

PREDICTABLE DEFENSES IN A TBI CASE

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Defendants raise defenses in the traumatic brain injury case throughout the entire process of litigation. For that reason, this paper will outline the process of taking in, evaluating, and preparing the traumatic brain injury case and, at each stage, how to prepare for and answer each defense.

A. DOCUMENT IT

Document the signs and symptoms of traumatic brain injury immediately when the client comes in. Document the signs and symptoms in at least two ways. First, through the client and second, through the medical records.

Does the client have it?

We send the client a TBI checklist. We do this when the client says that she has hit her head, had a deceleration/acceleration injury, or has suffered some sort of hypoxic injury through either lack of oxygen (such as in a near drowning) or through loss of blood (as with external or internal bleeding). But we send the checklist to the significant other of the client for them to provide the information about the signs and symptoms of the client. This is because the person who suffers from traumatic brain injury can be the worst historian either through perception or through denial. Our checklist contains the following categories of signs and symptoms:

- Physical Impairments
- Persistent Intellectual Impairments
- Psychological Consequences
- Persistent Mood Disorders
- Persistent Physiological Impairments
- Persistent Personality Alterations

Persistent Neurological Problems

The key is to focus on the TBI aspect of the case as soon as possible. In multiple trauma cases, the ER which treats the Plaintiff first, may overlook traumatic brain injury. The same thing happens in a law office. The client or the client's family may not complain of the symptoms right away.

Defense: The Plaintiff did not raise TBI as an injury in the complaint or answers to interrogatories. This can be a problem if your office as well as the ER and the treating physicians have ignored the traumatic brain injury signs and symptoms. The TBI checklist should get your office focused on this problem.

Defense: The Plaintiff did not complain of signs and symptoms of TBI until weeks after the accident. But this is not uncommon. First, in multiple trauma cases, especially in a significant car crash, for example, the head injury or traumatic brain injury oftentimes will be overlooked. The emergency medical service and the emergency department at the hospital will be too busy attending to broken bones and internal and external bleeding.

Second, even if it is not a multiple significant injury case, the CT scan most likely will not reveal anything. The standard of care in any emergency room is that if there has been any sort of head trauma, they order a CT scan of the head. Unless there is a subdural hematoma or some gross bleeding, CT scan will be negative. (The fact that the CT scan was ordered is evidence that someone complained about a head injury or deceleration/acceleration injury). However, someone who is unconscious can have a negative CT.

Third, the damage may not even be present right away given the biology and chemistry of the brain. Axons in the brain are the elongated fiber that extends from the cell body to the terminal endings and transmits the neural signal. The larger the axon, the faster it transmits information. Some axons are covered with fatty substance called myelin that acts as an insulator. These myelinated axons transmit information much faster than other neurons.

Swelling of the axon can occur after the initial trauma. The swelling occurs in discrete fault formations. Calcium enters into the damaged axon. The calcium infiltration initiates further damage by the activation of proteases. Proteases is an enzyme that breaks down proteins and peptides. Excessive calcium influx, again after the trauma, can trigger proteins that will help break down the cell or subcellular components. Ultimately, swollen axons can become disconnected and contribute to additional damage to the tissue in the brain. See, e.g., "Traumatic Brain Injury: Can the Consequences be Stopped?" *Canadian Medical Association Journal*, April 22, 2008, Volume 178, No. 9, Park, Ugene, PhD; Bell, Joshua D., BSC; Baker, Andrew J., MD. See also, "Medical Rehabilitation of Traumatic Brain Injury," L.J. Horn and N.D. Zasler, EDS., St. Louis, MO, Mosby, 1996. For a list of secondary injuries derived from this material, see <http://calder.med.miami.edu/pointis/tbipro/MEDICINE/over5.html> for "Overview: Incidents and Classification: Secondary Injury."

What Records Are Key

EMT: emergency medical at transport records. These will tell you vital signs at the scene of the car crash or other area, the Glasgow Coma Scale, and whether the patient is oriented times three. That means that the patient can state (1) who he/she is; (2) where he/she is; (3) when, that is what day of the week or who is the president now. If the patient can answer those three questions, he/she is A (alert) and O (oriented) times three. The fact that the person is alert X3 does not have great meaning in terms of diagnosing traumatic brain injury.

Defense: The Glasgow Coma Scale is a scale used when doing a basic physical examination of the patient soon after trauma. But there are three types of responses which are elicited. Those responses are (a) eye opening response; (b) verbal response; (c) motor response. The Department of Health and Human Services Centers for Disease Control and Prevention provides head injury classifications as follows:

Severe head injury: GCS score of 8 or less

Moderate head injury: GCS score of 9 – 12

Mild head injury: GCS score of 13-15

Note that with a mild head injury-and mTBI- you can have a GCS of 15. The scale is adopted from the Advanced Trauma Life Support: Course for Physicians, American College of Surgeons, 1993. See, <http://www.bt.cdc.gov/masscasualties/pdf/glasgow-coma-scale.pdf>.

Emergency Department Records: This will be two to three sheets of very important information about where injuries are located on the body. Also, read every word written or printed on these sheets. They are indicators of what was observed in terms of physical presentation such as injuries, lacerations, bruises, marks, swelling, and behaviors.

Intake Forms: This will have another description of the initial presentation of the patient. It will also have CPT code for the diagnoses which may indicate head trauma.

Nurses Notes or Progress Reports: These will be the most detailed descriptions of the day to day complaints of the patient. Read every one.

Radiology Reports: CT scan is the standard of care in the emergency department whenever there is any head injury.

MRI Scan

X-Ray

Prior Medical Records: These can show prior bad behaviors such as drug use and prior studies such as CT or MRIs which can indicate preexisting conditions.

Defense: The CT was normal. But CT scans can be normal on a patient who is unconscious and on a patient who is dead. They are designed to show only gross bleeds such as

a large subdural hematoma. They will not show axonal shearing or diffuse axonal injury to the brain.

Defense: He used drugs 10 years ago and that may cause or contribute to the white matter lesions in the brain or the impaired scores on neuropsychological testing. But the work and education records will disprove that there were any problems after the prior drug use.

Defense: Prior MRI showed demyelinating disease in the brain. This is consistent with multiple sclerosis (MS). That is what the Plaintiff's problem is now, not traumatic brain injury. But multiple sclerosis is a disease which involves the disintegration of the myelin sheath transmitting the nerves in the brain. MS is not easy to diagnose. There are criteria, the McDonald criteria, for diagnosing MS. Prior medical records will determine whether any of the common indicators or signs and symptoms of MS were present. These include tremors, diminished libido, diminished energy levels, and inability to find words. These of course are consistent with many other things as well. The first question is then whether the patient had MS or has MS.

The second question is whether the traumatic brain injury contributed to the cause of MS. The medical literature says that there is no proven link between traumatic brain injury and the initial cause of MS. It has been known to be aggravated by acute stress. See, e.g., "Psychological Stress and the Subsequent Appearance of New Brain MRI Lesions in MS," *Journal of Neurology*, 2000, Mohr.

Get and review:

Prior Employment/Personnel File

Education Transcripts (high school and college)

What to Look for in the Medical Records

Head trauma including face and scalp.

Bruising

Lacerations

Blood in the scalp

Lumps/bumps

Loss of or effects on any of the five senses

Vision (blurry, double vision (diplopian), loss of vision partially or completely)

Hearing (loss of hearing or tinnitus)

Smell (partial or complete loss of)

Touch (numbness, tingling)

Taste (especially a metallic taste)

Sensory loss

Numbness

Tingling

Loss of use of limb or hands or feet

Medication (especially psychogenic drugs)

O₂ saturation rate serial readings

Hemoglobin serial readings (The measure of hemoglobin is an indicator of the volume of blood in our system.)

Loss of consciousness (LOC)

GCS (Glasgow Coma Scale)

Complaints of headache, confusion, irritability, gait or balance problems, seizures

Defense: There was no loss of consciousness at the scene of the incident. See definitions of mild traumatic brain injury from the US Government and organizations around the world. The World Health Organization defines MTBI as: “the conceptual definition of MTBI is an injury to the head as a result of blunt trauma or acceleration or deceleration forces that result in one or more of the following conditions:

Any period of observed or self reported:

Transient confusion, disorientation or impaired consciousness;

Dysfunction of memory around the time of injury;

Loss of consciousness lasting less than 30 minutes.

Observed signs of neurological or neuropsychological dysfunction, such as:

Seizures acutely following injury to the head;

Among infants and very young children: irritability, lethargy, or vomiting following head injury;

Symptoms among older children and adults such as headache, dizziness, irritability, fatigue or poor concentration, when identified soon after injury, can be

used to support the diagnosis of mild TBI but cannot be used to make the diagnosis in the absence of loss of consciousness or altered consciousness.”

See also, VA/dod “Clinical Practice Guideline for Management of Concussion/mtbi”, April 2009 which defines traumatic brain injury as follows: “Any period of loss of or a decreased level of consciousness.” This is the same Department of Defense definition used by, for example, the Department of Navy in its Memorandum dated December 13, 2007 on “Policy Guidance for Traumatic Brain Injury (TBI): Definition and Reporting.” Thus a loss of consciousness, is not required. Alteration in consciousness can be drowsiness, shock, disorientation and the like. Put another way, consciousness is not an on/off switch. There are many levels of consciousness.

B. GRAPH IT

Headache Calendar

One of the most common symptoms of traumatic brain injury is chronic headache. You cannot see a headache on any diagnostic study. However, create a graphic calendar for each month from the date of the accident to trial date. Shade in each day in which there is a headache. Shade it a different color for the severity of the headache.

April 2005

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

KEY

- RED: Extremely painful day. Days where I feel dizzy, have auras, loose orientation.
- ORANGE: Severely painful day. Days where I feel dizzy, bad coordination.
- YELLOW: Moderately painful day. Days where pain alternates in peak periods.
- GREEN: Mildly painful day. Days where I have constant but tolerable pain.

Hemoglobin Readings

The brain is an extremely oxygen dependant organ. Deprivation of oxygen to the brain for a period of four minutes is recognized to cause permanent brain injury.

Cerebral Hypoxia refers to a reduced supply of oxygen to the brain. Cerebral Anoxia refers to a complete lack of oxygen to the brain. Brain injury as a result of oxygen deprivation either due to hypoxic or anoxic mechanisms are generally termed hypoxic/anoxic injuries (HAI). A total oxygen deprivation, anoxia, can be hypoxic in origin, that is from reduced oxygen supply or ischemic in origin, that is oxygen deprivation due to a disruption in blood flow.

For these reasons, look in the medical records for any internal bleeding and hemoglobin readings. Hemoglobin is the protein molecule in red blood cells that carries oxygen from the lungs to the body’s tissues and returns carbon dioxide from the tissues to the lungs. Hemoglobin level is used to determine blood volume in the body. The hemoglobin level is expressed as the amount of hemoglobin in grams (gm) per deciliter (dl) of whole blood. For an adult male, the normal is 14 – 18 gm/dl. The following is serial hemoglobin readings for a Plaintiff from our medical chronology:

Monday, 4/5/10 at 8:51 a.m.: Labs done but **no hemoglobin count.**

Monday, 4/5/10 at 1:19 p.m.: Labs done: **Hb 14.3**

Monday, 4/5/10 at about noon to 1 p.m.: Ship’s doctor recommended to wife to get her husband off the Ship. He said that there could be a couple of broken ribs and that there could be complications. He said that the Ship had thought of diverting to Key West but that Dr. said it was not necessary.

Monday, 4/5/10 at 10:23 p.m.: **Hb 11.6**

Tuesday, 4/6/10 at about 7 to 8 a.m.: Ship arrives in Grand Cayman.

Tuesday, 4/6/10 at 7:51 a.m.: **Hb 10.2**

2	002	4/6/10	15:03 (3:03PM)	“Complains that he has a significant injury to the chest wall and the spleen. <u>HB has dropped to 8.9</u> ”
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4/7/10	<p style="text-align: center;">23:46 (11:46PM)</p> <p style="text-align: center;">Admission/Transfer Notes.</p> <p style="text-align: center;">Glasgow Coma Scale: 3 Backboard Removed Cervical Collar remains on</p> <p style="text-align: center;">Primary Pain: Unable to Assess: Medical Condition Prohibits</p> <p style="text-align: center;">Glasgow Coma Score: 7 Eye opening response Glasgow: To pain Best Verbal Response: Glasgow: None Best Motor Response: Glasgow: Withdraws</p>
4/7/10	<p style="text-align: center;">23:49 (11:49PM)</p> <p style="text-align: center;">Glasgow Coma Scale: 3</p>
---	<p style="text-align: center;">Impression:</p> <p style="text-align: center;">Findings consistent with splenic injury. Well defined high densed lesion interior to the spleen and the region of the splenic flexure of the colon likely representing a hematoma secondary to splenic injury.</p> <p style="text-align: center;">2. Fat stranding along the descending colon superimposed colonic injury cannot be excluded.</p> <p style="text-align: center;">3. Suprahepatic fluid</p>
---	<p style="text-align: center;">Nursing Progress Notes.</p> <p style="text-align: center;">24:00 Bilateral Symmetrical Chest expansion noted. Breath sounds with scattered Rhonchi's noted decreased on basis. Patient has strong positive productive cough.</p>

Neuropsychological Exam Comparison Grid

The following is a grid use to compare neuropsychological exam results between the Plaintiff's and Defense's neuropsychologist:

Neuropsychological Exams
(Description of each test, Dr. Weinstein's and Dr. Raphael's evaluations)

Minnesota Multiphasic Personality Disorder-2nd edition

This well-known and well-respected personality assessment is often used to accompany neuropsychological tests to **assess personality and emotional status** that might lend understanding to reactions to neuro-functional impairment.

Weinstein	Raphael
<p>“DIAGNOSITC IMPRESSIONS:</p> <p>Mild to Moderate Traumatic Brain Injury Post-Traumatic Stress-Disorder”</p>	<p>See TAB J for raw scores</p> <p>“The clients endorsements resulted in a valid MMPI-2 profile. Client’s test results were positive for clinical finding of somatization, anxiety and depression” (PAGE 16).</p>

Trail Making Test

These tests measure attention, visual searching, mental processing speed, and the ability to mentally control simultaneous stimulus patterns. These tests are sensitive to global brain status but are **not too sensitive to minor brain injuries**.

Weinstein	Raphael												
<p>“[Client’s] visual scanning and sustained attention on a task requiring him to connect number in order (Trial Making Test A) resulted in an impaired performance with a timed score of 73 when 30.2” is considered normal with 10.4 standard deviation.”</p> <p>“Measures of his executive functioning intact normal performance on tasks of concept formation and problem solving, but impaired performance on a more sensitive measure of overall cognitive functioning (Trial Making Test B) with a timed score of 114” where 64” are normal with 23.4 standard deviation.”</p>	<table border="1" style="width: 100%;"> <thead> <tr> <th></th> <th style="text-align: center;">Raw data</th> <th style="text-align: center;">Error s</th> <th style="text-align: center;">T-Score</th> </tr> </thead> <tbody> <tr> <td>TMT-A (Time)</td> <td style="text-align: center;">46</td> <td style="text-align: center;">0</td> <td style="text-align: center;">23</td> </tr> <tr> <td>TMT-B (Time)</td> <td style="text-align: center;">105</td> <td style="text-align: center;">0</td> <td style="text-align: center;">25</td> </tr> </tbody> </table> <p>“...the client displayed Impaired visual scanning, visuomotor, and numerical sequencing skills (TMT-A) relative to other males of similar age and education. He also performed within the Impaired range on a similar but more complex test requiring the ability to shift sets between sequencing numbers and alphabetizing letters (TMT-B).” (PAGE 15)</p>		Raw data	Error s	T-Score	TMT-A (Time)	46	0	23	TMT-B (Time)	105	0	25
	Raw data	Error s	T-Score										
TMT-A (Time)	46	0	23										
TMT-B (Time)	105	0	25										

Grip Strength Dynamometer

The purpose of this test is to measure grip or forearm muscle strength. Handgrip strength is important for any sport in which the hands are used for catching, throwing or lifting. Also, as a general rule people with strong hands tend to be strong elsewhere.

Weinstein	
<p>“[Client’s] proximal strength as measured by [this test] indicate diminished strength, below expected normal levels: Dominant hand: 23 where 49.9 is normal, Non-dominant hand: 26 where 46.4 is normal.”</p>	

Medical Chronologies

These are essential to understand what happened and when.

C. ILLUSTRATE IT

D. BACK IT UP

Experts

Neurologist

Neuropsychologist

Defense: The neuropsychologist is not qualified to testify as to the cause of the brain damage.

In some states, including Florida, the neurologist may be the only one qualified to provide an opinion as to the causation of the brain damage. The thinking is that the neuropsychologist is not a medical doctor and, therefore, cannot render a medical opinion. The opinion about causation is a medical opinion. See, e.g., *Bennett v. Richmond*, No. 20S03-1105-CV-293 Supreme Court of Indiana January 31, 2012 for a review of some cases from around the country. In *Bennett*, the Court also cites to *Grenitz v. Tomlian*, 858 So.2d. 999 (Fla 2003) (where the Supreme Court of Florida held that a neuropsychologist is not competent under Florida statutes to testify regarding medical causes of organic brain damage in a medical malpractice action based on the child born with cerebral palsy, and that the determination of a non-psychological or medical cause of organic brain damage is a medical judgment, for purposes of determining whether psychologist may provide expert testimony on organic brain damage.

The Court in *Grenitz* held that “a psychologist may properly give an opinion testimony as to an existing mental condition and existing organic brain damage. Further a neuropsychologist is competent to testify as an expert regarding the results of neuropsychological testing reflecting the presence of organic impairment, pursuant to the statutory definition of the practice of psychology.”

Defense: Impairments found on the neuropsychological testing are “inconsistent.” This is the fall back of the defense neuropsychologist whenever they do find impairments. They say that the results are “inconsistent”, but they do not say with what. This is where the basic cross examination of a neuropsychologist comes into play as follows:

- Would you agree that neuropsychologists can through testing determine whether there is brain damage in a person?
- That is, do you agree that neuropsychologists can determine whether there are cognitive and similar deficits arising from brain damage?

- Do you agree that neuropsychology through testing is one of the acceptable methods or methodology used to determine whether brain damage exists?
- Do you agree that neuropsychological testing is valid to diagnose traumatic brain injury?
- Do you agree that a neuropsychologist is qualified to give an expert opinion as to the consistency of the test results with traumatic brain injury and the cause for that traumatic brain injury?
- Do you agree that although traumatic brain injury may be classified as mild, the ramifications or effects of that injury on a person's life may be severe?
- Do you agree that mild traumatic brain injury can be permanent?
- Do you agree that CT scans are not sophisticated enough to diagnose or detect abnormalities in the mild traumatic brain injury patient?
- A CT scan on an unconscious patient can be completely normal?
- Do you agree that CT scans in fact can be normal on a dead person? That is, someone who is dead can have a normal CT scan.
- The mental status examinations performed by neurologists and psychiatrists are not sophisticated enough to detect the subtle defects of a mild traumatic brain injury?
- EEGs, CT scans, and MRIs are not sophisticated enough to diagnose or detect abnormalities in the mild traumatic brain injured patient?
- Do you agree that concussion is by definition a brain injury?
- Do you agree that the best indicators of the severity of a brain injury are amnesia around the injury, that is, both trauma and loss of consciousness?
- Do you agree with me that a person can sustain a traumatic brain injury without loss of consciousness?
- Do you agree with me that a person can sustain a traumatic brain injury without striking their head?
- Do you agree with me that a person can sustain traumatic brain injury at the microscopic level as a result of an acceleration/deceleration injury?

- Do you agree with me that when there is an acceleration/deceleration injury with rotation, the likelihood is much greater that a person will sustain a brain injury? That is more so than someone who sustains an acceleration/deceleration injury without rotation?
- Are you aware that the American Orthopedic Society of Sports Medicine determined that the results of a neuropsychological test battery on the immediate post concussion assessment cognitive test “impact” were similar in patients with concussion who had loss of consciousness and those who did not have loss of consciousness, supporting the recommendation on current guidelines for diagnosis for concussion are inadequate?
- Do you agree that a person with a Glasgow Coma Scale of 15, the highest possible, can sustain a traumatic brain injury?
- Do you agree that frequently in the emergency room setting persons with traumatic brain injury are not diagnosed immediately after a wreck?
- Do you agree that no formal cognitive testing at all was performed on the Plaintiff in this case when she went to the emergency room at _____ medical center?
- Would you agree with me that people who sustain traumatic brain injuries are poor historians? That is, they are sometimes the worst people to recount all the facts that have happened?
- Do you agree that no impact test was performed on Plaintiff by EMS personnel or emergency room personnel?
- Would you agree with me, doctor, that some people who sustain traumatic brain injury do not recognize cognitive problems for days or weeks?
- Would you agree that one of the reasons why some people who sustain traumatic brain injury do not recognize these problems is that the brain swells and the swelling can occur for days or weeks after the injury?
- Would you agree with me, doctor, that based upon the brain injury literature that somewhere between 15–25% of all persons suffering from mild traumatic brain injury end up with permanent lifelong deficit?
- You have seen literature that says 15-25% of people who are diagnosed with mild traumatic brain injury have lifelong deficits as a result of those injuries, haven’t you?
- What is diffuse axonal injury? (diffuse or spread out microscopic shearing or injury to the axons or nerve cells within the brain)
- Can diffuse axonal injury be caused by acceleration/deceleration forces?

- Can rotational forces coupled with acceleration/deceleration forces cause diffuse axonal injury?
- Do you know how the wreck which occurred in this case happened? Please tell us your understanding of how it happened.
- Have you seen photographs of the truck or the car?
- Do you know how far the truck pushed the car down the highway after it crashed into the car?
- Do you agree with me that diffuse axonal injury is one of the most common and important pathological features of traumatic brain injury?
- Would you agree with me, doctor, that the susceptibility of axons to mechanical injury appears to be due to both the fact that they have what's called viscoelastic (stretching) properties and their high organization in the white matter tracts of the brain?
- How large is an axon?
- What happens when the axon becomes interrupted for some reason? (There can be a ballooning at the site of any fracture. You can get fracture of the myelin coating of the axon. You can get electrolyte abnormalities throughout the neurons. You can get changes in the nucleolus of the neuron because of the interrupted signal. You can get dying back or alluring degeneration over time.
- What is a neuron? (a nerve cell)
- What happens to us as individuals when our nerve cells in our brains by traumatic brain injury? (nerve cells can die and depending upon the type of mechanism, the number of cells, the location in the brain, the effects of the medications or intoxicants onboard at the time of the impact it can be a complicated picture).
- Would you agree with me that in order for a neuron to fire electrically, there is an electrochemical reaction? There is what is called an ephaptic transmission.
- Would you agree that the source of food that causes a neuron to fire are oxygen and glucose? Glucose is the fuel and oxygen provides some of the metabolic power required for the glucose to be utilized.
- Doctor, would you agree with me that although axons are supple under normal conditions, they become brittle when exposed to rapid deformations associated with brain trauma?
- Do you agree with me that a rapid stretch of the axons, nerve cells, can damage the axonal cytoskeleton (skeleton of the cell) resulting in a loss of elasticity (ability to

stretch) and impairment of the axoplasmic transport (transmission of the impulse which make the nerves work)?

- Would you agree with me that subsequent swelling of the axon occurs in discreet fault formations or any elongated varicosities that accumulated transported proteins?
- Would you agree with me that the swelling or damage to the axons is difficult or impossible to pick up on MRIs or CTs?
- Would you agree with me that a person can sustain a mild to moderate traumatic brain injury and you won't necessarily see any findings on the CT scan?
- Would you agree with me that calcium entry into damaged axons is thought to initiate further damage by the activation of proteases? (Excess of calcium influx can trigger proteins that will help break down the cell or subcellular components).
- Would you agree with me that ultimately swollen axons may become disconnected and contribute to additional neuropathological changes in brain tissue?
- Would you agree with me that diffuse axonal injury which is microscopic damage can render this damage nearly invisible to current imaging techniques?
- Would you agree that shear brain injury refers to the layers of axons splitting or separating over each other?
- Would you agree with me that diffuse brain injury may occur in the absence of impact forces, that is, without the skull hitting something?
- Would you agree with me that diffuse brain injury is dependant on inertial forces that are commonly produced by motor vehicle crashes?
- Do you agree with me that inertial forces are a result of rapid head rotational motions which deform the white matter and lead to diffuse axonal injuries sometimes referred to as shearing brain injury or axonal shearing?
- Are you familiar with the studies of Dr. Omayya?
- Are you aware that Dr. Omayya has found brain injury causing a bleed at 1,600 radians per second squared?
- Do you agree that radians per second squared is an angular velocity measurement?
- This is the same thing as rotational velocity?

- Would you agree with me that in mild to low moderate diffuse axonal injury there is often a remarkable absence of macroscopic pathology (damage) and the brain may appear normal in the x-ray, ct, or MRI?
- Are you aware of the studies on people who have been involved in whiplash wrecks where their brain tissue has been microscopically examined?
- Are you aware that there have been a number of studies, microscopic studies of brain tissue, which reveal the pathological signature of diffuse axonal injury and those indicators of diffuse axonal injury are a multitude of swollen and disconnected axons?
- Would you agree with me that the principle mechanical force associated with causing diffuse axonal injury is rotational acceleration of the brain resulting from unrestricted head movement in the instant after injury?
- Do you agree with me that rotational acceleration or translational displacement can be enough to produce diffuse axonal injury?
- Would you agree that this initial loading to the brain, that is acceleration forces, induces dynamic shear tensile and compressive strain within the tissue leading to dynamic tissue deformation? (compressive means axons are bunched up tight or together; tensile means that the axons are pulled apart).
- Would you agree with me that under normal daily activities, brain tissue is compliant and ductile to stretch and easily recovers its original geometry, that is, shape and size?
- Would you agree that under severe circumstances when the strain is rapidly applied such as during an automobile crash the brain tissue acts far stiffer essentially becoming more brittle (and that has been confirmed in animal experiments)?
- Would you agree with me that rapid uniaxial stretch or tensile elongation of axons is thought to result in damage to the axonal cytoskeleton, that is the skeleton of the cell?
- Would you agree with me that this classic viscoelastic response to rapid deformation prompts a classification of a dynamic injuries in which the applied force is occurring less than 50 milliseconds?
- Would you agree that disconnection of axons at the time of brain trauma is relatively a rare occurrence with the exception of tissue tearing and the white matter in severe brain injury?
- Would you agree with me that axonal pathology (cell damage) has been shown to develop over the course of hours to days after the injury and has even been observed months later?

- Would you agree that within seconds of dynamic axonal stretch, in-vitro axons can become temporarily unguled and misaligned from some loss of elasticity resulting from cytoskeleton damage?
- Would you agree that although axons may slowly recover back to their pre-stretch orientation and shape, there is a characteristic evolution of physical and physiologic changes? (Although axons may recover their shape, there can be permanent physical changes to the nerve cells).
- Would you agree in particular that mechanical damage to sodium channels may result in massive influx of sodium with resultant swelling? (The sodium potassium pump will be adversely effected. There is concern about aggressive potassium out of the cell. Sodium and potassium exchange for each other.)
- Would you agree that this sodium influx also triggers massive calcium entry through voltage sensitive calcium channels and reversal of sodium calcium exchangers? (In other words, calcium influx is an important problem.)
- Would you agree that in turn the increased intracellular calcium may play a role in the activation of proteolytic activity has been extensively examined? (The calcium will trigger or activate an enzyme that digests or breaks down protein.)
- Would you agree with me that after the crash for days or months can be these chemical changes and damage, which includes involving axonal pathology, progressive disorganization of the axonal cytoskeleton, progressive protein accumulations leading to disconnection of axons with the signature pathologic feature of a bulb formation at the terminal end of the axon referred to as “terminal clubbing?”
- Would you agree that there is mounting evidence to suggest that brain trauma can have prolonged effects and initiate insidiously progressive neurodegenerative processes?
- Would you agree that axonal pathology (the diffuse axonal injury, shearing injury result in chemical breakdown) is substantially under diagnosed?
- Would you agree with me that diffuse axonal injury is often a diagnosis of exclusion based on the inability of conventional imaging techniques (CT or MRIs) to detect brain damage (pathology) despite overt symptoms?
- Doctor, would you agree with me that most clinicians (doctors who actually see the patient and perform examinations) will upgrade a patient to moderate traumatic brain injury if there are positive findings on neuroimaging based on the outcome studies by Dr. Levine? (Dr. Levine based on his studies says that if you see a positive CT showing hematoma or intraaxial hemorrhage, you should upgrade to moderate or severe TBI.)
- Doctor, would you agree with me that a mild traumatic brain injury is sort of like a mild heart attack? You don't want either of them.

- Doctor, would you agree with me that the clinical manifestations of mild traumatic brain injury may offer the best clues to a potential diffuse axonal syndrome (that is, these are the best clues to determine whether there is mild traumatic brain injury)?
- Doctor, would you agree with me that persons suffering diffuse axonal injury often present with physical impairments, cognitive impairments, lewd disturbances, and behavioral impairments?
- Doctor, would you agree that physical impairments include which persons with mild traumatic brain injury can exhibit include an assortment of daytime fatigue, disequilibrium (loss of balance), photophobia (sensitivity to sunlight), tinnitus (ringing in the ears), blurry vision, nausea, or headaches?
- Doctor, would you agree with me that cognitive impairments related to diffuse axonal injury encompass problems with attention, memory, executive functions such as speed of processing, reasoning and mental flexibility?
- Doctor, would you agree with me that persons suffering from diffuse axonal injury often suffer mood disturbances, behavioral impairments, insomnia, behavioral discontrol such as irritability, easily triggered angered, easily triggered crying, and appearance of depression and anxiety?

Neuroradiologist: Use of diffuse tensor imaging MRIs.

Defense: The DTI MRI is experimental. However, it is not. See, e.g., *Journal of Neurotrauma* 26: 1-14. “Integrated Imaging Approach with MEG and DTI to Detect Mild Traumatic Brain Injury in Military and Civilian Patients,” Huang, et al. May 27, 2009.

There are numerous state court orders allowing admission of results of DTI MRIs. In such order, *Whilden v. Cline*, District Court, Jefferson County, CO. Order denying Defendant’s Motion in Limine, dated May 10, 2010, the court said: “There have been at least 3,393 articles on DTI with 176 articles related to DTI and traumatic brain injury and 29 articles related to DTI and mild traumatic brain injury.”

Defense: The DTI MRI is negative. However, DTI MRI may be indicative of focal axonal injuries and not indicative of diffuse axonal injuries. See, e.g., “Voxel- and Atlas- Based Analysis of Diffusion Tensor Imaging may reveal focal axonal injuries in mild traumatic brain injury - comparison with diffuse axonal injury” Kasahara, et al, accepted December 4, 2011, ScienceDirect.com. Therefore, you can have negative DTI MRI but still have mild traumatic brain injury. A negative DTI may rule out focal or specific areas of injury as opposed to diffuse or spread out damage or axonal injury.

Biomechanical Expert: To prove that the energy or force in the trauma in that case was sufficient to induce or cause traumatic brain injury.

Defense: The energy or force in the trauma was not sufficient to produce traumatic brain injury. This is where the biomechanical expert can come in and testify. The Defense moves in limine and says that the biomechanical expert is not competent to testify about causation on a medical issue.

Courts have held that biomechanical experts cannot testify that the Plaintiff's brain injury was not caused by the accident to within a reasonable degree of engineering probability. See, e.g., *Stockwell v. Drake*, 901 So.2d 974 (Fla. 4th DCA 2005).

However, other courts have held that biomechanical experts can testify "about the forces required to achieve the injuries that [the Plaintiff] suffered." See, *Berner v. Carnival Corporation*, 632 F.Supp.2d 1208 (So.D. Fla. 2009); Case No. 08-22569-CIV-ALTONAGA, July 2, 2009. In the *Berner* case, the court denied Defendant's Motion in Limine to Exclude Plaintiff's Biomechanical Engineer. The Plaintiff proffered the biomechanical engineer, a Ph.D. in biomechanics, to provide three professional opinions within a reasonable degree of engineering certainty: "(1) during the assault [the Plaintiff] was struck with sufficient force to cause his right orbital blow out fracture; (2) the force to cause [the Plaintiff's] right orbital blow out fracture was sufficient to destabilize [the Plaintiff] and/or stun him causing him to fall and strike his head on the floor; and (3) the energy on [the Plaintiff's] head upon striking the floor was sufficient to have caused his mild to moderate traumatic brain injury." The court in *Berner* went through a Daubert analysis. The court was swayed by the Plaintiff's argument that the biomechanics expert "is not offering a diagnosis; rather, she accepts the injuries as diagnosed by other doctors and her opinions focus on the forces involved and the blows sustained by [the Plaintiff] and the human tolerance levels or in other words levels at which certain injuries may occur." The Court in *Berner* cited to the standard on biomechanical engineering testimony, *Smelser v. Norfolk Southern Railway Company*, 105 F.3d 299 (6th Cir. 1997) in which the Court said:

Other courts that have considered whether a biomechanical engineer is qualified to testify about the cause of an injury have ruled consistently with *Smelser*. See, e.g., *Wagoner v. Schlumberger Tech. Corp.*, No. 07-CV-244-J, 2008 WL 5120750, at *1 (D. Wyo. June 19, 2008) ("[Biomechanics experts] may, for example, testify as to the forces involved in the . . . accident and how those forces may affect an individual or object; they may not express any opinions regarding whether plaintiff . . . has suffered a brain injury . . . or as to the . . . cause of the alleged brain injury."); *Morgan v. Girgis*, No. 07 Civ.1960(WCC), 2008 WL 2115250, at *5-6 (S.D.N.Y. May 16, 2008) (similar); *Bowers v. Norfolk S. Corp.*, 537 F. Supp. 2d 1343, 1377 (M.D. Ga. 2007) ("[A biomechanical engineer] may testify as to the effect of locomotive vibration on the human body and the types of injuries that may result from exposure to various levels of vibration. . . . [H]e may not offer an opinion as to whether the vibration . . . caused Plaintiff's injuries."); *Shires v. King*, No. 2:05-CV-84, 2006 WL 5171770, at *3 (E.D. Tenn. Aug. 10, 2006) ("[The biomechanical engineer] clearly should be allowed to testify regarding the forces applied to plaintiff's head . . . , and how a *hypothetical*

person's body would re-pond [sic] to that force. He cannot offer opinions, however, 'regarding the precise cause' of plaintiff's injury.").

In *Berner*, the Court said that the Plaintiff's expert may give an opinion about the energy involved and whether the energy is sufficient to have caused an injury of the type [the Plaintiff] alleges to have suffered. The Court in discussing the biomechanics methodology quoted from the Plaintiff's Biomechanics Report as follows:

Using Newton's Laws of Physics, the impact velocity of Berner's head striking the floor can be quantified. Impact velocity is independent of the mass of the object, but is dependent on the vertical distance the object travels. Berner is 5'9" tall. Utilizing the principles of Conservation of Energy and Work, falling from his upright posture, Berner's head struck the floor with a velocity of about 12 mph.

Concussions resulting from head impacts occur with impact energies between 36–44 lb-ft. [See Andrew S. McIntosh, et al., *The Dynamics of Concussive Head Impacts in Rugby and Australian Rules Football*, MED. & SCI. SPORTS & EXERCISE, Feb. 2000, at 1980, 1983.] Applying the Conservation of Energy Principles, the average head mass is 10 lbs and an impact velocity of 12 mph, Berner's head striking the floor resulted in an impact energy of about 56 lb-ft, which is sufficient to cause mild to moderate traumatic brain injury.

Dr. Williams explains that her conclusions are supported by the laws of physics; her education, experience, and research; and "by universally accepted principles in the bioengineering field, as well as all fields of engineering as evidenced in the article which [she] cited in [her] report." (Pl.'s Resp. Ex B. ¶ 11). "Once the energy was calculated, [Dr. Williams] compared [it] to the energy measured and reported to cause concussion (mild traumatic brain injury) in the article cited." (*Id.* ¶ 16). Using a study about the dynamics of head impacts in Australian rules football that resulted in concussions, Dr. Williams states "[c]oncussions resulting from head impacts occur with impact energies between 36–44 lb-ft." (Report at 5). According to Dr. Williams, this methodology "is sound and well recognized." (Pl.'s Resp. Ex B. ¶ 17).

In *Berner*, the Defendant argued that the study relied upon by the biomechanics expert was not reliable because it was based only on concussions, not brain injuries. The court held that there was sufficient evidence to establish that all concussions are brain injuries. The court said:

And Berner provides numerous references that a concussion is synonymous with a brain injury. *E.g.*, CENTER FOR DISEASE CONTROL & PREVENTION, FACTS ABOUT CONCUSSION AND BRAIN INJURY 6, <http://www.cdc.gov/ncipc/tbi/tbibook.pdf> ("The type of brain injury called a concussion has many symptoms."); *id.* (back cover) ("A blow or jolt to the head can cause a type of mild brain injury called a concussion."); MayoClinic.com, <http://www.mayoclinic.com/health/concussion/DS00320> (last visited July 2, 2009) ("[E]very concussion, no matter how mild, injures your brain."). The Court

is unconvinced this disagreement impeaches Dr. Williams's methodology or precludes introduction of that methodology at trial.

E. DEFEND IT

Other defenses not covered above include:

Defense: failure to mitigate. The Plaintiff should have gotten cognitive rehabilitation. On the other hand, if the Plaintiff undergoes cognitive rehabilitation, the Defense argues that he is getting better. However, cognitive rehabilitation only provides a coping mechanism to someone who suffers from traumatic brain injury. This is like providing crutches to a person who has lost a leg. The person still suffers from that injury. They have been given tools, however, to cope with the injury. The injury will never get better either through the crutches or through cognitive rehabilitation.

Defense: He is malingering, faking, exaggerating. This is where diagnostic studies, prior medical, employment, and education records are relevant to show what the Plaintiff was like before the accident and testimony from before and after witnesses is relevant.

Defense: He still works. To counter that the Plaintiff is the same, obtain his personnel file and talk to his supervisors and coworkers.