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## The Five Pillars of Concussion

by Carol L. Henricks

**A** concussion has a unique clinical presentation and can be difficult to diagnose. Many different kinds of injuries may cause a concussion, including assaults, blasts, falls, car accidents and other accidents. It is important to know if you have had a brain injury such as a concussion versus an emotional reaction to your circumstances.

Concussion causes primarily diffuse brain injury, not localized brain injury, for example like a stroke. Diffuse axonal injury (DAI) is a common neuropathological correlate of concussion. Axons are like wires that connect brain cells, and when they are damaged, the integrated network systems of the brain experience disconnection. When the networks have a lot of disconnections, the functions of the brain are slowed and may be inaccurate like an old glitchy computer.

There are five categories of neurological symptoms that are typically affected by concussion that may persist. The five pillars of concussion are visual function; attention/concentration/memory/cognitive function; sleep; balance and emotions. There is variability in the clinical presentation of these symptom categories.

**1 Visual Function:** Problems with visual function are common after a concussion. Injured persons may experience photophobia and a sense of “blurry vision”. To address the blurry vision, often an appointment with an optometrist, ophthalmologist or neuro-ophthalmologist is scheduled and the injured person is told that their eyes are fine. They may end up with new prescription eyeglasses, but that does not solve the problem. That is because the persistent visual problems are due to brain pathology, not a primary problem with their eyes. The ability to visually fixate (both eyes are steady and continue to look at the same point) and follow (both eyes move together in a coordinated way) is a complex integrated function that involves coordination of many areas of the brain. The frontal lobes, the brainstem (brainstem nuclei and coordination centers for the nerves that control the six muscles around each eye), the occipital cortex for visual information processing and other brain areas must work together. Struggling with visual focus can result in visual fatigue and double vision, among other symptoms.

**2 Attention / Concentration / Memory / Cognitive Function:** These are higher intellectual functions and they are not easily separated into separate tasks. In order to remember something, we have to pay attention to it, concentrate and try to remember. It is common after concussion for injured persons to have short-term memory problems and need to make notes and use reminders and

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alarms to get through their day. Information processing such as complex decision making and understanding ideas is difficult. Post-concussion injured persons are easily overwhelmed in situations where there is a lot of stimulation to process. Cognitive functions involve coordination of different areas of the cortex, thalamus, cingulate gyrus and other brain structures.

**3 Sleep:** Post-concussion sleep, particularly the sleep-wake cycle (circadian rhythm) is disrupted. It is hard to fall asleep, stay asleep and typical to wake up early in the morning and not return to sleep. Nightmares and night terrors (especially for military members and veterans) are common. Injured brain structures include the hypothalamus, thalamus and reticular activating system.

**4 Balance:** Problems with balance and dizzy spells are typical. Balance involves coordinating the activity of many areas of the brain including the vestibular system (inside the ear) proprioception (the body's way of localizing us in space), vision, frontal motor cortex, basal ganglia, brainstem and cerebellum. An injured person may experience dizzy spells, feel off balance when changing positions and find themselves walking to one side or the other or into walls or worse. They might start to feel "clumsy" and uncoordinated. Episodes of sudden "spinning" and feeling like they may pass out are not uncommon.

**5 Emotions:** Anxiety, depression and irritability are the most common emotional symptoms of post-concussion syndrome. As the underlying brain injury remains untreated, an injured person may manifest clinical symptoms of manic-depression, rage or suicide. There is a biological sadness as a consequence of concussion that may be present that is not a situational response. Emotional symptoms may include pseudobulbar affective (PBA) disorder or emotional incontinence: once someone begins to feel an emotion, they cannot stop the full expression of that emotion. Emotions and the expression of emotion are all brain functions. We don't have a thought, a behavior or a feeling that does not come from the brain. Brain areas controlling emotion include pre-frontal cortex, limbic system, hippocampus and amygdala.

If you notice that you are experiencing a constellation of these symptoms after an injury, make sure that a diagnosis of concussion is considered before beginning a treatment plan.



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