

# A HEAD INJURY IS NOT A BRAIN INJURY

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The National Institutes of Health says that approximately 300,000 mild and moderate head injuries are reported each year. They estimate, however, that probably more than 1 million mild head injuries alone actually occur, many of which are not reported.<sup>1</sup> Other studies have placed this figure at over 2 million. A substantial number of these head injuries arise in the workplace or in motor vehicle accidents related to work duties, resulting in a worker's compensation claim. Persistent complaints of mental and emotional disturbance attributed to head injuries can lead to prolonged disability.

That such claims are increasing exponentially is not an overstatement. It has resulted in what is now coined *NeuroLaw*, a field of medical jurisprudence dealing with the legal ramifications of such injuries.<sup>2</sup> Advocates believe that head injuries are unrecognized because of the difficulty in making the diagnosis or due to medical unawareness. They point out that there is now a *silent epidemic* of mild head injuries.

Why would head injuries be increasing in this country? Had they just been overlooked before? Do we have more sophisticated diagnostic methods now? Why would physicians not identify such a potentially serious problem?

The answer to these questions lies in part with the problems in distinguishing head injury from brain injury. These terms are often used synonymously and, therefore, can be misleading. A head injury is not a brain injury. A head injury is just what it says--a traumatic impact to the head which may or may not cause a brain injury. Whether or not there has been a Traumatic Brain Injury (TBI), is often difficult to assess, especially in mild cases which comprise 85 percent of the total. In fact, there may be few reliable diagnostic methods to confirm mild TBI.

Complicating matters further, most people have had one or more head injuries in their lifetime. Seventy-five percent to ninety percent of those will be minor and a physician may never be consulted. Every Sunday in autumn, one can watch professional football players on television taking repeated head beatings yet continuing to play the game unphased. Despite their good physical conditioning, the brain within their skull is just as vulnerable to trauma as the rest of ours. In a 1989 study of football players who experienced one or more mild head injuries, rapid recovery of function and no persistent symptoms was the rule.<sup>3</sup>

This is in sharp contrast to the so-called *silent epidemic*. Today, there is a flurry of claims for very mild or insignificant head injuries to which mental symptoms are attributed. The extent of disability often tends to correlate inversely with the degree of injury. The assumption is that these represent a mild TBI. A brief look at the scientific evidence is necessary to understand this complex and controversial problem.

## HOW THE BRAIN GETS DAMAGED

Injury to the brain can be direct or indirect.<sup>4,5</sup> In direct cases, the brain may be damaged by a missile, such as a bullet or other object, which penetrates the skull and enters brain tissue. There may also be blunt trauma to the head resulting in a skull fracture with bony fragments entering the brain. In the absence of fracture, blunt trauma can still cause brain contusion (bruising) as the somewhat movable brain strikes the inside wall of the skull at the site of

impact. As the brain recoils back, the opposite side can strike bony structures also causing what is known as a *contrecoup* injury.

Brain contusion usually involves some degree of bleeding, known as hemorrhage or hematoma. In some instances the bleeding is limited to tiny spots (petechial hemorrhage) which are difficult to detect. The traumatized brain can also show swelling, blood clotting, and tissue laceration.

Depending on where the damage is, focal or diffuse, neurological function is affected. This can lead to sensory loss, paralysis, alteration of consciousness, coma, and even death. This kind of damage does not usually present much of a diagnostic problem, and is not the controversial issue in TBI.

Indirect head injury, on the other hand, can present more of a diagnostic challenge. These are situations in which there is no missile or blunt trauma to the head, but the slightly movable brain is jostled by sudden or violent movement of the head. A common example of this is the rapid and repeated shaking of babies which leads to brain injury or death. In some experimental studies, animals were subjected to rapid acceleration/deceleration or rotational forces, and demonstrated brain damage on pathological analysis.<sup>6</sup> Specifically, long nerve filaments called *axons* appeared to have undergone a shearing effect (*axonal shearing*).<sup>7</sup> Of course, such experiments are not possible with humans, but proponents frequently use the theory of axonal shearing to explain alleged mild TBI in motor vehicle accidents where there has been no direct head injury or very minor head injury. Unless it is accompanied by evidence of hemorrhage, axonal shearing cannot be clearly documented in living humans through diagnostic studies. Also, the conclusions from these animal experiments to explain mild TBI in humans may not be wholly applicable, since the forces employed were far greater than is typically seen in low-impact head injuries.<sup>8</sup>

## FINDING THE DAMAGE

The diagnosis of TBI following a head injury is often made at the scene of the accident or shortly thereafter by looking for characteristic signs of brain insult. These can include an altered state of consciousness, seizures, impaired responsiveness, and focal neurological abnormalities on physical examination. The Glasgow Coma Scale is commonly used as a quantitative measure of the injured person's level of consciousness.<sup>9</sup> Scoring is on a 15 point scale divided into three categories: eye-opening response, verbal response, and motor response. The higher the score, the less impaired. Ambulance attendants and emergency department physicians will rate the injured person and monitor for improvement or worsening of the score with time. These scores have also been shown to have a predictive value for long-term impairment from a TBI. For example, individuals with scores of 8 or higher will not have long-term impairment in the majority of cases. Most of the mild TBIs in controversy have scores of 13 to 15.<sup>10</sup>

Other diagnostic studies for TBI include, as a minimum, a skull x-ray to determine whether or not there has been a skull fracture or penetration. A brain wave study or electroencephalogram (EEG) is also used to show a slowing pattern or focal abnormalities that are suggestive of TBI. However, these may be nonspecific findings or may represent a pre-existing abnormality. CT and MRI scans of the brain will usually identify bleeding and other structural abnormalities, but may be less useful for microscopic changes. More sophisticated radiographic studies such as positron emission tomography (PET) and signal positron emission

tomography (SPECT) scans, which provide functional imaging, have shown interesting use on a research level but are not reliable for diagnosing TBI.<sup>11</sup>

When these diagnostic studies have demonstrated abnormality consistent with TBI, there is usually little debate. There may be differing opinions on the prognosis and long-term impact, but at least the presence of TBI is established. The difficulty really comes in the majority of alleged mild TBI cases where everything is normal. In those instances, the diagnosis is often made on the basis of symptoms alone.

## **WHAT ARE THE SYMPTOMS?**

A shock or insult to the brain in which there is no *contusion*, is known as a *concussion*. The hallmark of a concussion is loss of consciousness (LOC), or at least dazed consciousness, coupled with posttraumatic amnesia (PTA). The amnesia can also be for events prior to the head injury as well as after. Mild TBI is usually defined as LOC for less than 20 minutes and PTA for less than 24 hours. A great many individuals with alleged mild TBI, however, describe little or no LOC and no PTA.

Following a concussion, individuals often describe a number of mental, physical, and behavioral symptoms, which in varied combination are referred to as Postconcussion Syndrome (PCS). It is estimated that 50 percent of individuals who have had a concussion will develop some degree of PCS. A PCS is considered evidence of mild TBI.

The type of complaints described in PCS are:<sup>12,13</sup>

### **MENTAL DISTURBANCES:**

- Attention
- Memory
- Speed of information processing
- Speech/language
- Mental Organization
- Perception
- Task efficiency
- Executive functions
- Word-finding
- Concentration

### **PHYSICAL SYMPTOMS:**

- Headache
- Sleep disturbance
- Fatigue
- Lack of energy
- Nausea
- Dizziness
- Ringing in the ears
- Blurred vision
- Photophobia

### **BEHAVIORAL CHANGES:**

- Irritability
- Angry outbursts
- Rapidly changeable mood
- Disinhibition
- Poor social judgement
- Anxiety
- Depression

Again, individuals may have a number of complaints from each category. No specific number or combination is necessary for the diagnosis of PCS. Adding to the difficulty of diagnosis are the results of studies which suggest that many of the symptoms reported as PCS are common among the general population and not related to a head injury.<sup>14</sup> Furthermore, the types of complaints that are likely to be part of PCS are commonly known to the general public. In one study, a group of subjects, who did not have personal experience or knowledge of head injury, were asked to select from a list of symptoms which they would expect to have. They chose a cluster virtually identical to PCS.<sup>15</sup>

Most of the time, a PCS is presumed when complaints follow a head injury and are said not to have existed before. But, people are not always reliable in how they reconstruct historical accounts. They may, for example, have forgotten having similar symptoms prior to the head injury, or erroneously may attribute new symptoms to the head injury when something else was responsible. In one study of personal injury claimants who did not have any direct or indirect head injury, there were high rates of complaints which are commonly associated with PCS or mild TBI: anxiety (93 percent), sleep disturbance (89 percent), depression (88 percent), headaches (79 percent), fatigue (78 percent), poor concentration (77 percent), irritability (65 percent), feeling disorganized (61 percent), confusion (59 percent), loss of task efficiency (56 percent), memory problems (53 percent), dizziness (44 percent), and word-finding problems (34 percent).<sup>16</sup> Therefore, while the complaints typically associated with mild TBI may be important in the diagnosis, they are not conclusive.

## **NEUROPSYCHOLOGICAL TESTS**

The increase in presumed diagnosis of mild TBI has been fueled to a great extent by the use of neuropsychological tests. These tests, often administered by well-trained professionals, attempt to provide a more objective means of measuring brain dysfunction and thereby help in the diagnosis of TBI. Since symptom history and diagnostic measures may not be conclusive, it is easy to understand why these neuropsychological tests would be attractive if accurate. Indeed, they offer more objectivity than plain observations, since the tests present tasks in a controlled and standardized format. There are dozens of different neuropsychological tests and many different test batteries. Broadly speaking, they are divided into the following categories:<sup>17</sup>

- General intellectual functioning (IQ)
- Attention and concentration
- Learning and memory
- Executive and problem-solving skills
- Language
- Visuospatial/visuoconstructional tasks
- Sensory-perceptual and motor functioning
- Emotional/psychological functioning

There are also tests for motivation and effort in the testing process, some of which are used to identify malingering. For example, tests may be administered which appear complicated but

in fact are quite simple and should be performed easily even by brain-injured people. If a great many errors are made or the results are worse than chance, the individual may be attempting to appear impaired. Other than in extreme cases, however, malingering may be difficult to diagnose, and the most that can be said is that the individual was exaggerating. Sometimes this is deliberate and sometimes this is for psychological reasons.

On questionnaire-type of tests such as the Minnesota Multiphasic Personality Inventory-2 (MMPI-2), if individuals endorse an unusually large number of symptoms, exaggeration can also be inferred. Often when individuals perform well on some tests and poorly on others, it is concluded that they must have been exercising good effort, so that the areas of poor performance must represent brain dysfunction. The difficulty with this analysis is that some individuals may not be exaggerating overall, but may see themselves with a particular impairment. They then perform accordingly, i.e. if you see yourself as impaired in some particular way, that is the way you will perform poorly. The perception, however, may be based on an erroneous preconceived assumption of brain injury.

The most important thing to note about neuropsychological tests is that they only measure behavior, they do not measure the source of that behavior. In that sense, they are merely enhanced plain observations. They are unlike a skull x-ray, EEG, or CT and MRI scans which measure the pathological source of a behavioral problem directly, i.e. the brain. Neuropsychological tests may have been developed to be reliable (consistently yield similar results across time or examiners) and valid (accurately measure what they intend to measure), but they cannot make the diagnosis of TBI. The most they can say is how well or poorly a person behaves across various parameters. At times, that might be because of brain dysfunction from TBI, but it might also be from other factors. Neuropsychological test results are merely a hypothesis.

In spite of their scientific and sophisticated appearance, neuropsychological tests present elementary tasks. Typical tasks include: connecting circles with numbers in their proper sequence, or circles and letters in alternating proper sequence; repeating from a list of words as many as can be remembered; repeating as much of a story as can be remembered; assembling blocks into a particular design; copying a figure; placing cards into proper categories; repeating a string of numbers; or doing arithmetic problems, just to name a few. All tests are measured on the basis of accuracy or speed. It is easy to see, therefore, that poor performance only means that a person did not do well, not necessarily that they could not do well.<sup>18</sup>

Although many neuropsychologists understand that their tests are only a tool which helps measure behavior and can only provide a hypothesis regarding TBI, others overreach and assert a diagnosis from the results of the tests. Some common pitfalls in neuropsychological evaluations are:

1. Over-reliance on tests alone
2. No detailed patient history
3. Assumption that history provided is accurate
4. No outside or collateral information
5. No tests to measure malingering or exaggeration

6. No consideration of alternative explanations for poor performance
7. Hypertechnical scoring and explanations
8. Equating poor performance with TBI

**-12-**

Neuropsychological tests may have a benefit in the diagnostic evaluation of TBI but they are more limited than is realized. For example, they do not have much value in the evaluation of moderate-to-severe TBI, because other diagnostic methods, such as CT and MRI scans, are more accurate. In alleged subtle or mild cases, accuracy of identification of TBI by neuropsychological tests is low--some studies indicate that it is no more than chance.<sup>19</sup> There are few good studies to demonstrate the accuracy of neuropsychological tests in subtle or mild TBI cases, because there may be no other means to document that there was a TBI. It stands to reason, you cannot measure your own accuracy if your own measures are the only means of comparison. Interestingly, the judgement of even experienced neuropsychologists has been challenged in some studies and, surprisingly, the results indicate that there is more inaccuracy with more experience. Finally, even if the neuropsychological tests accurately measure test functioning problems, this does not necessarily translate to every day life-functioning. The two may be very different. Once TBI has been diagnosed, however, neuropsychological tests can be a valuable means of measuring progress in rehabilitation.

Neuropsychological tests have been overvalued in part because of their hypertechnical presentation which gives the appearance of scientific precision. The average physician who uses those tests in order to help make the diagnosis of mild TBI, seldom can decipher what is being said, and may blindly accept their accuracy. The conclusions in test reports often include seemingly sophisticated identification of specific brain regions which are affected. However, studies show that lateralization or localization based on neuropsychological tests is not that accurate. Given the immense complexity of the human brain, these distinctions may be of very limited usefulness. It has been shown that individuals who have suffered brain injury in virtually identical areas, often demonstrate widely varying effects which are greatly modified by pre-existing and unrelated factors.<sup>20,21</sup>

### **WHAT ELSE IS GOING ON?**

Alternative reasons for symptoms that resemble mild TBI and for poor performance on neuropsychological tests can be divided into six categories: *deliberate distortion, lack of energy, inattention, secondary financial gain, psychiatric disturbance, and sociocultural factors* (see Table). Individuals who are apathetic, asocial, hostile, or paranoid may not cooperate fully with the testing process. Others may intentionally exaggerate impairment for some specific gain. These malingerers are often not easily detected.<sup>22</sup> As was discussed above, faking impairment may not be that difficult. In one study, children were instructed to "fake bad" on comprehensive neuropsychological testing with minimal guidance on how to do it.<sup>23</sup> Of 42 clinical neuropsychologists who reviewed these cases, 93 percent diagnosed abnormality, 87 percent of those said it was because of brain dysfunction; no clinician detected malingering. When specific tests for malingering or exaggeration are not administered, the likelihood of missing deliberate distortion is even higher.

Some people perform poorly on neuropsychological tests because they lack mental energy. They often say that they cannot think right. Many of them may be depleted due to physical illness unrelated to any head injury. Depression too can result in a lack of mental energy,

sluggish thinking, and poor performance on neuropsychological tests. Being preoccupied with headache or other bodily pain is known to affect performance on neuropsychological tests. In a review of whiplash injuries, it was noted that the presence of headache, rather than any other factor, correlated with impaired mental functioning.<sup>24</sup> Since most people who claim to have mild TBI complain of headache, this independent variable should be suspect.

Inattention and concentration difficulties are associated with TBI, but also occur with many other conditions. Anxiety states are notorious for creating preoccupation and distractibility. In addition, pre-existing attentional problems e.g. Attention Deficit Hyperactivity Disorder (ADHD) or Learning Disabilities (LD), can represent a lifetime of subtle impairment which may or may not have previously been identified.

One of the most common factors in worker's compensation claims of TBI is that of secondary financial gain through disability payments. Although some researchers believe that this potential is overemphasized, there are many reports of the role that litigation and financial compensation play in causing or continuing symptoms of mild TBI. One meta-analytic review concluded that mild closed-head injury typically has a good outcome, and severe mental deficits many months after such an injury, in the setting of financial incentives for illness behavior, raise the strong possibility of malingering or other nonphysical explanations.<sup>25</sup>

Psychiatric disturbance of many kinds can create mental deficits, memory impairment, slowed thinking, or other complaints typically associated with mild TBI. As indicated above, both depression and anxiety can at times do this. Posttraumatic stress symptoms, with a strong anxiety component, can also interfere with attention and lead to concentration problems. Finally, somatoform disorders, i.e. physical symptoms based on psychological factors, often occur when a psychological conflict exists for which an individual has no adequate solution. The opportunity of dropping out into a disabled role may occur as an unconscious mechanism to resolve that conflict. Sometimes it is just a response of an individual to the wear and tear of life--someone who may have had poor resources to continue the struggle. A head injury can serve as a face saving opportunity to escape that struggle.

Sociocultural factors also affect neuropsychological test performance. Congenital intellectual deficits, low socioeconomic status, or cultural differences, need to be taken into account. At times, neuropsychologists will estimate premorbid intelligence or capacities, when no earlier tests had been administered. To date, there is no well-validated and accurate method of doing so.<sup>26</sup> Yet, this is often used to assert that performance has declined because of mild TBI.

### **HOW LONG DOES IT LAST?**

If the bad news is that we have difficulty in accurately making the diagnosis of mild TBI, the good news is that the condition gets better. In mild TBI of up to 20 minutes LOC and 24 hours PTA, the vast majority improve within one to three months.<sup>27</sup> By then, controlled studies have shown that neuropsychological test results are almost indistinguishable from normals. By the end of a year, all should have recovered except where psychological or social factors are operative. Even in moderate-to-severe TBI, complete recovery occurs in the majority of cases within 18 to 24 months. Therefore, in spite of persistent complaints years after a mild TBI, there is little objective scientific evidence to substantiate them. Where an individual has no neurological complications, no abnormality on diagnostic tests, no loss of consciousness, no amnesia and was not even dazed, the likelihood of temporary deficits is minimal, much less persistent ones.<sup>28</sup> It is interesting to note that World War II veterans who sustained severe penetrating head injuries with direct damage to brain matter, were found to have an astonishing ability to recover and most had no measurable impairment in everyday

functioning.<sup>29</sup> Similarly, it is a curious observation that some of the more dramatic mental and behavioral symptoms reported as part of mild TBI in adults are not seen in children.<sup>30</sup> Therefore, prolonged complaints and disability should be viewed suspiciously.

### **MORE COMPLICATED THAN MEETS THE EYE**

In spite of the controversy of mild TBI, both sides will agree that complex factors are involved, not just the physical results of brain injury. Persistent complaints are said to be due to a combination of personality factors on which the brain injury exerts a peculiar effect, coupled with a psychological reaction to being injured that aggravates the condition.<sup>31</sup> It is certainly true that even a subtle impairment could be devastating to some individuals and not everyone copes with this type of setback the same. Secondary depression and anxiety could impair performance beyond that of the brain injury alone. One author describes this as a *shaken sense of self*.<sup>32</sup>

However, there is no reason why that dynamic should be occurring in disproportionately increasing numbers today in comparison to previous times. Similarly, if the effects of brain damage in mild TBI should have resolved in one to three months, then there is no reason for a persistent psychological reaction, since there should be relief that one is no longer impaired. Also, it is unlikely that such a psychological reaction would result in a chronic disability when the actual brain damage has been minimal or nonexistent.

It is more likely that the *silent epidemic* is a cultural phenomenon, much like a wave of other medical illnesses and syndromes today that have no identifiable medical pathology. Historical analysis will show that psychological illnesses masquerading as physical ones have taken different forms in different eras.<sup>33,34</sup> Hysterical paralysis of the previous century, for example, has given way to modern illnesses such as Chronic Fatigue Syndrome, Environmental Sensitivity, and Chronic Pain--all of which, by the way, have associated mental disturbances similar to that in TBI. It is unfortunate that an industry of rehabilitation is being built on shaky premises and inadvertently reinforces this psychological condition. This does not mean to say that there are not legitimate cases of mild TBI, some small number of which may even have persistent symptoms, but those legitimate cases must be diagnosed with accurate and reliable methods, and with close attention to the psychological history of the individual.