

The Importance of Subconcussive Head Trauma

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Definition

Subconcussive head trauma is head trauma that does not result in recognized concussion symptoms or signs. It is due to blows to the head, which are below the threshold to cause or elicit any symptoms of a concussion.

To refresh, concussion is defined as trauma-induced alteration in mental status, usually characterized by confusion and amnesia that may or may not involve loss of consciousness, link [“Mild Traumatic Brain Injury \(Concussion\) in infants, Toddlers, Children and Adolescents.”](#)

General Information

Both animal and human research have shown that subconcussive blows can cause damage to the central nervous system and pathophysiological changes in the brain despite not evoking any apparent acute behavioral changes. These studies have shown injury to the brain not only comes from concussive episodes, but also from repetitive subconcussive blows.

Imaging studies such as **Diffusion Tensor Imaging** have shown long term effects from repetitive head trauma sustained just by playing one season in a contact sport.

Postmortem studies have identified that repeated subconcussive impacts have an cumulative effect, and it is thought they accelerate the cognitive aging process, leading to altered neuronal biology later in life, in the form of early-onset Alzheimer’s disease, dementia, depression, and **chronic traumatic encephalopathy (CTE)**.

One of the neural pathways (networks) within the brain that has been studied reference to the acute effects of subconcussive head trauma is the **default mode network**.

Default Mode Network

The default mode network consist of a specific set of brain regions, which are engaged when we are left to think for ourselves undisturbed. It is also active when we are thinking about others and remembering the past and planning for the future. The network activates by “default” when a person is not involved in a task.

Function of the Default Mode Network

There are two possible functions of the default mode network: One is that it supports internal mentation that is largely detached from the external world. The other possible function is that it supports exploratory monitoring of the external environment when focused attention is relaxed.

You may ask, why is an understanding of the default mode network's anatomy and function important as far as mild traumatic brain injury is concerned. It is important because understanding the functions and dysfunctions of the default mode network gives us insight into such mental disorders as schizophrenia, Alzheimer's disease, autism, depression, long term trauma, such as in child abuse and chronic traumatic encephalopathy, post-traumatic stress disorder, obsessional disorders, and attention-deficit/hyperactivity disorder. What is of interest, recent research has demonstrated a clear association between subconcussive heard trauma and dysfunction within the default mode network of the brain.

Broglio and colleagues have shown the repetitive nature of subconcussive impacts has a cumulative effect, which can lead to deterioration of cerebral structures and function later in life. The foundation of this deterioration of cerebral structures and function later in life is due to the fact at the neurophysiological level, the mechanical forces causing subconcussive head trauma cause stretching and tearing of white matter axons, which leads to diffuse axonal injury. Once an axon has been completely torn or severely damaged through stretching, it becomes a permanent injury. This is due to the fact axonal regeneration in the adult central nervous system is extremely limited after injury, the reasons of which are discussed in the Forensic Science Newsletter "[Subconcussive Head Trauma](#)," page 12.

An important consideration affecting a patients' recovery after mild traumatic brain injury is their age. The developing brains in the child and adolescents seems to be more vulnerable to repeated concussions and subconcussive head trauma than the adult brain, due to the differences in the degree of myelination, volume ratio of brain to water, elastic properties, the dendritic arborizations and cortical interneuronal connections are not fully developed, and the blood-brain barrier integrity.

Summary

It has been shown exposure to repetitive subconcussive head trauma, as well as concussions, are cumulative due to the failure of axonal regeneration, which in turn can lead to cognitive impairment, dementia, depression, early onset Alzheimer's disease and chronic traumatic encephalopathy

There are now several books available for your review on the website, <http://www.forensicjournals.com/books/>. These books are entitled, "Traumatic Injuries to the Head, Vertebrae, Spinal Cord and Peripheral Nerves of the Newborn During Birth," which is under the heading of Neuropathology. Under the heading of Forensic Pathology are three books entitled, "Nonsexual and Sexual Traumatic Injuries of the

Perineum, External Genital Organs and the Breasts: Adult, Elderly and Pediatric,”
“Traumatic Injuries of the Organs of the Pelvis: Adult and Pediatric,” and “Traumatic
Injuries of the Organs of the Retroperitoneal Space.” A fifth book, “Traumatic Injuries of
the Organs of the Abdominal Cavity: Adult and Pediatric,” will be available shortly.