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Childhood Head Injury and the Potential for Behavior Change

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Introduction

Childhood is a physically active time for most children, which often leads to a series of bumps, bruises, cuts and scrapes. In spite of the *inevitability* of children getting hurt once in awhile as they are growing up, trying to keep children safe continues to be one of the most primary responsibilities of parents and teacher-caregivers.

Since the brain continues to develop its' basic structures throughout the first two decades of life, protecting the brain from "traumatic injury" is critical. At the end of this article, there are some links to web sites with information on safety for children and adolescents as well as a site on traumatic brain injury in children. For example, consistent use of bike helmets, in and of itself, could significantly reduce the incidence of traumatic brain injury.

The problem with traumatic head injury

When a person's brain is injured, usually from some type of blunt force, changes in behavior can appear, and these changes may continue to develop over time. The changes seen depend on which part of the brain was injured and the extent and severity of the injury.

Children who have suffered traumatic brain injury may have normal or better than normal intelligence, but still struggle with organization and making "sensible daily decisions." In adulthood, they can have trouble with social relations due to one of the common symptoms of traumatic brain injury, disinhibition, or "speaking one's mind."¹

¹"Brain Injury In Children," [brain injury .com](http://braininjury.com) <http://braininjury.com/children.html>

Children may do better in the school environment because it is highly structured. When they become adults, however, they can have trouble functioning well when they are in less structured working environments and are expected to work more independently.²

Damage specifically to the prefrontal cortex (the area approximately behind the forehead) can impact learning, memory, and concentration. It can also produce behaviors that are impulsive, socially inappropriate, and even violent.

Multiple studies have found a "correlation³ between head injuries and aggression and violence."⁴ Many of the most violent criminals (both juvenile and death row adults) have experienced serious head injury. It is not clear if the head injury causes violence or if violence prone individuals suffer more head injuries, but the majority of studies on the link between injury to the head and aggressive behavior focus on damage to either the frontal lobes⁵ or the temporal lobes (the areas approximately above the ears).^{6 7}

Head injuries in childhood

If a child suffers a head injury where the skin is broken, and/or the skull has been cracked, we assume that there will be damage to the brain. However, head injuries can occur with no obvious damage - we cannot "see" anything on the outside of the head. Shaken Baby Syndrome is an example of this. Damage to the brain from head injury in early childhood may not show up in behavior until later on, when the area of the brain that was damaged matures.

On a cellular level, the force of a "closed" head injury⁸ can tear the myelin sheaths which surround the axons of neurons in the cortex. This tearing is due to the fact that the skull is not the same on the inside as the outside. The outside is smooth, but "parts of the inner surface are rough and

² Ibid.

³ A correlation between two things says that they occur together at a rate greater than chance, but it does not imply actual cause and effect.

⁴ Karr-Morse, Robin and Meredith S. Wiley. Ghosts from the Nursery: Tracing the Roots of Violence. New York: Atlantic Monthly, 1997, 170.

⁵ Frontal lobes control planning, self-regulation, and sustained effort, as well as higher abstract thinking and judgment.

⁶ Temporal lobes contain the limbic system structures for the regulation of emotion and behavior.

⁷ Karr-Morse, op. cit., 171-2.

⁸ A closed head injury is one in which the skull remains intact, is not broken.

jagged.”⁹ Thus, when the head is hit or hits something, the brain is “shoved” up against the inside of the skull resulting in this tearing.



After injury, there is swelling in the axon that eventually goes away, but there is also “scarring” of the tear. The process of scarring can continue for weeks, months, or years. “As the axon scars over, fewer and fewer impulses can be carried through the tough scar tissue, and the axon may begin to... die” and lose connections to other neurons.¹⁰ Frontal lobe damage “early in life, before internal controls have developed,” is particularly serious.¹¹

Traumatic brain injury “can cause a wide range of functional changes affecting thinking, sensation, language, and/or emotions. It can also cause epilepsy and increase the risk for conditions such as Alzheimer’s disease, Parkinson’s disease, and other brain disorders that become more prevalent with age.”¹²

How does this happen and who is at greatest risk?

“Modes of injury include motor vehicle accidents, bicycle accidents, falls, sporting injuries, and child abuse.”¹³ When looking at all age groups,

⁹ Franklin Institute, “Protect-Watch Your Head,” Resources for Science Learning, Philadelphia, PA, 2004. The Franklin Institute Online, <http://www.fi.edu/brain/head.htm> .

¹⁰ Ibid.

¹¹ Karr-Morse, op. cit., 172-3.

¹² Op. Cit., “Brain Injury In Children.”

¹³ Op. Cit., “Brain Injury In Children.”

according to the CDC, "the leading causes of TBI [Traumatic Brain Injury] are: falls (28%); motor vehicle-traffic crashes (20%); struck by/against (19%); and assaults (11%)."¹⁴

Bicycle accidents in older children are a common cause of traumatic brain injury. "Children suffer 50,000 bicycle-related brain injuries in the U.S. each year, and more than 400 of them die as a result."¹⁵ Wearing a helmet can lessen the severity of an injury "by as much as 85%", but less than half of all bike riders wear helmets.¹⁶

Males are one and a half times more likely than females to suffer traumatic brain injury, and the age groups at greatest risk are 0-4 year olds and 15-19 year olds.¹⁷ Traumatic brain injury is worse in children than it is in adults. Children's skulls are "only 1/8 as strong as that of adults. Thus, children are much more vulnerable to injury through deformation and fracture of the skull, which can injure the brain.... At one time it was assumed that children were more resistant to brain trauma than adults because their developing brains could rewire over time. In fact, it may be that children are more susceptible than adults to permanent brain damage even when the forces involved are equivalent."¹⁸

What does research say about head injury and behavior?

Looking at the worse case scenario, there is "strong speculation" that injury to the frontal lobes (particularly the prefrontal cortex¹⁹) is a "primary cause of sociopathy or cold-blooded criminal behavior."²⁰ Injury to the temporal lobes can cause "episodic dyscontrol...," where "violent behavior erupts seemingly out of nowhere." The behavior is "unpatterned, and occurs without provocation or premeditation."²¹ Studies in both Sweden and the U.S. have found a correlation between damage to the prefrontal cortex and violent behavior as well as the emergence of antisocial personality

¹⁴ "Facts about Traumatic Brain Injury," Centers for Disease Control, 8/2005. <http://www.cdc.gov>

¹⁵ Franklin Institute, op. cit.

¹⁶ Ibid.

¹⁷ Op. Cit., "Facts about Traumatic Brain Injury."

¹⁸ Op. Cit., "Brain Injury in Children."

¹⁹ Ibid.

²⁰ Karr-Morse, op. cit., 172

²¹ Ibid.

disorder.²² In addition, damage in the prefrontal cortex has been correlated to the development of depression.²³

The prefrontal cortex slowly develops throughout the prenatal period, childhood, and into early adulthood. Thus, traumatic brain injury to children and adolescents can seriously disrupt the functions of this area of the brain, since it is not "done" developing. Besides causing impulsive behavior patterns, damage to this area can impact learning.

Let's look at an example of memory. Damage to the prefrontal cortex can disrupt "source memory" which is the ability to remember *where or when* something happened. Source memory is "one of the slowest types of recall to develop in childhood, and the first to deteriorate with age. (This may be why young children can be so easily led astray by suggestive questioning.)"²⁴

Conclusion

The first 20 years of life are a time of un-measurable, yet critical, learning, and the brain is the organ where this learning occurs. So protecting the brain during development (as well as in adulthood, of course!) requires us to look for *potential* dangers- in the physical environment (like climbing structures set on asphalt), and in activities involving children (like riding a bike, tricycle, or other wheeled toy, or riding in a car!). When we become aware of a potential danger, we can then pose solutions or responses that will keep children safer²⁵ (like wearing bike helmets) and yet allow them to be active, curious, and open to learning.

Here are some applicable sites on safety and traumatic brain injury:

Bike Helmet Safety Institute: pretty much every thing you need to know about bike helmets

<http://www.helmets.org/index.htm>

²² Franklin Institute, op. cit.

²³ Ibid.

²⁴ Ibid.

²⁵ We can NEVER keep children absolutely safe, but we try to set up safe environments for children and establish reasonable guidelines for safety.

Center for Neuro Skills - "Children and Traumatic Brain Injury":
Information and Resources for addressing traumatic brain injury.
<http://www.neuroskills.com/children.shtml>

Medline Plus: Child Safety: this site has multiple links to other safety sites
<http://www.nlm.nih.gov/medlineplus/childsafety.html>

Kid's Health: This is a great site to bookmark. Here is a link to the section
on head injuries:
http://www.kidshealth.org/parent/firstaid_safe/emergencies/head_injury.html

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