

Concussions: Keep Your Head in the Game

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Concussions are a mild traumatic brain injury (TBI) which causes bruising or swelling of the brain due to a forceful impact of some kind. When this impact occurs, there is a pathophysiological disruption to the brain which interferes with normal functioning of the brain.

The U.S Centers for Disease Control and Prevention estimates that “1.6 million to 3.8 million concussions occur in the United States each year.”¹

The human nervous system is regulated by the human brain where it is constantly receiving signals to control all the functions of our entire body. The brain, the most important and complex organ in our body, is located within the skull and is suspended there by cerebrospinal fluid to aid in protection from injury. There are different compartments to the brain consisting of the forebrain, midbrain and hindbrain and is then subdivided into four lobes. The largest part of the brain is called the forebrain which contains the cerebral cortex. The cerebral cortex is the outermost portion and processes our emotions, thoughts, memory, language, consciousness and reasoning. The brain contains four lobes known as the frontal, temporal, parietal and occipital lobes (Figure 1). The frontal lobe is located toward the front of the brain and is responsible for our emotion, personality, concentration, language/ability to speak, reasoning, planning and coordination of movements. The temporal lobe is located near the temples or along the side of the head and is responsible for our hearing/sound, speech comprehension and memory. The parietal lobe is located right behind the frontal lobe and is responsible for processing information from the body’s senses such as touch, taste, pain and temperature. It is also important for navigation and spatial orientation. The occipital lobe is located toward the back of the brain and is responsible for our primary visual cortex which relays visual information from the eyes to the brain and helps with color, light perception and movement.

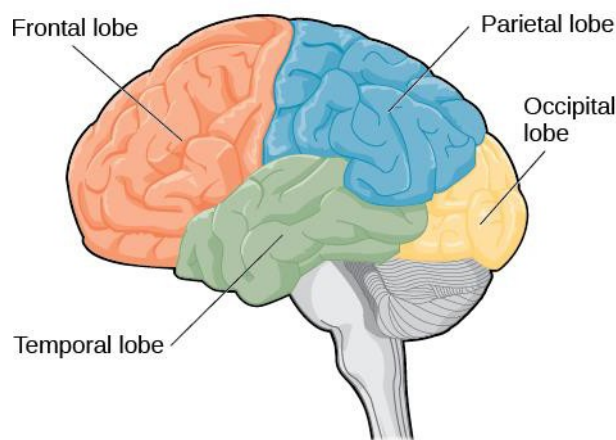


Figure 1.

The brain is also divided into two halves known as left and right hemispheres and both are used simultaneously. Each hemisphere is connected by a bundle of nerve fibers called the corpus callosum. Each hemisphere controls the opposite part of the body, so the left brain controls the right side of the body and vice versa. The left side of the brain plays a role in language, speech, writing and arithmetic whereas the right side of the brain plays a role in vision and auditory processing, spatial skills and creativity such as artistic/music ability.

The brain communicates with the rest of the body through the spinal cord as well as 12 pairs of cranial nerves that arise from the brainstem (Table 1). The brainstem (Figure 2) consists of the medulla oblongata, pons and midbrain. This area is very important in relaying information to the body and the brain helps supply cranial nerves to the head and face, as well as controls breathing, heart rate and most importantly, consciousness. Each cranial nerve controls a different part of the body. The cerebrum consists of cranial nerves I and II. The midbrain consists of cranial nerves III and IV. The pons consists of cranial nerves V, VI, VII and VIII. The medulla oblongata consists of cranial nerves IX, X, XI and XII.

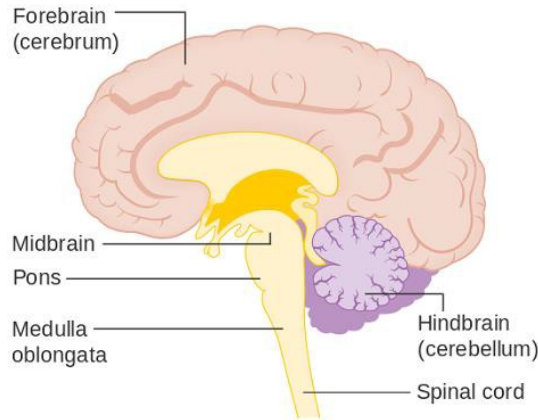


Figure 2.

Table 1.

Number	Name	Function
I	Olfactory	Smell
II	Optic	Sight
III	Oculomotor	Eye movement, pupil constriction
IV	Trochlear	Eye movement
V	Trigeminal	Facial sensation, chewing
VI	Abducens	Eye movement
VII	Facial	Facial expression, taste
VIII	Vestibulocochlear	Hearing, balance
IX	Glossopharyngeal	Taste, swallow, saliva secretion
X	Vagus	Heart rate, digestion
XI	Accessory	Head and neck movement
XII	Hypoglossal	Tongue movement

Concussions occur mostly because of motor vehicle accidents and falls, and among military population and during athletic or recreational competition such as football, soccer, cheerleading and wrestling.

Children and elderly individuals are more prone to injury and also take longer to recover. When someone suffers a TBI, it can result in emotional, physical, cognitive or sleep impairments.

1. Emotional:

- Sadness
- Nervousness
- Irritability
- More emotional

2. Physical:

- Headaches
- Nausea/vomiting
- Balance problems
- Numbness/tingling
- Visual problems
- Dizziness
- Dazed or stunned
- Sensitivity to light/noise

3. Cognitive:

- Difficulty concentrating/remembering
- Repeat questions
- Forgetful of recent information
- Confused about recent events
- Answers questions slowly
- Feeling mentally slowed down
- Feeling mentally foggy

4. Sleep:

- Sleep more or less than usual
- Trouble falling asleep
- Drowsiness

“Up to 90% of TBI patients experience at least one oculomotor dysfunction (e.g., tracking or scanning), and up to 40% have visual dysfunctions (e.g., eye teaming, focusing, scanning, or eye movements) persisting beyond 3 months.”² There is a high prevalence in the TBI population of “convergence insufficiency (30%), deficits of saccades (19.6%) and deficits of accommodation (21.7%).”³ Whenever the visual skill that requires us to focus gets affected, it will lead to difficulty keeping reading material in focus and will experience intermittent or constant blur which will lead to trouble in the classroom or work-related activities.

Symptoms typically resolve on their own between one to 14 days after a concussion occurs. Those that continue past one to two weeks are termed post-trauma vision syndrome.

These patients typically experience headaches, light sensitivity, contrast sensitivity issues, motion sensitivity, dizziness, double vision, depth perception issues, eye tracking trouble, trouble with looking at screens or scrolling through tablets or phones, and losing place while reading, etc. Returning back to play or back to the classroom is the critical question. If one returns to play too early, it can lead to second impact syndrome, which is a second concussion when the first one has not yet fully healed. If this occurs, it can result in severe brain damage and/or death. Follow these guidelines when it comes for return to play (Table 2). Each step is done daily, so to complete the entire protocol would take a full week or seven days. An individual needs to be symptom free for 24 hours to begin the next stage, so if at any point, the recurrence of any symptoms occurs, then one must return back to stage one and repeat the whole process over again until each stage is completed symptom-free. There is no same day return to play after someone suffers a concussion.

Table 2.

Rehabilitation Stage	Functional Exercise at Each Stage of Rehabilitation	Objective of Each Stage
1. No activity	Complete physical and cognitive rest. No screens.	Recovery
2. Light aerobic exercise	Walking, swimming or stationary cycling, No resistance training	Increase HR
3. Sport-specific exercise	Running drills, No head impact activities	Add movement
4. Non-contact training drills	Progression to more complex training drills (ex: passing drills). May start progressive resistance training	Exercise, coordination and cognitive load
5. Full contact practice	Follow medical clearance participate in normal contact training activities	Restore confidence and assess functional skills by coaching staff
6. Return to play	Normal game play	Player rehabilitated

To help assess and manage concussion from a post-concussion, ImPACT testing is used. It is a U.S. Food and Drug Administration-cleared medical device used before a concussion occurs for baseline testing and then repeated after a concussion occurs to check for any differences. ImPACT checks for visual perceptual problems such as visual recognition memory, visual attention span, visual working memory, visual processing speed, visual reaction time, design discrimination, selective attention time and non-verbal problem-solving. However, it does not check the overall visual system in regards to blurry vision, eyestrain, headaches, double vision and/or any reading

difficulties, so it is important to seek an optometrist specializing in vision therapy/binocular vision or a neuro-optometrist/ophthalmologist. Another protocol to use for athletes of all ages is the King-Devick Test, which is undertaken on the sidelines of athletic competitions or in an optometric settings. “Requiring saccades, attention, and visual interpretation, the test can evaluate functioning of the brainstem, cerebellum, and cerebral cortex.”⁴

Treatment options for post-concussion patients will vary for each and every individual because no two brains are alike and will result with different visual complaints. After the problem is finally diagnosed, some options to help successfully decrease or eliminate visual complaints can include just a simple small change to their current glasses prescription which can improve visual function. Other types of corrective lenses can be used such as yoked prism lenses, which helps align two images for people with posture and balance issues and also for those suffering from double vision. Tints such as sunglasses or by adding a 40% blue tint on prescription glasses as well as an anti-reflective coating are very helpful for patients who are light sensitive when they are outdoors or have trouble viewing or scrolling on electronic devices.

Also, changing the brightness and contrast levels on monitors helps with these symptoms. Concussive patients tend to be using some sort of medications that can cause dry eye symptoms, so it is important to evaluate the tear film and prescribe an eye drop to help remedy this. Vision therapy is very helpful where many different visual exercises are done with devices and computer programs to help improve focusing, coordination, oculomotor control and eye teaming. There are also phototherapy programs such as syntonometric optometry or light therapy, which is the use of specific frequencies of visible light that are projected in the eyes in order to enhance visual information processing and visual efficiency.

A recent study found that “56% of concussions are diagnosed in the emergency room, with another 29% diagnosed in a physician’s office.”⁵ It truly takes a team to rehabilitate an individual back to symptom free and perform to their optimal level after someone suffers a concussion. This team includes neurologists, optometrists, vision therapists, ophthalmologists, physical therapists, occupational therapists, speech therapists and psychologists. Concussions are very serious and should not be taken lightly. It is always best to report them when they occur or experience symptoms in order to recover fully and get back out on the playing field.

References:

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