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 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, which is also used as a source of protection for the brain. 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 experience damages and are no longer able to send signals to different regions of the brain or throughout the body. The body tries to repair the injured areas of the brain, but has to do so with limited energy, which is provided by cerebral blood flow. The brain’s high demand for energy combined with the decline of cerebral blood flow makes it difficult for the brain to return to a stable state. 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 (figure 1). Not all individuals that experience

**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
a concussion lose consciousness; this actually occurs less than 10% of the time. In most cases, the person will feel dazed and confused.

**Reporting and Limiting Concussions**

In 2012 the US reported 3.8 million concussions. This number is double from 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 ignore concussion-like symptoms because they encourage their athletes to be tough, especially minor symptoms such as being dazed and mental abnormalities lasting less than 15 minutes are not reported. These symptoms are in fact classified under a grade 1 concussion. Athletes also want to stay in the games and practices to maintain a certain toughness about them. 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 professional.

The likeliness of a concussion occurring 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 an athlete experiencing a concussion every season. Concussions also take place in different settings outside of sports. Adults experience much different high-risk environments; therefore, motor vehicle accidents lead the way for concussions in adults.

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 the player’s responsibilities to practice these techniques until they are second nature to them. Even though concussions cannot be completely eliminated, taking proactive steps can drastically minimize these incidents. Athletes and everyone in

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**Figure 2**

**Grading Concussions:**

**Grade 1:**
- Individual exhibits confusion.
- No loss of consciousness.
- Abnormalities and concussion symptoms last LESS than 15 min.

**Grade 2:**
- Individual exhibits confusion.
- No loss of consciousness.
- Abnormalities and concussion symptoms last MORE than 15 min.

**Grade 3:**
- Any loss of consciousness.
general should take baseline tests to help diagnose and evaluate concussions. Jacksonville Orthopaedic Institute offers ImPACT Testing (figure 4) to evaluate attention span, working memory, sustained and selective attention time, response variability, non-verbal problem solving and reaction time. Baseline tests provide information on the individual’s mental performance before a concussion occurs. This way if a concussion occurs and the test is taken again, comparisons can be made in mental performance. Then, it can be determined if the individual that 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. Neglecting to do so can lead to even worse traumatic brain injuries and other injuries throughout the body because there is a loss in coordination, attention and balance. Once the concussion takes place, the injured individual should seek professional help right away. Usually athletic trainers will evaluate athletes during games and practices. If trainers are unavailable, a doctor should be seen right away. When a concussion is evaluated on the sidelines, a trainer will typically use the concussion test shown in figure 3. The only way to return to an activity after sustaining a concussion is for it to be classified as a grade 1 and a sideline test is passed. If a second grade 1 concussion occurs in the same event, the individual needs to sit out until they show no symptoms at rest or exercise for at least a week. Nerve cells in the brain are repaired after being injured, but if the individual returns to play too quickly, the cells may never recover and cell death will take place. If a grade 2 concussion occurs, the individual needs to be symptom free for a week before being able to return. A second grade 2 concussion requires at least 2 weeks without symptoms before being able to return. However, if the brain shows swelling or any abnormalities, the individual may need to sit out the rest of the season or an extended period of time.
If a grade 3 occurs and consciousness is not gained, the individual needs to have emergency care. Otherwise a grade 3 concussion where consciousness is lost for a few seconds requires one week of being symptom free before being able to return. Losing consciousness for a few minutes requires two weeks of being symptom free before being able to return. Having a second grade 3 concussion requires the individual to sit out for at least a month. It is important to closely observe the concussed individual the first 48-72 hours after the incident occurs. If symptoms worsen or 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, cases of it 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 altogether. 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 concussions.

References:

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