



## 20 Questions (and answers) about Traumatic Brain Injury

for insurance claims adjusters, case managers, attorneys, and health-care providers

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### 1. What is traumatic brain injury (TBI)?

Physical force injury to the head can cause nerve cells in the brain to stretch, tear, and pull apart, making them unable to relay messages from one part of the brain to another. Sufficiently forceful trauma to the head causes the brain suddenly and violently to slam against the bony structures of the interior of the skull resulting in "traumatic brain injury." The head striking an object (a windshield or the ground) at a fast rate of speed or something striking the head (a flying or falling object) can cause brain injury. Injury to brain cells interferes with all sorts of information processing—thinking, remembering, seeing, and controlling and coordinating bodily movements. Traumatic brain injury can range from relatively mild to catastrophically severe depending on multiple factors including degree of force, multiple trauma, neurological complications, and timeliness of emergency medical treatment.

### 2. What is the difference between the terms "closed head injury" and "traumatic brain injury"?

Closed head injury (CHI) implies force trauma to the head that does not result in penetration of the skull (such as a bullet or open skull fracture would). Usually, closed head injury implies traumatic brain injury, but this may not necessarily always be the case. Whether or not *brain* injury is sustained depends on the power of the physical force injury. If the injury is great enough, physical force radiates from the skull into the brain or causes sudden movement of the brain inside the skull, resulting in damaged nerve cells. Even if closed head injury does not cause *brain* injury, it may cause "soft tissue" injury such as in cervical strain or myofascial trauma. Symptoms of soft tissue injury may mimic mild brain injury. Differential diagnosis is essential.

### 3. What, specifically, is "mild traumatic brain injury"?

Clinicians classify head (or, more correctly, *brain*) injury based on quality or length of change in consciousness and length of amnesia (memory loss). Both loss of consciousness (or even a semi-conscious state) and amnesia are directly caused by the sudden trauma and tearing of nerve cells. When this trauma occurs, the brain simply cannot maintain its normal functioning and shuts down, completely (causing unconsciousness) or partially (causing a feeling of being dazed), until cellular functioning can recover. "Mild brain injury" refers to the extent of loss of consciousness (30 minutes or less) and amnesia (24 hours or less), *not to the functional effects*. The diagnosis can be made if even one of the following conditions is observed: (1) loss of consciousness of any length, (2) amnesia of any length, (3) altered consciousness (e.g., being "dazed"), or (4) focal neurological deficits (e.g., temporary vision loss, or a seizure). A mild traumatic brain injury can result in permanent, life-altering consequences.



#### **4. What are the essential *functional* consequences of mild traumatic brain injury?**

Directly caused by the "diffuse axonal injury" and other physiological changes in the brain, thinking becomes slow, memory becomes unreliable, and concentration becomes haphazard. The roadblocks of damaged and disconnected neurons mar the processing of electro-chemical messages within the brain. Processing (i.e., thinking) takes more time because it is subject to errors caused by unfamiliar neural detours. Judgment and decision-making may be faulty because the complex interrelated brain connections are just not available to the person now as they were before the injury. The individual senses incomplete mental processing and loses confidence in thinking. Complex or unfamiliar tasks become frustrating, as thinking no longer yields insights or easy problem solutions. Irritability prevails, as the individual attempts to cope with a brain that just seems always to function in a mental fog. A host of complicating cognitive and emotional reactions can evolve. To some extent, some of these problems can be permanent.

#### **5. Can brain injury occur without direct trauma to the head?**

Yes. Whiplash injury or violent shaking of the head can cause brain injury. It is the sudden movement of the brain inside the cranium that causes damage to neurons. Sudden acceleration-deceleration of the head in an automobile collision, even with airbag deployment where the head is protected from striking a solid object, can cause brain injury because the brain slams against the inside of the skull, displacing, tearing, and bruising nerve cells. A roller coaster ride may make you feel dizzy for a few minutes due to inner ear disturbance, but produces nowhere near the physical force of even a 20 or 30 mph automobile crash. Even what seems like a sudden stop at the end of the ride (which, of course, it really isn't) is nothing compared to hitting a stationary object at just 15 or 20 mph.

#### **6. Since x-rays, MRI's, or CT's can diagnose many head and brain injuries by showing areas of fracture, hemorrhage, or certain kinds of tissue injury, can they also show evidence of traumatic brain injury?**

Often, they cannot. Traumatic brain injury, especially if mild, involves scattered disconnection among neurons and supportive tissue, stretched (and damaged) axon membranes (known as "diffuse axonal injury"), chemical injury due to neurotransmitter toxicity, and cellular dysfunction due to changes in ionic balance. These kinds of changes to brain cells do not result in sufficient change in the tissue density to be detected by conventional imaging techniques. Even if diffuse axonal injury does cause some subtle change in tissue density, the injury is so scattered throughout the brain that there is insufficient focal concentration of injury to yield detection by these procedures. Often, more elaborate imaging techniques such as SPECT (single-photon emission computed tomography) or PET (positron emission tomography) can detect changes due to brain injury because these techniques measure brain cell *metabolism*, not tissue density. CT and MRI scans are usually employed initially in any degree of head trauma to check for life threatening bleeding or swelling in brain tissue.



## **7. What are the differences among the diagnostic terms "post concussion syndrome," "posttraumatic stress disorder," and "brain damage"?**

"Post concussion syndrome" refers to a set of often-reported symptoms that occur, and often linger for weeks or months, following traumatic brain injury, mild or otherwise. Post concussion symptoms may be due to *either* brain injury or soft tissue injury, or both. The syndrome includes headache, dizziness, concentration difficulty, memory failures, irritability, mental dullness, fatigue and weakness, light or sound hypersensitivity, sleep difficulty, depression, and loss of self-confidence. "Post-traumatic stress disorder" is a diagnostic term referring, specifically, to an emotional (anxiety-based) disorder caused by a psychologically intense event, and usually does *not* (but can) accompany post concussion syndrome, especially if the person remembers some horrifying aspect of an injury event. The term "trauma" in this case refers to emotional, not physical, impact. "Brain damage" is a general term referring to any injury to brain tissue from any cause.

## **8. How is the diagnosis of traumatic brain injury made using neuropsychological examination?**

Brain injury causes structural *and functional* changes. Structural changes may not be easily detected by conventional imaging procedures (see Q&A 6, above) due to the typically diffuse nature of injury. Therefore, assessing functional changes in thinking, coordination, language, emotions, and personality provides the key to diagnosing traumatic brain injury. Objective and scientifically created neuropsychological tests are sensitive to these trauma-induced functional changes that usually are not produced by the normal brain. By combining data from a thorough interview and results of neuropsychological and sometimes personality tests, the neuropsychologist creates a functional profile that can be compared to the kinds of profiles usually produced by persons with various kinds of brain injury. Neuropsychological examination also differentiates emotional and personality changes from trauma-induced changes (such as depression from organic brain dysfunction).

## **9. Do neurologists or neurosurgeons perform neuropsychological tests?**

No. Only specifically trained psychologists who specialize in neuropsychology (the study of brain and behavior relationships) are qualified to administer and interpret neuropsychological tests. Neurologists and neurosurgeons often administer a variety of mental status procedures but these are neither standardized nor sensitive enough to detect subtle dysfunction (especially of *mild* traumatic brain injury) that can be revealed on objective neuropsychological tests. Neurologists, neurosurgeons, and neuropsychiatrists are medical doctors who rely on physical procedures and trained observation for diagnosis, and medical/surgical techniques for treatment. Neuropsychologists are clinical psychologists who, through the use of standardized *behavioral* assessments, seek to understand the complex interactions of psychological and biological components that produce dysfunctional behavior.

## **10. Can a neuropsychological examination differentiate acquired from pre-existing problems, and differentiate which behavior or thinking problems are related to brain injury and which are not?**

Yes. Some neuropsychological tests are developed to be sensitive to changes caused by brain injury. Other tests are administered that are specifically *not* sensitive to brain injury. Comparing results from both types of tests helps define whether brain injury has occurred or not. Similarly, some procedures differentiate pre-existing emotional and personality characteristics that existed before the injury. "Differential diagnosis" is the hallmark of a comprehensive neuropsychological examination. The neuropsychologist sorts out the pre-existing emotional and psychological factors from the acquired changes due directly to brain injury.



### **11. Why is it possible for the same apparent level of brain injury in two different persons to produce very different degrees of outcome?**

Just as no two people are alike, no two brains are alike. Brain injury manifests itself depending on a host of factors such as intellectual capacity, physical health, age, emotional stability or instability, attitudes toward illness and health, concurrent (non-brain) injuries, quality of immediate medical attention following an injury, psychological adjustment or maladjustment, and dozens of other factors. Also, just as the kinds and amount of physical injury (broken bones, soft tissue contusions, or lacerations) vary among individuals involved in accidents, so do the amount and kind of head rotation, impact speed, and other factors that determine the degree of injury.

### **12. What effect does pain have on the determination of whether the injured person's problems are caused by brain injury?**

Pain often accompanies traumatic brain injury due to head and neck soft tissue injury, cervical strain, back injuries, and other acquired medical problems. Chronic pain and suffering certainly diminishes one's concentration, focus, and emotional well being. Thus, the potential for pain to influence the assessment of brain injury, especially in mild brain injury, is always a concern. However, research studies have demonstrated the robustness of many neuropsychological tests and documented their ability to differentiate brain dysfunction from non-brain injury conditions such as pain, as well as from depression or anxiety. A comprehensive examination must consider pain and discomfort factors as well as brain injury factors in the overall functional consequences of injury and the potential for recovery.

### **13. How important are medical records to the neuropsychologist?**

Medical records are just as important as the neuropsychological tests themselves in order to achieve a thorough assessment. Records provide the background for understanding the biomechanism of an injury and the evolution of injury characteristics, the quality and outcome of medical and other interventions, pre-existing health characteristics, and other data and independent observations to support or refute interpretations from neuropsychological test results. Educational records can also help establish level of pre-injury mental functioning. While neuropsychological data are extremely important in the whole clinical picture of an injured person, all the data must fit, or "hang together," with the rest of the medical history.

### **14. Is a neuropsychologist legally qualified to determine and render opinions about the *cause* of brain damage and the resulting behavioral and psychological problems?**

Yes. Case law in many jurisdictions across the United States has deemed clinical neuropsychologists, by virtue of their specialized training and experience, qualified as the professional expert of choice to determine the cause or etiology of brain damage and its resulting behavioral and psychological problems.

### **15. Is the neuropsychologist qualified to render impairment ratings?**

Yes. In fact, it is the set of results from objective neuropsychological tests that provides the best foundation for rating functional impairment. If the *AMA Guides to the Evaluation of Permanent Impairment* are used, the nervous system section of the rating guidelines relies on functional consequences of altered mental status, language, consciousness, and behavior—exactly that which is objectively evaluated in the neuropsychological examination.



## **16. How can the neuropsychological examination help to offer an accurate prognosis?**

Neuropsychological status, as well as medical condition, forms the basis for prognosis following a brain injury. Extent of an injury (structurally and functionally), rate of recovery so far, complicating factors such as severe pain and other injuries, emotional and psychological reactions, support (or lack thereof) from family and employers, attitudes in the injured person about health and recovery, potential secondary gains from injury, cognitive and attitudinal strengths, and other factors contribute to the foundation for predicting outcome from brain injury. The comprehensive neuropsychological examination evaluates these areas to help determine the injured person's potential to achieve functional improvement and to identify treatment that will help achieve that improvement. Maximum improvement from mild traumatic brain injury is usually achieved in six to nine months, but can take longer. Maximum improvement from moderate or severe brain injury can take years.

## **17. Can the neuropsychological examination predict real-life functioning on the job and at home, including the ability to drive?**

At least better than any other clinical procedure, yes. How one performs on tests of memory, concentration, mental processing speed, problem-solving flexibility, thoroughness of thinking, and self-monitoring have direct implications for how one will perform on a job. Neuropsychological examination results not only provide this prediction but also establish graduated return-to-work recommendations to help insure success in injury recovery and returning to work, if that is, indeed, possible. Similarly, ability to drive safely can be predicted by one's ability to sustain attention and avoid distractibility, make quick and reflective decisions, and sustain simultaneous thinking about lots of things going on at once.

## **18. What treatment can a neuropsychologist offer a person who has had a traumatic brain injury and how effective is it?**

Neuropsychological treatment of brain injury falls into three areas: (1) teaching how to strengthen weakened skills, (2) teaching compensation strategies to lessen the impact of areas of permanent dysfunction, and (3) teaching positive attitudes and health concepts that encourage both healing and adaptation. Depending on the individual's motivation, these strategies can be very effective in helping reverse some of the effects of brain injury. Some people respond to short-term therapy, others may require months of intensive work.

## **19. Is it possible for a person to fake the results of neuropsychological testing?**

Numerous safeguards are built into the neuropsychological examination to detect attempts to fake test performance. Consistent patterns among test results that correspond to known functional impairments, quality of test motivation and attitude, and known empirical findings that characterize brain injury but not other conditions are all used to evaluate test results for "dissimulation"—faking, malingering, symptom exaggeration, or distortion. Only a person well trained in neuropsychological tests might successfully fake a pattern of results that could be misinterpreted. The examination is too complex and composed in such a manner that producing a coherent and clinically familiar pattern of results indicating damage where none exists would be highly unlikely. A condition known as "conversion reaction" may be seen occasionally where an individual expresses strong psychological disorder in physical and neurological symptoms. Again, an experienced neuropsychologist can differentiate this condition from real, organic brain injury.



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**20. Is it possible for a person to *not* have brain damage and *not* intentionally fake any tests yet still be misdiagnosed as having brain damage?**

It is possible but rare. As long as the pre-injury history (medical, educational, vocational, and psychosocial) is well known, neuropsychological test results can be interpreted quite accurately and within a meaningful context, avoiding "over-diagnosis." The chances for erroneous conclusions are then minimal. Again, data from a variety of sources must "hang together" in order to derive an accurate diagnosis. Prejudgment, missing critical history, or failure to account for pre-existing or reactive psychological factors can lead to misinterpretation of test data. This is why the neuropsychological examination must be comprehensive, leaving no stone unturned when sorting out complex injury and its causes and consequences.

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