FA) in TBI patients that may correlate with disability.”

“DTI was used to identify white matter abnormalities in patients with persistent cognitive impairment following mTBI”

“...showing a pattern of abnormalities in mTBI that is similar to DAI. Even more recently, Niogi et al reported voxel-wise analysis of DTI in mTBI and showed correlation of white matter abnormalities with a single reaction time measure.”

“We have shown that DTI can identify abnormalities in patients cognitively impaired following mTBI.”

29. D.R. Rutgers, et al, *Diffusion Tensor Imaging Characteristics of the Corpus Callosum in Mild, Moderate, and Severe Traumatic Brain Injury*, **American Journal of Neuroradiology** October 2008, 29: 1730-1735:

“Traumatic axonal injury is a frequent cause of impaired clinical outcome in patients with traumatic brain injury...[and] **DTI has evolved in recent years as a valuable complementary technique to investigate traumatic axonal injury.**”

30. Niogi, SN, et al, *Structural Dissociation of Attentional Control and Memory in Adults With and Without Mild Traumatic Brain Injury*, **Brain**, 131(Pt 12):3209-21, October 24, 2008:

“More generally, such findings suggest that diffusion anisotropy measurement can be used as a quantitative biomarker for neurocognitive function and dysfunction.”

31. Chappell, Michael – *Multivariate analysis of diffusion tensor imaging data improves the detection of microstructural damage in young professional boxers* – **Magnetic Resonance Imaging** (May 27, 2008):

“DTI is a valuable tool to identify microscopic changes in brain tissue resulting from damage or disease...”

“This scatter plot shows the expected pattern that with mild head injury MD increases and FA decreases.”

32. Wilde, E. A. – *Diffusion tensor imaging of acute mild traumatic brain injury in adolescents* – **Neurology** 70 March 18, 2008:

“Diffusion tensor imaging (DTI) is an imaging technique acquired on a standard MTI scanner that has been shown to be far more sensitive to white matter injury than conventional MRI.”

“Validity of DTI in adult TBI has been supported by a positive correlation of FA in the internal capsule and splenium with the Glasgow Coma Scale (GCS) score...”

“...the DTI indices were sensitive to pathologic processes of MTBI that contributed to the postconcussion symptom severity of our patients.”

33. Rutgers, D.R. – *White Matter Abnormalities in Mild Traumatic Brain Injury: A Diffusion Tensor Imaging Study* – **AJNR Am J Neuroradiol** March, 2008:

“DTI quantifies white matter architecture through an extensive description of water diffusion and allows for the reconstruction of white matter fibers in 3D through fiber tracking Algorithms.”

“...patients with mild TBI had multiple white matter regions with reduced FA, predominately involving cerebral lobar white matter, cingulum, and corpus callosum.”

“...that subacute or early chronic DTI changes are an indicator of long-term DTI abnormalities in mild TBI.”

“The present study shows that patients with mild TBI have multiple white matter regions with abnormality reduced FA, predominately in cerebral lobar white matter, cingulum, and corpus callosum.”

34. Yuan, W – *Diffusion Tensor MR Imaging Reveals Persistent White Matter Alteration after Traumatic Brain Injury Experienced during Early Childhood* – **AJNR Am J Neuroradiol** 28:1919-25 Nov-Dec 2007:

“DTI is an advanced MR imaging technique that can detect in vivo anisotropic diffusion properties in WM.”

“...that DTI is a feasible, sensitive, and noninvasive means of examining WM changes in young children with moderate, as well as severe, injuries.”

35. Kraus, Marilyn F. – *White matter integrity and cognition in chronic traumatic brain injury: a diffusion tensor imaging study* – **Brain** (September 14, 2007) pp. 1-12:

“DTI provides an objective means for determining the relationship of cognitive deficits to TBI, even in cases where the injury was sustained years prior to the evaluation.”

“DTI allows for the specific examination of the integrity of white matter tracts, tracts which are especially vulnerable to the mechanical trauma of TBI.”

“Because DTI is more sensitive to changes in the microstructure of white matter, it shows considerable promise in the assessment of TBI.”

“The data presented here demonstrate that DTI allows for a more sensitive delineation of severity and mechanism of white matter pathology, and may help to explain apparent discrepancies between clinically diagnoses injury severity and cognitive outcomes across the spectrum of TBI.”

36. Benson, Randall – *Global White Matter Analysis of Diffusion Tensor Images is Predictive of Injury Severity in Traumatic Brain Injury* – **Journal of Neurotrauma** Volume 24, Number3, March, 2007:

“FA changes appear to be correlated with injury severity suggesting a role in early diagnosis and prognosis of TBI...”

“The present study demonstrates the ability of a white matter FA histogram-based method of analyzing MRI diffusion tensor images to discriminate between persons with traumatic brain injury and healthy volunteers and to predict short term clinical outcome from TBI”.

2. DTI had been shown to have clinical predictive power

As shown below, DTI has been shown to predict significant sequelae of TBI:

1. Fakhran, Saeed, et al, *Symptomatic White Matter Changes in Mild Traumatic Brain Injury Resemble Pathologic Features of Early Alzheimer Dementia*, **Radiology** volume 269: Number 1 – October, 2013:

“Recent studies of white matter abnormalities at diffusion-tensor imaging in patients **with mild TBI have correlated findings with clinical assessment tools of cognitive function, showing complex or widespread patterns of reduced white matter integrity associated with cognitive dysfunction.**”

“**Total concussion symptom scores correlated positively with FA values at the gray matter-white matter junction**, most prominently at regions of geometric inflection and in the primary and association auditory cortices. There were no regions where FA values negatively correlated with total concussion symptom scores.” (internal citations omitted).

“**Our study correlates white matter abnormalities who had mild TBI with patient-reported postconcussion symptoms.**”

“Other studies have correlated postconcussive cognitive dysfunction with focal white matter abnormalities.”

2. Treble, Amery, et al, *Working Memory and Corpus Callosum Microstructural Integrity after Pediatric Traumatic Brain Injury: A Diffusion Tensor Tractography Study*, **Journal of Neurotrauma** 30:1609 – 1619 (October 1, 2013):

“Although the correlates of changes in different DTI metrics remain under investigation, recent studies suggest that FA and radial diffusivity, but not axial diffusivity, are significant predictors of post-traumatic changes in cognitive outcomes.”

“In adults with sTBI, **whole-brain FA analysis revealed positive correlations between anterior and posterior callosal subregions with visual WM performance and functional activation patterns.**”

3. Yeh, Ping-Hong, et al, *Postconcussional Disorder and PTSD Symptoms of Military-Related Traumatic Brain Injury Associated With Compromised Neurocircuitry*, **Human Brain Mapping** September 13, 2013:

Recent DTI studies suggest that cognitive impairment following trauma may correlate with the severity of white matter injury [see Levin et al., 2010 for review].”

4. Zwany Metting, et al, *Pathophysiological Concepts in Mild Traumatic Brain Injury: Diffusion Tensor Imaging Related to Acute Perfusion CT Imaging*, **PLOS ONE** May 2013, Volume 8, Issue 5:

More importantly, these **DTI findings were found to be associated with hemodynamic abnormalities assessed with perfusion CT imaging in the acute phase of injury.**"

5. Huang, Ming-Xiong, et al, *An Automatic MEG Low-Frequency Source Imaging Approach for Detecting Injuries in Mild and Moderate TBI Patients With Blast and Non-Blast Causes*, **NeuroImage**, 61 (April 20, 2012) 1067 – 1082:

"DTI studies in TBI patients have reported **reduced fractional anisotropy (FA) in major white-matter tracts in central areas of the brain and the FA abnormality correlates with the GCS and post-traumatic amnesia.**"

6. Sharp, Curr Opin Neurol,(December, 2011) "DTI abnormalities correlate with cognitive and neuropsychiatric impairments. Importantly, **DTI can contribute to the prediction of clinical outcome and has begun to be applied to the study of sports and blast injury.**"

7. Kumar, Raj – *Serial Changes in Diffusion Tensor Imaging Metrics of Corpus Callosum in Moderate Traumatic Brain Injury patients and Their Correlation with Neuropsychometric Tests: A 2-Year Follow Up Study* – **J Head Trauma Rehabil** Vol. 25, No 1, pp. 31-42 (February, 2010):

"In conclusion, our study suggests that **FA and RD indices are surrogate markers of microstructural alterations in patients with TBI over time and correlate significantly with some NPT scores.**

8. Lipton, Michael, M.D., Ph.D. – *Diffusion-Tensor Imaging Implicates Prefrontal Axonal Injury in Executive Function Impairment Following Very Mild Traumatic Brain Injury* – **Radiology**: Volume 252: Number 3-September 2009:

"In conclusion, we found **that lower DLPFC³⁰ white matter FA in acute mTBI helps predict impairment executive function in these patients.**"

9. Wilde, E. A. – *Diffusion tensor imaging of acute mild traumatic brain injury in adolescents* – **Neurology** 70 March 18, 2008:

³⁰ DLPFC stands for dorsolateral prefrontal cortex.

“Validity of DTI in adult TBI has been supported by a **positive correlation of FA in the internal capsule and splenium with the Glashow Coma Scale (GCS) score...**”

10. Benson-*Global White Matter Analysis of Diffusion Tensor Images is Predictive of Injury Severity in Traumatic Brain Injury*, J. of Neurotrauma, Vol. 24, No. 3, pp. 446-459, 2007.

“**FA changes appear to be correlated with injury severity...**”

c. DTI IS DEMONSTRABLY RELIABLE UNDER A DAUBERT-LANIGAN ANALYSIS.

When the court does *not* find general acceptance then it should look to the other factors to determine if reliability can be established. See Lanigan, 419 Mass. at 26; Daubert, 509 U.S. 593-585; Patterson, 445 Mass. 640-641. “Where general acceptance is not established by the party offering the expert testimony, a full Daubert analysis provides an alternate method of establishing reliability.” Zito, 28 A.D.3d 42. The Third Circuit has held, under Daubert, that “the judge should only exclude the evidence if the flaw is large enough that the expert lacks ‘good grounds’ for his or her conclusions.” In re: Paoli R.R. Yard PCB Litig., 35 F.3d 717, 746 (3d Cir. 1994); see Daubert, 509 U.S. at 590.

DTI is demonstrably reliable through the other factors set forth in Daubert/Lanigan because it (i) has been tested; (ii) has been peer-reviewed; (iii) has a low error rate; and (iv) has been developed independent of litigation. Therefore, evidence of DTI is admissible even if this Court does not find acceptance in the relevant scientific community of DTI.

i. DTI Has Been Tested, Approved by the FDA, and is Supported by the Medical Literature.

DTI has been tested through multiple peer-reviewed studies as cited above. As of October, 2013, there were 7,900 papers on DTI that have been published in peer-review journals.³¹ 580 of the papers are on DTI and TBI and 150 of those papers employed a voxel based analysis such as the one used by Dr. Benson.³² Dr. Benson’s methodology has been subject to the peer-review process through medical groups and the federal government.³³

³¹ See Exhibit 1 at paragraph 53.

³² *Id.*

³³ *Id.* at paragraph 2.

DTI's reliability is further exemplified by its approval from the FDA. DTI software was submitted in 2001 to the FDA for Section 510(k) premarket notification and was granted permission to be marketed with the following language under Indications for Use: "Diffusion tensor imaging produces magnetic resonance (MR) images whose contrast is dependent on the local diffusion coefficient of water. Diffusion tensor imaging can be used to image the directional dependence of the diffusion coefficient in tissue such as white matter." The FDA tested the software for "safety and effectiveness" before granting permission for it to be marketed, specifically the:

"effectiveness of a device is . . . [determined] on the basis of well-controlled investigations, including 1 or more clinical investigations where appropriate, by experts qualified by training and experience to evaluate the effectiveness of the device, **from which investigations it can fairly and responsibly be concluded by qualified experts that the device will have the effect it purports or is represented to have.**" 21 U.S.C. 360c.(3)(A) (emphasis added).

The DTI software was being manufactured by GE Medical Systems and the application states that the "Diffusion Tensor Imaging Option was evaluated to the IEC 601-2-33 International medical equipment safety standard for Magnetic Resonance Systems. Evaluation testing confirmed accuracy statements in the User manual." In 2003, the FDA granted permission for a device to be marketed that stated DTI "differentiates tissues with restricted diffusion from tissues with normal diffusion" and whose indications for use concluded that "[t]hese images when interpreted by a trained physician, yield information that may assist in diagnosis."

The medical literature makes clear that DTI is a widely accepted tool for assisting in the diagnosis of mTBI and post concussive syndrome. The defendant is asking this Court to disregard the overwhelming consensus of the medical community and preclude evidence of DTI because it is a tool used for diagnosis as opposed to a biomarker capable of exclusive diagnosis. The plaintiff's expert is using DTI as one of many tools to diagnose post concussive syndrome. This is how the overwhelming majority of medical diagnoses are made: by taking all the information together and drawing a conclusion. DTI cannot, by itself, determine that the plaintiff has a brain injury caused by the subject car crash. However, the plaintiff's records show symptoms of a concussion immediately following the crash, a drop in performance at work and

school following the crash, ongoing symptoms indicative of post concussive syndrome, lesions on the brain in an MRI, damage detected by DTI in the same areas as the lesions – areas expected to be damaged in a person with mTBI, and no prior head injury. It is when all the evidence is viewed together that Dr. Benson reached his diagnosis of post concussive syndrome; a diagnosis reached by a total of _____ doctors in regards to the plaintiff. The argument that DTI cannot by itself relate the brain damage found in the plaintiff to the car crash is irrelevant because it is not being used by itself to do so and therefore the defendant’s motion should be denied.

ii. **DTI Has A Low Error Rate:**

In assessing the reliability of a particular scientific technique, consideration should generally be given to the known or potential rate of error and the existence and maintenance of standards controlling the technique's operation. Daubert, 509 U.S. at 594.

As described in Dr. Benson’s affidavit, the odds of the Plaintiff’s findings occurring as a result of chance are statistically impossible.³⁴ There is little doubt that DTI demonstrates that the Plaintiff has damage to her white matter that are typical for traumatic axonal injury. The findings are confirmed by the Plaintiff’s symptoms.

iii. **DTI Was Not Developed For Litigation**

One such factor applicable here is whether experts are “proposing to testify about matters growing naturally and directly out of research they have conducted independent of the litigation, or whether they have developed their opinions expressly for purposes of testifying.” Daubert v. Merrell Dow Pharmaceuticals, Inc., 43 F.3d 1311, 1317 (9th Cir. 1995). In the present matter, Dr. Benson did not develop his opinions regarding DTI for the purpose of testifying. Rather, Dr. Benson has submitted peer reviewed articles and testimony to the United States Congress that support the use of DTI for the diagnosis of mTBI. He employs DTI in his work for the NFL and recently spoke at a conference of experts on DTI to bring the benefits of DTI to our soldiers and veterans. Dr. Benson’s anticipated trial testimony concerning DTI and its validity and reliability

³⁴ See, Exhibit 1 at pp.4- 5, paragraph 20.

have all grown naturally and directly out of research and other activities conducted completely independent of this lawsuit.

D. DTI HAS BEEN ADMITTED BY COURTS UNDER BOTH FRYE AND DAUBERT STANDARDS

As cited above, DTI is 20 and 0 for use in diagnosing all TBI. Within that 20, Dr. Benson is 9 and 0 and the use of DTI in mTBI is 15 and 0.

There is no case in the country that has excluded DTI when conducted by a competent doctor³⁵ on an appropriate patient³⁶ and presented with peer-reviewed literature. Additionally, there are several other cases across the country admitting DTI over objection:

In Woods v. Ruth,³⁷ the Defendant filed a motion to strike Dr. Benson's testimony arguing that using DTI-MRI evaluations to diagnose brain injury is not reasonably reliable because it is considered experimental and has never been independently tested and scientifically validated as a reliable method for diagnosing brain injury. The Court denied the defendant's motion stating that in 2014:

"after fifteen years, tens of thousands of studies, and thousands of publications, the 'methods should no longer be considered experimental'" – quoting a 2009 article published in the Institute of Nerve Medicine

"The scientific method in question is the use of DTI-MRI evaluation in diagnosing brain injury...the method has been tested using control groups and over two thousand subjects have been studied across one hundred publications."

"the Court finds that using DTI-MRI evaluations to diagnose brain injury is reasonably reliable, and that any concerns regarding the method go to the weight of the evidence rather than its admissibility."

³⁵ There is a case where the expert was found to be lacking in DTI experience. Dr. Benson is one of the leading DTI practitioners in the world and is regarded as an expert in DTI.

³⁷ Case No. 13-cv-99, (District Court, County of Arapahoe, CO, Division 402 (2014). The court's order is attached as Exhibit 15.

In Nordstrom v. Fleet Farm of Menomonie, Inc.,³⁸ the court denied the defendant's motion to exclude all evidence obtained with DTI. In January, 2014, the Court found that:

"DTI is FDA approved and peer reviewed. It has been in clinical use for many years and is generally accepted in the scientific community as a reliable and accurate tool which can detect damage to the white matter of the brain."

"DTI does not involve a novel scientific theory, therefore, a Frye-Mack analysis is not required."

In Ebel v. Apache, et al.,³⁹ the defendant filed a motion to exclude Dr. Benson using DTI as a tool to assist in diagnosing mTBI arguing that it has not been proved to be reliable for single subjects. The court ruled in December, 2013, "having read and considered the submissions of counsel..., having heard oral arguments, and otherwise being fully-advised in the premises" denied the defendant's motion. The court admitted the evidence "because diffusion tensor imaging and the expert opinions related thereto satisfy the standards for admissibility of expert testimony...." The Ebel Court stated at hearing:

"First, with regard to the DTI, that motion is denied. It's my opinion that the cases that have looked at the issue have reached the conclusion that DTI is sufficiently reliable to be admitted under Daubert standards. It's also my opinion that there is sufficient evidence that would allow DTI to be used in the clinical setting as it relates to individuals, and that this is just one part of the evidence that would be used to show that this plaintiff has mild traumatic brain injury.

If that were the only evidence, then I might have problems. But it's not. It's going to be used in combination with other things. And I believe that the threshold is met for admitting that. The other things go to weight and can be the subject of cross-examination."⁴⁰

In Ruppel v. Kucanin,⁴¹ the defendant sought to preclude evidence of a diffuse axonal brain injury under Federal Rule of Evidence 702. The defendant specifically argued that Dr.

³⁸ Case no. 82-cv-11-5842, (MN, County of Washington, January 17, 2014). The court's order is attached as Exhibit 16.

³⁹ Case No. D-101-CV-2012-01210, (NM, December 11, 2013). The court's order and transcript is attached as Exhibit 17.

⁴⁰ See, Exhibit 17, transcript, at p. 72.

Benson's opinion that the plaintiff suffered an mTBI was not reliable because he used DTI to reach his conclusion. The court issued a ruling denying defendant's motion to exclude DTI evidence complete with a lengthy discussion of DTI and specifically Dr. Benson's use of DTI under a Daubert analysis.⁴² The court stated that:

"DTI and FA quantification based on comparative scans appear to be reliable methods for Dr. Benson to arrive at his expert opinion of both Ruppel's diagnosis of diffuse axonal injury and the cause of that injury."

"there have been numerous validation studies, published in peer reviewed journals, on the use of DTI to detect diffuse axonal injuries."

"DTI is regularly used as a diagnostic tool at the Detroit Medical Center and at other locations throughout the country"

"the United States Army Telemedicine and Advanced Technology Research Command ("TATRC") sponsored a "Diffusion MRI TBI Roadmap Development Workshop" at which it was acknowledged: "DTI has detected abnormalities associated with brain trauma at several single centers.""

"approval for marketing by the FDA indicates that its effectiveness was determined pursuant to 21 U.S.C. § 360c(a)(3)(A)."

"DTI has been accepted within the medical community." "Importantly, as discussed below, there are many articles published in peer-reviewed publications that cover the effectiveness of DTI in detecting mild TBI."

"the evidence shows that DTI and analysis of white matter in DTI images are generally accepted methods for determining mild TBI."

The Court further found that DTI was demonstrably reliable through the remaining Daubert factors, independent of its general acceptance in the medical community. The Court denied the defendant's motion and allowed Dr. Benson to testify regarding DTI and mTBI.

In Hansen v. Crain,⁴³ the Plaintiff suffered an mTBI and the defendant filed a motion in limine to exclude evidence obtained through DTI. The court found that DTI "is not novel

⁴¹ Case No. 3:08 CV 591, (USDC Northern Division of Indiana, Southbend Division) (2011).

⁴² The Court's order in Ruppel is attached as Exhibit 18.

⁴³ Case No. 62-CV-10-2435 (MN, April 4, 2011). A partial transcript of the court's proceedings is attached as Exhibit 19.

science, it has been around for maybe some twenty years, and is relied upon by medical professionals in a number of settings.” The court rejected the defendant’s argument that there can be other causes, other than a TBI, that could cause similar DTI results stating:

“The criticism is that it is not perfect, In fact, many other things besides trauma can lead to a similar finding on a scan of this nature. And that, in part, relies on clinical correlation and past history of a person’s medical, psychological, or trauma conditions. That, like any other causation issue such as a herniated disc, if it’s caused by the accident or not --- MRI doesn’t tell you if a herniated disc is caused by an accident or not, it tells you it’s a herniated disc. The doctors are allowed to opine whether they believe that injury or insult was caused by this, that, or the other thing. In this case, ...[the DTI results] form part of the basis for a qualified physician’s opinion as to injury or causation from a motor vehicle accident passes that portion of our Frye Mack test, and I believe that it will be helpful to the jury.”

In Hammar v. Sentinel Insurance Company, Ltd.,⁴⁴ the defense raised a Frye challenge to the admissibility of DTI. In denying the defense challenge, Judge Barton wrote in September, 2010:

- “3. DTI of the brain is proven and well-established imaging modality in the evaluation and assessment of normal and abnormal conditions of the brain. DTI demonstrates evidence of traumatic brain injury pathology and can reveal abnormalities that are not visible on standard MRIs...
4. DTI is generally accepted by the medical community, FDA approved, peer reviewed and approved, and a commercially marketed imaging modality which has been in clinical use for the evaluation of suspected head traumas including mild traumatic brain injury.”

In Whilden v. Cline, et al.,⁴⁵ the Plaintiff alleged he suffered an mTBI after being involved in a motor vehicle accident. The court denied the defendant’s motion to exclude evidence of DTI finding that:

⁴⁴ State of Florida, Thirteenth Judicial Circuit of the State of Florida, Hillsborough County, Civil Action No. 08-019984 (Barton, J)(September 27, 2010)

⁴⁵ Case No. 08-cv-4210 (CO, Jefferson County, May 10, 2010). The court’s order is attached as Exhibit 20.

“the technology [is] sufficiently reliable and scientifically accepted so as to be of benefit to the jury.”

“This court is convinced that it produces predictable, reproducible results and accurately images the portions of the brain to which it is applied. For these purposes, it is sufficiently accepted in the scientific and medical communities. It has been the subject of a substantial number of published studies and article, including peer reviewed articles.” (internal citations omitted)

In Booth v. Kit, the U.S. District Court for the District of New Mexico denied the defendant’s motion to strike, limit, or exclude, expert testimony that, in part, relied on DTI testing.⁴⁶ The court held that the expert’s testimony was admissible under Rule 702 because the reasoning and methodology underlying the testimony was scientifically valid and therefore sufficiently reliable.⁴⁷ The court indicated that Dr. Orrison’s reasoning and methodology had been sufficiently tested, peer reviewed, lacked a high error rate, and was generally accepted in the scientific community.⁴⁸ The court made clear that “any perceived weakness in Dr. Orrison’s conclusions **may be attacked on cross examination or by contradictory opinions by one or more other qualified experts.**”⁴⁹

In LeBoeuf v. B & K Contractors, Inc., a trial court judge properly allowed experts from both sides to testify regarding plaintiff’s brain damage and the various tests performed on him (including DTI) in a bench trial restricted to damages.⁵⁰ The trial court judge found that the plaintiff did have a brain injury and awarded him damages.⁵¹ In affirming the plaintiff’s award, the appeals court noted that the “expert medical testimony regarding the nature and degree of injuries [the plaintiff] sustained was conflicting” and that the trial court judge found “that the

⁴⁶ Civ. No. 06-1219 JP/KBM, 2009 U.S. Dist. Lexis 125754, at *12, (D. N.M. March 23, 2009), attached as Exhibit 21. The expert in that case, Dr. William W. Orrison, Jr., MD reviewed the plaintiff’s medical history and performed a PET scan, an MRI scan, and a DTI study. *Id.* at *9.

⁴⁷ *Id.* at *7-12.

⁴⁸ *Id.*

⁴⁹ *Id.* at *12 (emphasis added).

⁵⁰ 2008 1351 (La.App. 4 Cir. May 27, 2009) at *15, *41-42; 10 So. 3d 897; 2009 La. App. Unpub. Lexis 324, attached as Exhibit 22.

⁵¹ *Id.* *49-52.

evidence established [the plaintiff] sustained a mild brain injury.”⁵² The appeals court decline[d] to disturb the trial court’s award of general damages.⁵³

In Lamasa v. Bachman, the Supreme Court, Appellate Division, First Department, New York, considered whether a trial court properly admitted evidence of mild traumatic brain injury that had been obtained through DTI.⁵⁴ The court held that DTI evidence was properly admitted because it could not be characterized as novel science and that the defendant’s concerns went to the weight of the evidence, not its admissibility.⁵⁵ The court reasoned that “plaintiffs’ experts, **relying on objective medical tests**, testified to brain damage and other injuries that they attributed to trauma, and the **conflicting medical evidence and opinions of defendant’s experts concerning the permanence and significance of plaintiff’s injuries simply raised issues of fact for the jury.**”⁵⁶ In denying defendant’s motion for relief, the lower court explained that:

DTI is an imaging technique used to study the random motion of hydrogen atoms within water molecules in biological tissue (e.g., brain white matter) and spatially map this diffusion of water molecules, *in vivo*. DTI provides anatomical information about tissue structure and composition. Changes in these tissue properties can often be correlated with processes that occur, among other causes, as a result of disease and trauma.⁵⁷

The lower court further held that, as to the issues of causation and the precise physical injuries the plaintiff suffered as a result of the collision, “the parties had numerous expert witnesses testifying and in considering the conflicting testimony of the parties’ respective expert witnesses, the jury was not required to accept one expert’s testimony over that of another, but was entitled to accept or reject either expert’s position in whole or in part.”⁵⁸ On appeal, the

⁵² *Id.* at *49-50.

⁵³ *Id.* at *50.

⁵⁴ 56 A.D.3d 340 (N.Y. App. Div. 2008), attached as Exhibit 23. The plaintiff alleged he suffered a mild traumatic brain injury after being rear-ended by a truck while parked at a red light. *Id.*

⁵⁵ *Id.* See Also, Brief and Appendix for Plaintiffs-Respondents at 44-46, Lamasa v. Bachman, 2008 WL 5949015 (N.Y.A.D. 1 Dept.) (Appellate Brief) (No. 2008-0468), attached as Exhibit 24. The Plaintiff’s expert testified that DTI is a reliable method for determining the presence of brain injury in the brain’s white matter, that DTI has been cleared by the FDA, that DTI can reveal abnormalities that aren’t visible on standard MRIs, and that “[a]mong the benefits of use and study of diffusion tensor imaging, at this point it is fair to say that it is an accepted fact, or given, that DTI indexes brain injury.” *Id.*

⁵⁶ Exhibit 23 (emphasis added).

⁵⁷ Lamasa v. Bachman, 2005 WL 1364515 (N.Y.Sup.), attached as Exhibit 25 at *2, FN3.

⁵⁸ *Id.* at *6 (citations omitted).

New York Supreme Court, Appellate Division, upheld the trial court's admission of the challenged expert testimony.⁵⁹

In Andrus v. Mark Russell Fulgham,⁶⁰ defendants moved to exclude plaintiff's evidence based on diffusion tensor imaging (DTI), arguing that it is a novel method of imaging and one that is inherently unreliable. In opposition, plaintiff referenced a wide array of medical literature and articles discussing DTI, its acceptance in the neuro-imaging field and its usefulness in diagnosing and evaluating brain injuries and abnormalities, where more conventional imaging has been less reliable. The court held "under these circumstances, the Court is persuaded by the plaintiff's position and determined that while DTI imaging is a developing technology, there is nothing to suggest that it is inherently unreliable or inadmissible under the standards set forth in Rimmasch. Therefore, [the defendant]'s motion in limine is denied."

The science behind DTI is the main reason why every court in the country has admitted DTI over objection with the proper expert and the proper subject. DTI meets the requirements of Frye and Daubert/Lanigan.

E. THE DEFENSE ARGUMENTS AGAINST DTI ARE NOT SCIENTIFICALLY BASED AND SHOW A FUNDAMENTAL MISUNDERSTANDING OF THE SCIENCE OF DTI

1. DTI IS NOT IN CLINICAL USE AND THE PEER REVIEWED LITERATURE ONLY ALLOWS FOR GROUP COMPARISONS

The Plaintiff refers the Court to the sections where the peer reviewed quotes are provided as well as the affidavits in Sections ?? above. The Plaintiff encloses a photograph of the NICoE, the Department of Defense's elite brain injury Institute at Walter Reed National Medical Center's neuroimaging protocol. DTI is part of that protocol clinically to help diagnose and treat

⁵⁹ Exhibit 23.

⁶⁰ Case Number 040904243 (3rd Judicial District, Salt Lake County, Utah) (July 17, 2006). The court's order is attached as Exhibit 26. The materials for the other cases allowing DTI evidence not summarized herein are attached as Exhibit 27.

our veterans. The Plaintiff also refers the Court specifically to the Hulkower article⁶¹ cited above. After reviewing 10 years and 100 articles of DTI and TBI, the authors conclude:

“DTI is an extremely useful and robust tool for the detection of TBI-related brain abnormalities. The overwhelming consensus of these studies is that low white matter FA is characteristic of TBI. This finding is consistent across almost all the articles we reviewed, despite significant variability in patient demographics, modest differences in data acquisition parameters, and a multiplicity of data analysis techniques. This consistency across studies attests to the robustness of DTI as a measure of brain injury in TBI.... DTI can both qualitatively and quantitatively demonstrate pathology not detected by other modalities and is, therefore, an important tool not only in the research setting but in the clinical setting as well.”

“We also found an overwhelming consensus that imaging abnormalities detected with DTI are associated with important clinical outcomes. This further validates DTI as a meaningful measure of clinically important brain injury.”

The authors also found that in 35/100 articles they reviewed, DTI was being used to clinically assess individual patients.⁶²

2. DTI IS NOT ABLE TO TELL THE ETIOLOGY OF ANY WHITE MATTER DAMAGE FOUND

The Court in Hansen v. Crain,⁶³ correctly rejected this argument as cited surpa. As stated above and repeatedly, DTI is simply a diagnostic tool to help the clinical by objectively demonstrating white matter abnormalities. Few if any, radiologic tools can demonstrate etiology. X-Rays cannot, MRIs cannot, CT Scans cannot yet these tests are regularly allowed into evidence. It is an undisputed fact that mTBI can and will cause white matter damage that is shown on the DTI in this case. Dr. Benson has rendered the clinical opinion that these results are related to the mTBI and provide objective evidence of damage to the wiring of her brain. If the defense wants to cross examine Dr. Benson regarding the etiology, that is their prerogative. However, to seek to exclude objective evidence of damage to important structures of her brain, in a case of where the defense is calling the Plaintiff a malingerer or someone with non-organic psychiatric issues, is patently unfair.

⁶¹ See, Hulkower, M.B., et al, *A Decade of Traumatic Brain Injury*, **AJNR**, published January 10, 2013 as 10.3174/ajnr.A3395 and attached as Exhibit 28.

⁶² See, Exhibit 28 at p. 8.

⁶³ See, Exhibit 19.

3. DTI IS NOT RELIABLE BECAUSE IT IS NOT STANDARIZED

There are many different methods to employ DTI. This is a strength, not a weakness. Dr. Benson employs both voxel based analysis (VBA) as well as Tract Based Spatial Statistics (TBSS). This approach is specifically mentioned in the Hulkower article.⁶⁴ Employing VBA and TBSS validates the findings and is an accepted methodology.

The Defense points to an article from 2007 where nine different facilities produced 9 different results with the same data. First, this study was published in 2007, well before the AFSNR published their guidelines which served to standardize DTI acquisition and interpretation. Second, the article points to the need to ensure that DTI expert is properly trained and employs the same analysis with the control group as to the client. Dr. Benson has reproduced results from different facilities because of his expertise in the acquirement and interpretation of DTI data.

4. DR. BENSON'S NORMATIVE DATA IS VALID

Dr. Benson's normative sample consists of 87 healthy controls split fairly evenly⁶⁵ between men and women with ages ranging from 19-81. Contrary to the defense Motion, Dr. Benson uses an age corrected mean to compare the Plaintiff's score. Age affects FA in a linear fashion. We know the older we get the lower the average FA will get. The defense twist and turns the statistical makeup of the control group to suggest that Dr. Benson artificially raised the mean FA by skewing the group young and then compared the Plaintiff's FA to a normal of a much lower age. The defense simply ignores the age correction.

5. PARTIAL VOLUME AFFECTS INVALIDATE THE DTI DATA

The defense correctly points out that FA is significantly lower in gray matter and close to zero in the ventricles. The defense states that some voxels will cover gray matter, overlap gray and white matter or cover some area of the ventricles. This will result is very low FA without

⁶⁴ See, Exhibit 28 at p. 5.

⁶⁵ Male 52%, female 48%.

any white matter damage thus invalidating certain results. The partial volume affect is well controlled by three steps taken by Dr. Benson:

1. TBSS eliminates any partial volume affect by measuring only the middle of the white matter and thus “stays away” from gray matter and ventricles.
2. FA scores that are way too low are eliminated in VBA-any part of ventricle in a voxel or gray matter in the voxel will so skew the FA score downward that the computer will easily discard that voxel.
3. Dr. Benson employs Segmentation Software so that his VBA measure only white matter, not gray matter
4. Dr. Benson discards any voxel that does not appear as white matter on all 87 normal controls.

All of the steps above ensure that DTI only measures the white matter FA.

6. DR. BENSON’S FA SCORES ARE NOT VALID BECAUSE THERE IS NO WAY TO ENSURE THE VOXELS ARE PROPERLY MATCHED

The defense correctly points out the normal FA will vary from region to region. The defense argues that in order to get valid FA scores, one must ensure you are comparing the matching correct voxel from the patient to the normal database. In the population, there are those with distorted brains with certain lobes much larger than “normal”. In those cases, DTI will be invalid because you cannot match the patient brain with the “normal” database.”

Dr. Benson has software that maps the patient brain onto the normal database brain which is easier to do since the study only focuses on white matter. The software will inform Dr. Benson the percentage of voxels that were correctly matched. If >95% of the voxels are correctly matched, then the study is considered valid. In addition to the software, Dr. Benson also visualizes the brain to see if the brain has any morphological abnormality that precludes proper matching. Lastly, the defense ignores the TBSS which eliminates any matching problems because it finds that white matter tracts themselves.

7. THE EMORY “CONSENSUS” STATEMENT DISAPPROVES OF THE USE OF DTI IN LITIGATION

The Emory Statement is not a consensus statement at all. Plaintiff encloses the affidavit of William Jungbauer, an attendee at the conference at Emory. As he testifies:

- “12. On the last day in the session someone (I believe Dr. Wortzell) asked for a vote on whether or not DTI should ever be admissible in the Courtroom as evidence of mild traumatic brain injury in individual cases. The group refused to consider or even vote on such a prohibition.
13. The group after exhaustive discussions did not reach any consensus on any standards or criteria for admissibility or exclusion of any specific neuroimaging modality including DTI....
15. Dr. Wortzel quotes from the report that was published after consensus conference at Emory University. In his article he states:
- “The report, explicitly note that advanced imaging techniques (fMRI), DTI, PET, and SPECT) are used ‘only in a few clinical settings’ wherein sensitivity and specificity have been established. “Further, the applicability of normative imaging databases (typically compromising young, healthy subjects) in courtroom testimony is questionable. We also note that the use of normative imaging databases for comparisons to individual subjects for the purpose of expert witness testimony may constitute an inappropriate use of materials collected from research subjects. (Meltzer, et al, 2013)”
16. The conferees did NOT reach any consensus on the statements quoted by Dr. Wortzell from the report. There was never any vote on any of the assertions made as to whether or not the group agreed or disagreed with the statements in general, or whether any consensus of the group (or even a plurality) of the group would recommend to any Court to rely on such statements in a void as reason to admit or exclude evidence or testimony.
17. Dr. Wortzell further states in his article that the report of Meltzer, et al, proposed thirteen “standards” to guide subspecialty societies such as the American Society of Neuroradiology and inform the legal community. The conference did NOT adopt “Standards”.
18. I spoke by telephone on September 24, 2013 with John Banja, one of the co-authors of the 2013 article that was recently published and from which Dr. Meltzer quotes. Dr. Banja agreed that the conference did not reach “consensus” on any “standards” and called Dr. Wortzell’s use of these terms “an unfortunate choice of words by Dr. Wortzell”.
19. The article published by Meltzer, et al, and the article published by Dr. Wortzel should not be interpreted to represent any statements of standards for use by any Court in determining admissibility or exclusion of evidence as adopted by a consensus of those conferees attending the Emory University conference in December of 2012.”

There was no consensus and the views expressed in that article reflect only the views of the authors, not of the attendees or even a majority of the attendees. Further, the Statement ignores Dr. Hulkower’s meta analysis quoted supra and ignores an abundance of research cited above and elsewhere that supports the use of DTI to assist in the diagnosis of TBI.

8. DR. ZIMMERMAN'S VIEWS ON DTI APPEAR TO BE DIFFERENT IN COURT THAN THEY ARE IN THE PEER REVIEWED LITERATURE

While Dr. Zimmerman often testifies against the use of DTI when being paid by the defense, in the peer reviewed literature, he is not so negative. The following quotes are from peer reviewed articles

Structural dissociation of attentional control and memory in adults with and without mild traumatic brain injury Brain (October, 2008)

“Damage to these white matter pathways may be predictive of dysfunction in the corresponding cognitive domain, thus extending the ability of DTI to the diagnosis of cognitive sequelae in mild TBI.”

Extent of Microstructural White Matter Injury in Postconcussive Syndrome Correlates with Impaired Cognitive Reaction Time: A 3T Diffusion Tensor Study of Mild Traumatic Brain Injury (May, 2008)

“MR diffusion tensor imaging (DTI) may be used to better assess DAI.”

“DTI is indeed sensitive to the microstructural effects of traumatic axonal injury.”

Diffusion Anisotropy Changes in the Brains of Professional Boxers, Am. J. Neuroradiol 27:2000-04 (October, 2006)

“Diffusion measurements were found to be reflective of the clinical severity and prognosis of TBI, suggesting that diffusion parameters can be used as markers in TBI evaluation.”

“Such a marker may also useful (sic) in evaluating patients with TBIs not caused by boxing such as those sustained in car crashes.”

“Quantitative DTI shows promise as a clinical marker for early TBI in boxers. It also is expected to be a useful tool in the study of TBI in general.”

Clinical Use of Diffusion-Tensor Imaging for Disease Causing Neuronal and Axonal Damage , Am. J Neuroradiol 20: 1044-1048 (June/July 1999)

“We believe that the use of diffusion-tensor imaging and production anisotropy maps can assist in diagnosing and determining the extent of diseases that cause fiber damage and neuronal degeneration.”

9. DR. WORTZEL IS NOT QUALIFIED TO PROVIDE OPINIONS ON DTI

Dr. Wortzel is not qualified by education to give opinions on matters of neuroradiology because he is not a radiologist; he is not a neuroradiologist; he has no residency in diagnostic radiology; he has no fellowship in radiology; and he has no fellowship in neuroradiology.

Dr. Wortzel is not qualified by knowledge or skill or experience or training to give opinions DTI because not only does he have no formal training on radiology or neuroradiology, he has no formal training in the administration and interpretation of diffuse tensor imaging and does not conduct DTI testing or imaging.⁶⁶ He cannot independently analyze the raw data of the DTI because he is not trained to do it.⁶⁷ Dr. Wortzel admits he is not an expert in performing the analysis of that data. Dr. Wortzel cannot look at an MRI using DTI and determine if there is abnormal white matter, and if so, how much, or whether there is volume loss and if so, the location of same. Dr. Wortzel does not reanalyze DTI data.⁶⁸

Aside from travelling around the country testifying about DTI, Dr. Wortzel's qualification consist of an article he authored in the Journal of Am Acad Psychiatry Law-the subject article contains no original research but claims to be a review of the literature. There is a "Peer-Reviewed Abstract" that covers the same subject, use of DTI findings in litigation. The Journal that published the article is more of a legal journal than a medical journal.

The article itself is unscientific in that it cherry picks information and excludes pro DTI findings. The article claims to have performed a PubMed Search anchored to the terms diffusion tensor imaging and mild traumatic brain injury. They claimed the search yielded 30 results

⁶⁶ See Deposition of Dr. Wortzel in the matter of Capps v. Red Devil, CA No. 2011-4015 (Tulsa County, State of Oklahoma) attached as Exhibit 29 at pp. 118-119.

⁶⁷ Id. at pp. 106-107.

⁶⁸ Id. at p. 119.

which the authors limited to 24 studies. The period appears to be from 2002 until 2010, which is now four years old. However, even in this limited period, Dr. Wortzel inexplicably ignores 41 different articles that cover this topic.⁶⁹ Some of the articles have titles that makes one wonder how Dr. Wortzel missed them:

“Mild Traumatic Brain Injury: tissue texture analysis is correlated to neuropsychological and DTI findings”;
“Diffusion tensor imaging and white matter lesions at the subacute stage in mild traumatic brain injury with persistent neurobehavioral impairment”;
“Diffusion tensor imaging of mild traumatic brain injury”;
“The role of neuroimaging in sport-related concussion”;
“Investigating white matter injury after mild traumatic brain injury”;
“Traumatic brain injury and the frontal lobes: what can we gain with diffusion tensor imaging?”
“Are functional deficits in concussed individuals consistent with white matter structural alterations: combined FMRI & DTI study.”

In essence, Dr. Wortzel is claiming to be an expert in DTI because he did a literature review that left out more articles that he includes and whose conclusions are against the great weight of the articles published in medical journals on DTI.

VII. CONCLUSION

This Court should deny the Defendants’ Motion to Exclude Evidence Related to DTI. DTI is generally accepted in the relevant scientific community, as amply illustrated by the voluminous peer reviewed literature, for diagnosing white matter damage. DTI is demonstrably reliable, as the methodology described by Dr. Benson is peer reviewed, in clinical practice throughout the country and used by the United States Military to assist in diagnosing and treating mTBI. When courts have considered the general acceptance and/or reliability of DTI they have unanimously found the evidence admissible with the proper expert and the literature made available to them. The defense has not been able to identify one single case where DTI evidence was excluded under any test of admissibility. For the above stated reasons, this Court should find DTI evidence reliable and deny the defendant’s motion.

⁶⁹ Attached as Exhibit 30 is a chart of the articles left out of the search.

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