Physiology of a Concussion

A concussion is a traumatic brain injury (TBI) that is caused by something hitting the head, or another injury that shakes the brain inside the skull. The brain has a layer of spinal fluid around it to aid with movement and the skull houses the brain and is also used for protection. At times, this is not enough protection for the brain when it is shaken or moved violently, causing it to hit the hard skull. The brain then bounces off one side of the skull and impacts the opposite side. With this action, the brain is impacted on two different sides causing further damage. The force of the brain hitting the skull produces contusions (bruises) in the brain. Nerve cells inside the head are damaged and no longer able to send signals to other regions of the brain or throughout the body. The body uses cerebral blood flow found in the spinal column to transport nutrients and energy to the brain. A concussion slows cerebral blood flow, making it difficult for the brain to repair injured areas and return to a stable state without sufficient blood supply. These changes temporarily alter the autonomic nervous system and circadian rhythm (sleep cycle). Once a concussion occurs, the person may experience a wide range of symptoms that are classified into 4 categories: physical, cognitive, emotional and sleep-related (see figure 1).

Figure 1
Concussion Symptoms:

Physical
- Headache
- Dizziness, nausea and vomiting.
- Trouble with balance and coordination
- Blurred vision

Cognitive
- Dazed and confused
- Difficulty concentrating, thinking or making decisions
- Trouble remembering things right before or after concussion
- Slurred speech

Emotional
- Feeling anxious or irritable
- Feeling sad or more emotional than usual

Sleep-related
- Sleepiness or difficulty falling asleep
- Sleeping more or less than usual
Reporting and Limiting Concussions

The US reported 3.8 million concussions in 2012, which is double what was reported in 2002. The abrupt increase is mostly due to the fact that concussions are now closely observed and more likely to be diagnosed. Coaches, at times, ignore concussion-like symptoms because they encourage their athletes to be tough. Minor symptoms such as being dazed and mental abnormalities lasting less than 15 minutes are often not reported. These symptoms can be classified as a concussion. Athletes also want to stay in games and practices to maintain a certain toughness about themselves. This social belief endangers the athletes and can lead to threatening long-term effects. It is very important to be cautious when dealing with head injuries and making sure the injured individual sits out until he or she is cleared by a trained medical professional.

The likeliness of a concussion increases when participating in high-risk activities. Young children have the highest rate of concussions with most cases occurring from bike riding and playing sports. For adolescent males, football has the highest risk for a concussion at 75%. For adolescent females, soccer has the highest risk for a concussion at 50%. There is almost a 20% chance of a high school athlete experiencing a concussion every season. Concussions also take place in different settings outside of sports. For adults, motor vehicle accidents lead the way for concussions because they experience different high-risk environments than adolescents.

Having proper technique and safety equipment is crucial in limiting the occurrences of concussions. It is important for coaches to teach their players proper techniques and it is each player’s responsibility to practice these techniques until they become second nature. Even though concussions cannot be completely eliminated, taking proactive steps can drastically minimize these incidents. Athletes and everyone in general should take baseline tests to help diagnose and evaluate concussions. Jacksonville Orthopaedic Institute offers ImPACT Testing (see figure 3) to evaluate attention span, working memory, sustained and sustained attention time, response

Concussion Statistics:
- 15.8% of football players that lost consciousness after sustaining a concussion return to play the same day.
- High school athletes who have been concussed are 3 times more likely to sustain another concussion in the same season.
- 47% of all reported concussions occur during high school football.
- 33% of concussions happen during practice.
- Nearly 5.3 million Americans live with a traumatic brain injury-related disability.
variability, non-verbal problem solving and reaction time. Baseline tests provide information on the individual’s mental performance before a concussion occurs. If a concussion occurs and the test is readministered, comparisons can be made in mental performance. Then, it can be determined if the individual who has experienced the concussion is ready to return to normal activities.

**Return to Play**

If a concussion does occur, it is important to sit out from the activity in which the injury took place. Neglecting to do so can lead to even worse traumatic brain injuries and other injuries throughout the body due to a decrease in coordination, attention and balance. Once the concussion takes place, the injured individual should seek professional help right away. Usually, certified athletic trainers (ATC) will evaluate athletes during games and practices. If an ATC is unavailable, a doctor should be seen right away. When a concussion is evaluated on the sidelines, an ATC will typically use a concussion test similar to the one shown in figure 4. The concussed individual and their recovery progress should be closely monitored, especially the first 48-72 hours after the injury occurs. They have to be symptom free in order to safely return. While healing, nerve cells in the brain are repaired, but if the individual returns too quickly, the cells may not recover and cell death will take place. If the brain shows swelling or any abnormalities, the individual may need to sit out for the rest of the season or an extended period of time. There may be other factors that cause recovery times to differ. Having a history of previous concussions will commonly delay recovery time. Also, psychological issues such as migraines, depression, anxiety, mood disorder and developmental disorders affect recovery time. If symptoms continue to worsen or if the individual does not seem to be progressing, they should immediately seek professional help.
Aging Effects

One of the biggest issues following a concussion is Second Impact Syndrome (SIS), which is the occurrence of another concussion while symptoms from a previous concussion are still present. The body is unable to regulate the stresses of multiple concussions and brain edema (swelling) becomes difficult to control. Even though SIS is rare, 50% of the cases have shown to be fatal. With this in mind, it is important to take the safe approach when deciding if someone is ready to return from a concussion. Everyone is different and recovers from a concussion at a different pace. All tools should be used to decide if it is safe to return. Even if psychological tests show that the individual is safe to return, physical tests focusing on vision and movement may still classify the individual as unsafe to return.

Multiple concussions that occur after symptoms of a previous concussion disappear are referred to as repetitive head injury syndrome. With each concussion, the body loses its ability to repair injured areas. This leads to longer recovery times and stronger symptoms. Studies have shown that individuals with multiple concussions have a higher chance for brain related illnesses later in life such as Alzheimer disease, dementia and depression. If one does experience multiple concussions changes have to be made in order to avoid future injuries. It may require additional protective equipment, changing positions in a sport, or stopping the activity all together. Currently, there is little research on the changes that take place later on in life after a concussion. It is best to take a safe approach when preventing, treating and recovering from concussions.

Call JOI today to schedule your concussion assessment

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References:


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