



Image: High pressure gradients develop within the brain during rapid back and forth motion of the head during whiplash. The brain stem is labeled bs. With permission from Whiplash! A Patient's Guide to Recovery. San Diego, (C) Spine Research Institute of San Diego, 1999.

By **Matthew J. DeGaetano, DC and Steve Baek, DC**
 Certified in Personal Injury

Brain Injury in Children

Incidence

Traumatic brain injury (TBI) is the leading cause of disability and death in children and adolescents in the U.S. According to the Centers for Disease Control and Prevention, the two age groups at greatest risk for TBI are age 0-4 and 15-19. Among those ages 0 to 19, each year an average of:

62,000 children sustain brain injuries requiring hospitalization as a result of motor vehicle crashes, falls, sports injuries, physical abuse and other causes
 564,000 children are seen in hospital emergency departments for TBI and released.
 Among children ages 0 to 14 years, TBI results in an estimated in:

2,685 deaths

37,000 hospitalizations

435,000 emergency department visits

In its 2004 Report to Congress, *Traumatic Brain Injury in the United States: Emergency Department Visits, Hospitalizations, and Deaths*, the Centers for Disease Control and Prevention notes falls are the leading cause of TBI for children age 0-4.

MTBI in Children

Minor brain injuries are much more common than was once perceived. In particular, the association of MTBI with CAD trauma has received increasing attention in the last several years. Attention has also been focused lately on the effect of MTBI on children. In one study the authors followed children with brain injuries for 23 years and found that 31% continued to attribute physical, emotional, and intellectual problems to the original injury. In another study it was discovered that children who had suffered a brain injury were 3.3 times more likely than controls to develop behavioral disorders, and that mean IQ scores were significantly lower in preschool aged children who had been injured.

Although the specifics of the injuries were not described by Hawley, "mild" injuries were those causing LOC of less than 15 minutes and a GCS of 13-15. The author found maladaptive behavior in over 80% of these children in the moderate and severe groups and in 73% of the mild groups, indicating that this was a fairly significant complication of TBI among children. Perhaps more interesting was the fact that in most cases, these children were not receiving any formal psychological follow-up care and also in most cases, if the injury was more than a year old, the students' teachers were unaware of the TBI history, a situation the author noted as presenting potential problems with discipline. Of the traits commonly described among these children, were arguing, hitting, aggression, retaliation, violence, among other acts of disobedience.

Regardless of the initial severity of their TBI (characterized in this study using the GCS), children have been shown to improve cognitively over the first three months after their injury. However, children suffering severe TBI showed a decline between one and two years postinjury. Less severely injured children continued to demonstrate growth in working memory reflective of the combined effects of development and recovery associated with time. The authors speculated that the observed declines in the severe group might be attributable to degenerative brain

changes associated with excitotoxicity and inflammation, and disrupted development of the frontally guided distributed network mediating working memory.

MTBI as Risk for Brain Tumor? In a recent report, children who had previously been treated for brain injury were found to be more susceptible to the development of brain tumor (OR=1.4; 95% CI 1.0, 1.9). The relationship rose when LOC was added to the calculation (OR=1.6; 95% CI 0.6, 3.9), and rose again when overnight hospital stay was used in the analysis (OR=1.7; 95% CI 0.7, 4.6). When the children had a birth injury and a subsequent brain injury the OR increased to 2.6 (95% CI 1.1, 6.9).

Sources:

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Keenan HT, Runyan DK, Marshall SW, Nocera MA, Merten DF. A population-based comparison of clinical and outcome characteristics of young children with serious inflicted and noninflicted traumatic brain injury. *Pediatrics*. 2004 Sep;114(3):633-9.

Shaken Baby Alliance Fact Sheet

Symptoms

Physical impairments cognitive impairments emotional impairments
Speech

Short term memory deficits

Mood swings

Vision

Impaired concentration

Denial

Hearing

Slowness of thinking

Self-centeredness

Headaches

Limited Attention Span

Anxiety

Motor Coordination

Impairments Of Perception

Depression

Spasticity Of Muscles

Communication Skills

Lowered Self-Esteem

Paresis Or Paralysis

Planning

Sexual Dysfunction

Seizure Disorders

Writing

Restlessness

Balance

Reading

Lack Of Motivation

Fatigue

Judgment

Difficulty controlling emotions

Any or all of the above impairments may occur to different degrees. The nature of the injury and its consequences can range from mild to severe, and the course of recovery is very difficult to predict for any given child. With early diagnosis and ongoing therapeutic intervention, the severity of these symptoms may decrease in varying degrees. Symptoms can vary greatly depending on the extent and location of the brain injury. Impairments in one or more areas (such as cognitive functioning, physical abilities, communication, or social/behavioral disruption) are common.

Recovery

What makes a brain injury in children different?

While the symptoms of a brain injury in children are similar to the symptoms experienced by adults, the functional impact can be very different. Children are not little adults. The brain of a child is continuing to develop. The assumption used to be a child with a brain injury would recover better than an adult because there was more “plasticity” in a younger brain. More recent research has shown that this is not the case. A brain injury actually has a more devastating impact on a child than an injury of the same severity has on a mature adult. The cognitive impairments of children may not be immediately obvious after the injury but may become apparent as the child gets older and faces increased cognitive and social expectations for new learning and more complex, socially appropriate behavior. These delayed effects can create lifetime challenges for living and learning for children, their families, schools and communities. Some children may have lifelong physical challenges. However, the greatest challenges many children with brain injury face are changes in their abilities to think and learn and to develop socially appropriate behaviors.

Common deficits after brain injury include difficulty in processing information, impaired judgment and reasoning. When an adult is injured, these deficits can become apparent in the months following the injury. For a child, it may be years before the deficits from the injury become apparent. An example of this is described in the story of “Betsy.”

Betsy was an active, inquisitive 6 year old girl. She was involved in a motor vehicle accident and sustained a moderate brain injury. She was treated at the hospital and discharged to home with outpatient therapies to continue her recovery. She missed a little over a month of school as she recovered. She was able to return to her first grade class, and with help from teachers and her parents, was able to complete the school year with average grades. She needed help in learning new things, but was able to remember them with extra repetitions.

Betsy continued in school, getting average or above average grades. It wasn't until she reached fifth grade that her grades started to decline. Teachers and her parents did not understand the change. She went to school; she tried to do her homework every night. She complained that she just didn't understand the schoolwork anymore. She became more irritable and argued with the teachers at times. No one thought to connect the brain injury years ago with her current issues.

Betsy was experiencing the long term effects of brain injury in children her school work increased in complexity, and required more sophisticated problem solving. The areas of the brain responsible for those functions were injured in the accident. Until now, those skills of abstract reasoning and more complex problem solving were not expected to be present. It was only when Betsy “grew into her injury” that her deficits became more readily apparent.

Fortunately, the mom was able to find her local Brain Injury Association and ask them about why Betsy was having trouble now. Information about the “neurocognitive stall “after a brain injury was sent to her, and she was connected with a professional that had experience working with children with brain injury. It will be a longer road to recover from her brain injury than anyone originally imagined, but Betsy, now connected with the right resources, has a much better chance of meeting the challenges of her brain injury.

Return to School

When children with TBI return to school, their educational and emotional needs are often very different than before the injury. Their disability has happened suddenly and traumatically. They can often remember how they were before the brain injury. This can bring on many emotional and social changes. The child's family, friends and teachers also recall what the child was like before the injury and may have adjusting their expectations of the child.

It is extremely important to plan carefully for the child's return to school. Parents will want to find out ahead of time about special education services offered in their community. This information is usually available from the school's principal or special education teacher. The school will need to evaluate the child thoroughly. This evaluation will let the school and parents know what the student's educational needs are. The school and parents will then develop an Individualized Education Program (IEP) that addresses those educational needs.

Remember the IEP is a flexible plan. It can be changed as the parents, the school and the student learn more about what the student needs at school.

Learn about TBI. The more you know, the more you can help yourself and your child. See the list of resources and organizations below.

Work with the medical team to understand your child's injury and treatment plan. Don't be shy about asking questions. Tell them what you know or think. Make suggestions.

Keep track of your child's treatment. A 3-ring binder or a box can help you store this history. As your child recovers, you may meet with many doctors, nurses and others. Write down what they say. Put any paperwork they give you in the notebook or keep it in the box. If you are asked to share your paperwork with someone else, make a copy. Don't give away your original.

Talk to other parents whose children have sustained a brain injury. There are parent groups all over the U.S. Parents can share practical advice and emotional support. Check with your local Brain Injury Association to find parent groups near you.

Suggested Resources:

Teaching Strategies for Children with a brain injury
Students with Traumatic Brain Injury Returning to the Classroom
Mild Brain Injury and Returning to School
NICHCY Fact Sheet

Suggested Resources:

Young Adults and College - an article originally published in THE Challenge! newsletter.
Financial Aid for Students - a publication from the HEATH Resource Center.

Concussion in Children

Concussion in children is common. Parents often ask, "When it is safe for a child to return to play or other activities?" and "How can I help my child recover from a concussion?"

Infants, Toddlers and Preschool Children

Very young children (i.e. infants, toddlers, and preschoolers) frequently sustain bumps and bruises to their heads from a host of mechanisms including falls (down stairs or from heights such as counter tops or beds), direct impacts (e.g. getting hit in the head with a ball), motor vehicle crashes, tricycle/bike accidents or child abuse.

Sometimes these events can be significant enough to result in a concussion. Deciding whether a child who has hit his or her head needs an immediate concussion assessment can be difficult. Young children may have the same concussion symptoms as older children, but they do not express them in the same way. For example, young children cannot explain a feeling of nausea or amnesia or even describe where they hurt. Parents and physicians should keep this in mind when considering the presence of concussion symptoms listed below. When in doubt, refer a child for immediate evaluation. Primary care physicians (PCPs) should ask caregivers about all "bumps on the head" and should consider referring a child with a "bump on the head" to the emergency department if they suspect a concussion.

Acute signs and symptoms of a concussion:

Vomiting

Headache

Crying and inability to be consoled

Restlessness or irritability

Follow-up in Young Children who have Sustained Concussions

All children with concussion or suspected concussion should be followed closely by their PCP or a provider with experience recognizing concussions. A follow-up visit with the doctor after the event can offer the opportunity for families to ask questions and for the doctor to assess the child for ongoing symptoms. Although diagnosing post-concussion syndrome in young children is difficult, it is important to assess for these symptoms to determine if further evaluation is needed. The follow-up visit can also provide an important opportunity for discussion of age-appropriate injury prevention to minimize the possibility of subsequent concussions.

Infants and young children less than 3 years of age who have had a concussion can have their development tracked by their county's developmental program for young children. This is particularly important for children who have sustained a complicated concussion (i.e., a concussion with contusions or hemorrhage apparent on imaging), those who have had multiple concussions and/or those with underlying neurologic disease.

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