



Concussions

What Every Parent Should Know

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Concussion Defined

Each child is unique, and each of their brains can be likened to signature fingerprints of intelligence. This is why it is critical to understand what a concussion is and how it could affect your child. If you ask five people the question “what is a concussion?” you are apt to get five different answers. Even among doctors variations are found in the definition. For our purposes, a concussion will be defined as an injury to the brain that results in a temporary or permanent alteration in brain performance and affects one or more of the following: thinking, behavior, emotions or physical. Usually, this loss of brain function lasts for only a short period of time and the loss of function resolves without invasive treatment. However, given the dynamic growth of the child’s brain and the ongoing metabolic needs of the youthful mind, any injury to the brain, no matter how seemingly trivial, can cause problems in the child’s day-to-day performance at home, at school, with friends or on the playing field

What Happens to the Brain in a Concussion



Figure 1: Brain in Head created by smokedsalmon

The human brain is an amazing organ and in many ways is very much like a computer. With a concussion, much like a computer, you can lose data, thereby slowing down the processing speed and damaging the operating system.

With the consistency of firm gelatin, the brain is somewhat cushioned from everyday jolts by the cerebrospinal fluid that surrounds it in the head. However, the brain is also surrounded by

the hard bone of the skull. When a hard blow or sudden forceful movement of the head causes the brain to bounce against the skull, there is a potential for injury to the brain – and this may result in a concussive event. When your head is struck by a blunt object (a fist, a thrown object, or a bat, for example), the resulting injury is called an “acceleration injury”. On the other hand, when you strike your head against a stationary object (for example, the ground or the dashboard of your car), the injury is called a “deceleration

injury” resulting from your head moving and then stopping suddenly while your brain continues to move until it slams into the skull.

As the brain moves in the skull, it will first bump into the skull on the side where it was hit – this is commonly called the “coup” site. The brain might then bounce against the opposite side of the skull – producing a second injury to the brain at the “contracoup” site. Consequently, two different parts of the brain may be injured by one blow. As the brain moves, it may also twist in the skull. It is this twisting motion that most often causes loss of consciousness. This also explains why not everyone loses consciousness when suffering concussion! In fact, most people are not even aware that they have sustained a concussion until someone else notices the individual’s functional or behavioral changes.

However, a concussion may occur without the head striking or being struck by an object. Just the forward and backward movement, much like a ‘whiplash’ can jostle the brain enough to cause a concussion. It is all a function how the head receives the force, not on how hard the head is hit or how fast the head moves front to back. Basically, the brain can be in the wrong place at the wrong time. Although most commonly associated with motor vehicle wrecks, whiplash and the brain injury connected with it can also be caused by sports, being hit or shaken, and amusement park rides.

Types of Concussions

There are many different ways that concussions can be classified but we will discuss the three ways that are usually classified.

First, according to the International Conference on Concussion in Sports, concussions can be classified as either simple or complex. In a simple concussion, symptoms normally resolve in about a week to ten days with full normal functions returning. Complex concussions, on the other hand, may result in symptoms that do not resolve spontaneously and may include long term risk of complications. A person with a very severe concussion, or someone with multiple concussions, will in all probability fall into the complex category.

The second classification is traumatic versus non-traumatic. Traumatic concussions occur when there is a hit to the head or when the head is hit against something. Each time a hit occurs a force is applied that may be absorbed by the bones or transmitted into the brain. For example, a child who gets hit in the face and thereby sustains broken facial bones may actually be at lower risk for brain injury because the bones of the face have actually absorbed some of the energy that could have been harmful to the brain.

Finally, the third classification of concussions is based on “grading” of the injury. While there are many different grading systems, the American Academy of Neurology has developed a scale based on three grades, a system very similar to other groups who have developed grading systems for concussion.

Grade	Hallmarks	Comments
Grade 1	Confusion; No loss of consciousness; Symptoms resolve in less than 15 minutes	Most common but very difficult to recognize
Grade 2	Confusion; No loss of consciousness; Symptoms last more than 15 minutes	If symptoms last longer than 1 hour, medical observation is warranted
Grade 3	Loss of consciousness for any period of time	Easiest to recognize

Figure 2: AAN Grading of Concussions

Prevalence of Concussions

The Centers for Disease Control (CDC) states that sports concussions are at an epidemic level with an estimated 1.6 to 3.8 million concussions every year. Each year, there are approximately 173,000 visits to emergency departments for head injuries related just to sports. This rate has increased by almost 65% over the last ten years at least in part because of the increased awareness of the dangers of concussion and the increased recognition of the injury. Sports injuries are the second leading cause of concussion for teenagers and young adults – second only to motor vehicle crashes.

Causes of Concussions

The CDC estimates that falls and motor vehicle incidents are the two major causes of all concussions among all age groups. Other known causes are assaults and being struck in the head by something. Falls cause half of the concussions in children and over 60% of those in adults over 65 years of age. Motor vehicle crashes result in the largest number of brain trauma related deaths of all causes. An athlete may fall into most of these categories of causes and any of these causes can result in concussion due to direct hits to the head or whiplash injury.

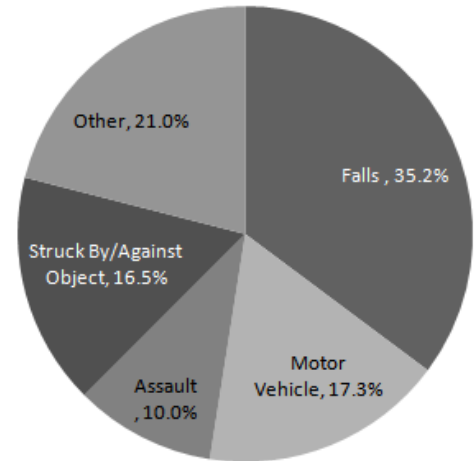


Figure 3: Causes of Concussion

Concussion Risk Across all Ages

Obviously, anyone who takes a blow to the head is at risk of sustaining a concussion. However, children under 18 years of age and adults over 65 years old, have been pinpointed as two high-risk groups.

The young may be at higher risk because of their inherently more active life style – they participate in activities that may put them at higher risk. However, children may also be at higher risk for suffering a disruption in brain functions simply because their brains are still not fully developed. The pathways that govern how their brains work – the neural circuits – are still developing. Therefore, a disruption in the circuit may cause much more noticeable symptoms than a similar injury in an adult. In addition, long-term effects may be an issue with the child.

Aging adults may be at higher risk for concussion because of the increased risk of falls in this age group. There is also some research which indicates that chemical changes in the aging brain may have something to do with the health of the brain. Adults who have sustained multiple blows to the head throughout life also tend to have greater declines in cognitive function at a younger age. We will discuss more about these repeated injuries later.

Concussion in infants and young children

The brain of an infant or young child is much more easily injured due to the relative immaturity of the brain; however, concussions in this age group are sometimes difficult to recognize. Infants and young children are most at risk for concussion stemming from falls and abuse. Short falls (from four feet high or less) are almost always benign in small children. Any mother with a toddler knows that children in this age group average about four falls each day. Of course, as with any injury to the head, infants and toddlers who fall and hit their heads should be observed for signs of concussion.

Shaken baby syndrome (SBS) is a preventable form of abuse that is also called abusive head trauma. In this syndrome, the infant or young child sustains a brain injury due to being violently shaken. In extreme cases, the child may stop breathing and the heart may stop due to bleeding around the brain.

Concussion in boys

Concussions in boys can occur in motor vehicle crashes where the risk to boys aged 16 to 19 years is higher than among any other group. Concussions can and do occur in almost every sport including horseback riding; however, these brain injuries are most common in boys' sports. Anecdotal evidence from athletic trainers suggests a concussion rate of about 5% each year for high school students. However, more formal studies show that as many as 50% of players may have experienced concussion symptoms each year.

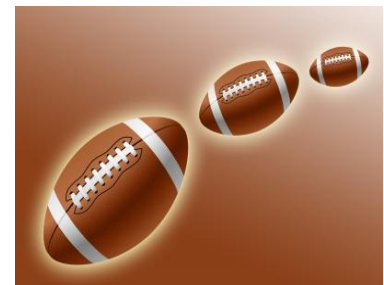


Figure 4: American Football
created by Idea go

A boy may be unwilling to report symptoms of concussion fearing that he will be taken out of the game or that he may lose his position on the team. Many times, a boy who suffers a concussion may not even realize that he is suffering symptoms. Parents and coaches must stress to each boy that he is responsible for himself AND his teammates. A player with a concussion may continue to go through the motions in a game even though he may not have any idea what is going on around

him. A teammate may actually be in a better position to recognize a concussion than the boy himself. It is also important that each child understand a few basic facts about concussion:

- If you feel like you suffered a concussion, then you suffered a concussion.
- If you get hit hard enough or often enough, you may be unable to play again.
- With a concussion, you can't process what is happening quickly – and, therefore, you won't be able to play as well.

Concussion in girls

Although the studies are not conclusive, some studies suggest that girls may be more susceptible to concussion in sports than boys. In particular, girls who play soccer may be at higher risk for brain injury. See Figure 5 for a comparison of concussion rates for various sports.

Of interest are the findings that girls may present with more emotional and cognitive issues (see section on symptoms) than boys.

Girls may also have more lasting symptoms than boys and it may take a girl longer to return to play. This finding may be due to a boy's reluctance to report symptoms for fear of removal from competition. There is also a theory that girls may have weaker neck muscles than boys, thus leading to an increased chance for injury. In any case, the evaluation of a concussion and determination of return to school and play should be the same regardless of the child's gender

Concussion Sports Statistics

As should be apparent, athletes may be at high risk for concussion. Concussion rates are typically measured as the number of concussions per 100,000 athletic exposures (AE). An athletic exposure is defined as one athlete participating in one organized athletic practice or competition. According to studies, current rates for different sports are presented in the following table.

Sport	Rate (per 100,000 AE)
Boys' Football	60-77
Girls' Soccer	33-35
Boys' Soccer	17-19

Boys' Lacrosse	30-47
Girls' Lacrosse	20-31
Boys' Wrestling	17-24
m	16-19
Boys' Basketball	11-21
Girls' Softball	11-16
Boys' Baseball	5-6
Girls' Field Hockey	10-25
Girls' Volleyball	5-9
Cheerleading	11

Figure 5: Concussion Rates in Common Sports

Concussion in adults

As has already been mentioned, the risk of concussion in adults increases with age. The CDC estimates that people over 65 years of age have higher rates of hospitalization and death from traumatic brain injury than any other age group. Concussion and brain injury related to falls also increases with age. An adult older than 85 years of age is two times more likely to be hospitalized for a brain injury due to a fall than an adult aged 75 to 84. The same 85 year old adult is six times more likely to be hospitalized for a brain injury than a 65 year old. Elder abuse or neglect, assault and motor vehicle crashes are other possible causes of concussion and brain injury in an adult.



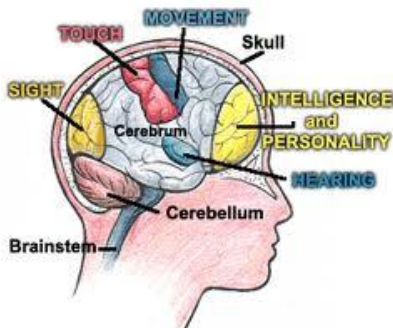
Figure 6: Banana Skin by Chris Sharp

On Field Assessment

- Any child who is suspected to have suffered a concussion should be removed from participation until he or she is evaluated by a physician with training in the evaluation and management of sports concussion.

- No athlete should be allowed to directly compete (this does not mean the child cannot practice certain aspects of the sport) in any sport until he or she has resolved all of the symptoms associated with the concussion.
- Following a concussion, a neurologist or physician with proper training should be consulted prior to clearing the athlete to return to participation.
- A certified athletic trainer should be present at all sporting events, including practice where athletes are at risk for concussion.
- Educational efforts should be maximized to improve the understanding of concussion by athletes, parents and coaches.

Recognizing the Symptoms of Concussion



Your child has just taken a hit to the head. How can you tell if he has a concussion? The most important thing to remember about recognizing a concussion is that any change in a child’s baseline behaviors after a blow to the head should be considered abnormal. In addition, the abnormal behavior should be considered a direct result of the hit until you know for certain it is not. Often, the best indication of a concussion is a parent’s statement that the child “just isn’t acting right”.

That being said, symptoms of concussion can be classified into three general categories: somatic (physical), cognitive (thinking), and mood (behavior) disorders. Symptoms can also be classified as “early” or “late” depending on when they appear in the concussion syndrome. Symptoms may depend on that part of the brain affected by the injury. Different areas of the brain are responsible for different functions. For example, an injury to the “sight area” of the brain may result in visual disturbances. There is a lot of overlap in brain functionality, so the area of coup or contracoup may or may not be a good indication of symptoms to watch for.

Somatic Issues

The somatic or physical problems may include symptoms such as headaches, dizziness, visual changes, sensitivity to light or photophobia, sensitivity to sounds or phonophobia. Photophobia

and phonophobia are alterations in sensory perception. When an individual's senses are affected, sounds, touch, hearing, taste or smell may either be heightened or lessened.

Headaches are a very common symptom associated with concussions. There are many different types of headaches that can result from a concussion. Headaches are usually an early sign of concussion, but it may persist for days or weeks. Headaches can be categorized as intracranial, in which the brain itself has been shifted or extracranial resulting from injuries outside of the brain.

In an intracranial injury, the brain has its own protective headache mechanisms that cause the headache. A migraine headache would be classified in this category. This migraine-type pattern may result from concussion in patients who have a family history of migraines. Migraines are a very specific headache pattern that can affect any of the senses including the visual system, auditory or hearing system, and the sense of touch.

The second category deals with injury outside of the brain. In a whiplash type of event, the greater occipital nerve at the base of the neck can become stretched, which causes headache patterns from the back of the head forward. Headaches can also be caused by:

- Stretching of the muscles of the back of the neck;
- Irritation of the small nerves on the head such as when a ball hits the nerve directly;
- Temporomandibular joint (TMJ) pain can cause headache due to slight jaw displacement.

Dizziness or vertigo is a symptom in which your child may complain of "spinning," feeling "wobbly," "ringing in the ears" or feeling lightheaded when sitting or standing. Although usually an early sign of concussion, if dizziness continues, your child should also be evaluated by an ear, nose and throat specialist to rule out problems with the inner ear. As already discussed, any of the senses (sight, hearing, touch, taste and smell) can be heightened or lessened in a concussion. Any complaints of disturbance should be evaluated by your child's doctor.

Nausea and vomiting may occur with a concussion as well as changes in speech patterns.

Immediately after a concussion, your child may have bleeding from the ears and/or nose.

Especially important, if your child has bleeding from the ears, he should be immediately evaluated by a doctor. Particularly, if your child experiences bouts of repeated vomiting, she must be

evaluated by your physician. You should also seek immediate emergency care if your child experiences seizures after a head injury.

It is very common for a child to have physical symptoms (e.g., headaches, dizziness and fatigue) from both a concussive injury and a cervical (neck) injury given the way the head and neck are traumatized.

Cognitive Issues

Cognitive changes that occur with concussion are changes in how the individual thinks and mentally processes information. This second category can be associated with a sense of foginess or a sense of distance. If your child is looking in your direction but seems to be looking through you, that is a possible sign that he is not processing as he should be. The expression "like in a deer caught in the headlights" is a perfect description of the look of a concussion victim: he is there, he is looking at you but there is a look of disorientation.

The child with a concussion may have increased fatigue, decreased academic performance, change in school grades, difficulty with comprehension, slow mental processing, decreased attention and diminished concentration.

Your child may feel very fatigued, lackluster, not having the daily energy that he once enjoyed. He may feel distant and disconnected. As a parent, it is crucial that you contact the school teachers or coaches to see if the concussion is affecting his performance on the playing field OR in the classroom. These subtle changes in academics or performance may not be easily recognized in the home environment and if not caught early may become an even bigger problem at school when his grades begin deteriorating. These cognitive issues may start immediately after a concussion and could last for weeks.

It is important to inform all teachers that the child had a concussion and to look for any changes in class participation, grade performance or attention/concentration during class. Be proactive.

Many children who incur concussions are academically at very important times in their lives. Eleventh graders have ACT, SAT and college entrance placement exams. Concussions during these

times can affect performance and scores. A trained physician should evaluate the impact the concussion may have on academic performance not only on knowledge, memory and recall, but also, in terms of endurance of actually taking and sitting through a four hour exam.

The same decisions that go into return to play need to be assessed in return to test.

Behavior/Emotional Issues

The third category of problems commonly observed in children with concussion are behavioral issues. Disturbances typically seen are changes in mood: anxiety, depression, irritability, heightened sense of frustration, and anger seemingly out of proportion to what is going on. Again, it is important to recognize any change from the child's baseline. If a child who is typically outgoing suddenly becomes withdrawn, he should be evaluated. These changes in mood and behavior can cause family and peer stress. The child may also begin having problems relating to teachers and coaches.

Often, these changes in personality can be quick bursts of emotion not accompanied by provocation. An example is a child who is playing with his brother and what would seem like a seemingly innocuous comment by the brother becomes a scream fest from the child post-concussion. Clinically, the child with concussion will typically get into fights with a little brother or sister or the mother. Strategies on how to handle these situations are certainly unique to each child but best to not argue or engage the child during these episodes. They are usually short in duration and escalate and de-escalate quickly. Always best to remember change the environment around the child not the child himself.

Post -Concussion Sleep and Pain Issues

A child with concussion may also experience sleep disturbances and issues with pain. These two problems should be considered overlap syndrome. This means that the brain itself was injured and had temporary or transient loss of function. When the child with a concussion gets a secondary problem such as fatigue, headaches or dizziness, it begins to affect how the child sleeps. The concussion itself may have resolved but a secondary sleep problem or pain syndrome develops. The sleep or pain problem may very often mimic concussion and, frequently, caregivers who are

not well trained in concussion may perceive that this is a direct ongoing problem stemming from the concussion. In actuality, the intrinsic or the internal problems of the concussion have been resolved but the secondary effects are ongoing. Often, ongoing mood disorders, cognitive changes, and physical symptoms are related to the sleep and pain issues. It is crucial that the physician recognize those events, treat them, and allow the child to move on.

Concussion care works best when all the individuals in a child's life are on the same page in terms of information and observation. Once a child is diagnosed with a concussion, it is important to let his teachers, tutors, coaches, family members and whoever else comes into contact with the child on a regular basis. It is crucial to have information regarding a child's behavior in different environments, times of day and with different people. The 'team' in your child's life offers a fuller picture of how the concussive symptoms may or may not be affecting his life.

Diagnosis of Concussion

When you suspect your child has suffered a concussion or when your child's coach or doctor on the sideline of a sporting event suspects the child may have suffered a concussion, you take the youngster to a physician. How is a concussion diagnosed? Again, you must first suspect a concussion if the child is not acting "normally" for him. Your child and all members of his team must understand the implications of suffering a concussion. The members of the team must take care of each other and report when a teammate "doesn't seem quite right". In addition to protecting each other from potentially life-threatening problems, they are also helping the team since a player with a concussion is not capable of playing to his or her full potential. Specific tests that may be done to determine if a concussion has occurred include a neurological exam, imaging tests, and computer testing. At a minimum, a good neurological exam should be done when a concussion is suspected.

Neuro-Rehabilitation Exam

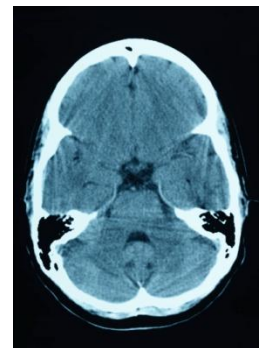
In a neurological exam, the coach or healthcare provider will ask your child questions to determine his orientation to time, place, person and the circumstances of the injury. Your child may be asked to repeat a series of numbers backwards to test his ability to concentrate. His memory may be

tested by asking him to name the team he is playing against; he may be told to remember a word and then asked to repeat the word in five minutes. A coach may ask the athlete to relate the most recent play run in the game or practice.

The doctor or coach will check your child's pupils for symmetry and reaction to light; they might also check the child's coordination by having him touch his finger to his nose with eyes closed. The coach may have your child do sprints or knee bends to determine if the activity causes headaches, unsteadiness, nausea, dizziness or visual changes. Often times, the initial neurological examinations are negative which may reflect subtle changes that are missed, insensitivity of the examiner to the neurological exam or early onset of symptoms that have yet to evolve into more apparent problems. This is one of the reasons the American Academy of Neurology suggests following-up with an expert trained in childhood concussion brain injury.

Imaging tests

Brain imaging is not always needed after a concussive traumatic brain injury. It is more likely that your child will need some sort of x-ray if she has persistent memory problems after the immediate incident is past; she has seizures after the incident; she vomits multiple times after the injury; any symptoms seem to be getting worse rather than better over time. A cranial computerized tomography (CT) scan is the standard test to assess the brain right after injury. A CT scanner takes multiple X-rays and combines all the resulting images to produce detailed, two-dimensional images of your child's skull and brain. Given that CT scan do carry added radiation risks, many centers have developed Post-Concussion head CT protocols aimed at identifying only those children who do require neuroimaging post trauma.



Pre- and Post-Concussion Computer Testing

There are several companies that offer pre-sport computer-based assessments for those children at higher risks of concussion. The concept of taking these assessments is to establish a baseline neurocognitive profile that in the event of a concussion then a pre and post (retaken) test can show

changes to support injury, improvement or ongoing deficits. Computer assessments pre-injury are becoming very popular amongst high school, college and professional institutions.

Although it is clear that some form of neurocognitive testing needs to be done on this population, it is yet unclear of the sensitivity of these computer tests to truly define not only the onset of concussion but also the presence of ongoing symptoms. These tests typically look at single and complex reaction time, memory, and processing skills.

The strength of these computer tests is that they are quick, computer-based, easily administered, can be used by non-medical as well as medical professionals and have rapid results. Weaknesses of these computer tests is that they do not test verbal skills, do not evaluate behavior, are not able to physically see how this child is performing and reacting, do not take into account that the child may be suboptimal in how they are taking the test, and the tests do not differentiate some of the secondary disorders (sleep disturbance and pain syndrome) that may mimic concussion.

Because these computer tests have been primarily used for athletes, more research needs to be done with children with non-concussion or secondary type disturbances or overlap syndromes. In addition, testing should be done to determine if these computer tests are valid with non-sports concussions. Since these tests do not currently measure the verbal and behavioral components of concussion injuries, this should also be an area for future development and testing.

For individuals who use computer testing, both pre- and post-injury on a particular child, the test may be useful; however, you cannot use the computer test to say specifically that the child has recovered from concussion because the validity and the specifics of the computer test may be asking two different questions. The computer tests for processing speeds, reaction times, and comprehension; with a concussion, we are talking about higher level performance, academic performance and behavioral and emotional performance. Again, computer testing does not really define emotional or verbal responses. How each individual child relates to social and academics is crucial.

It is important that a physician trained in concussion evaluates the child, with very specific guidelines for definition of recovery and return to play. Computer testing can be used as an

adjunct to testing but must NEVER be the defining outcome determinant. Using only a computer-based test will result in missing a large number of children who have ongoing symptoms. Missing the diagnosis on these children will result in an increased risk for releasing them to play and back to academics too early. Ultimately, these children may be at higher risk for a secondary injury or failure in performance.

Complications of concussion: Second Impact Syndrome

Second impact syndrome is when an individual who has already had a concussion suffers a second event. This is a cumulative process and this is what most practitioners are most concerned about. In second impact syndrome, the initial injury in most concussions does not cause a problem. However, a repetitive concussion over a series of events leads to one injury on top of the first -- the second impact.

There is no clear definition or research-based timeframe that identifies a second impact injury. Having said that, we know that seven days is the crucial period. If your child still has symptoms and is not fully recovered from the initial injury and has a second injury, then this is typically recognized as a second impact syndrome injury. The gray area for diagnosis is when you have a child who completely resolves after seven days without symptoms and you return them to play gradually and then a second injury occurs after seven days. Is that injury a second impact syndrome injury? Certainly the closer you are to the initial injury, the higher the risk for a second impact. The most crucial factor is complete resolution of the initial concussion. If a child is two to three weeks after concussion, still shows some symptoms, and has a second impact, then you have a child who has not completely cleared. If you have a child who is completely cleared, and three weeks later gets another injury, then you are less likely to consider that a significant second impact. However, it is a second injury in a relatively short period of time and needs to be taken seriously and evaluated by a physician with training in this area.

The concern with cumulative trauma is that these cumulative injuries in an individual who really does not clear may result in chronic traumatic encephalopathy (CTE). CTE causes long-term memory, behavior, cognitive and performance issues. You see this frequently in boxers and in some soccer players who do a lot of heading of the ball. These micro-events add up over time and

cause a change in the circuits and micro-structure of the brain. These changes can cause long-term debility and premature dementia. Obviously, this is something we never want to have happen in sports and is why sports physicians tend to be proactive on the subject of concussion.

Approximately 11% of concussions in high school sports in one study were repeat concussions. However, another study found that as many as 20% of concussions in boys' and girls' soccer and basketball were repeat concussions. High school athletes who suffer 3 or more concussions are eight times more likely to experience loss of consciousness, and five times more likely to experience amnesia of the event than an athlete who has not suffered a previous concussion. Children who are seen in a hospital emergency room for head injury, concussion, skull fracture or intracranial injury are more than twice as likely to sustain a subsequent head injury within one year as are children seeking care for an injury unrelated to the head.

Duration of Concussion Symptoms

How long will the symptoms of concussion last? This varies from child to child and depends upon the specific nature of the injury, the mechanism of injury, and what type of symptoms they are having. Frequently, you see children with headaches, dizziness, and fatigue that resolve within the first 24-hours to the first two weeks.

Although the concussion itself is often better in a short period of time, the child may have a subsequent minor injury that causes pain and symptoms similar to those of the concussion. It should also be noted, especially in children, that there may be lasting changes in personality, greater irritability, and increased difficulty with concentration and attention.

How can you differentiate between these secondary symptoms and the symptoms of a concussion? You know your child. Watch for signs that things have changed. Watch for the child that looks like he has an attention deficit disorder where one did not exist before. Watch for signs that your child is having more difficulty with concentration or more difficulty learning. If the child is more distractible or more impulsive, a further evaluation should be done. Typically, these types of problems are not seen in an adult. Again, these symptoms may relate to the fact that a child's

brain is still developing and any injury during that time frame can disrupt how the maturational processes are proceeding.

Several studies have been done indicating that approximately 1 out of 4 athletes with concussion suffered symptoms that cleared in less than 24 hours. About 1/3 of all athletes had symptoms that resolved in 1 to 3 days. The studies generally find that symptoms in 3 out of 4 athletes have resolved by the end of one week. Within a month, 97-98% of all athletes with concussions have cleared.

Treatment

In almost all cases, rest is the best way to allow your child's brain to recover from a concussion. The American Academy of Pediatrics recommends both physical and mental rest for children. This means avoiding physical exertion as well as activities that require mental concentration, such as playing video games, watching TV, texting, taking major tests or using a computer. Teachers and coaches must understand that athletic and school workloads should be temporarily reduced.

For headaches, acetaminophen (Tylenol, others) is probably the best medicine to use. Unless prescribed by the child's doctor, other pain relievers such as ibuprofen (Advil, Motrin, others) and aspirin should not be used since these medications may increase the risk of bleeding. Any other medications should only be used when recommended by a physician who understands and deals with concussion on a regular basis. No one should return to play or vigorous activity while signs or symptoms of a concussion are present. Experts recommend that children and adolescents not return to play on the same day as the injury. See the section on when it is safe to return to play. Any plan regarding concussion must address the role of preventative protocols in order to keep concussions from happening.

Teach Your Children Well: Preventing Concussions

When talking about concussions, prevention truly is the best treatment. It is critical that parents, coaches, teammates, physicians, and others insist on those things that are known to help prevent head injury and concussion. The following tips may help to prevent or minimize your child's risk of brain injury:

- Always wear all recommended protective gear during any sport or other recreational activity. Protective headgear must fit, be worn correctly and be well maintained.
- Wear your seatbelt at all times, even if you are just driving around the block. Seatbelts are required for children in all states and penalties for not wearing a seatbelt include financial AND health related costs.
- Report yourself or your teammate if you suspect that conditions are not safe or if you suspect that one of you might be at risk for a concussion.
- Particularly for the very young and elderly, it is important to make your home safe by keeping it well lit and free of clutter on the floor. Block off stairways and be sure windows cannot be opened far enough for a toddler to fall out. Remember that falls are among the leading causes of head injury in these two age groups.
- Be sure your children understand the dangers around swimming pools and unguarded swimming areas. Teach them not to dive into water unless they know how deep it is. Make sure they know, understand, and follow posted safety rules at water parks and swimming pools.
- Along with other protective equipment, be sure to tell your child the importance of wearing sensible shoes. High heels or shoes with slippery soles pose a risk to children...and to the elderly.



Figure 7: Swimming Pool with Stair created by David Castillo Dominici

The Million Dollar Question: When can my child play again?

This question is really a two part question: when can my child return to full function in school and when can my child return to full function in sports' play. There is no universal definition for when and how to return the child to play. There are guidelines and there are certainly criteria that are institutional and non-institutional. Academic centers have specific policies, the NCAA has some policies and procedures, and certainly the American Academy of Neurology (AAN) has outlined some recommendations. What is most important and what is really emerging as the leading thought is to first diagnose that a concussion has occurred. After the diagnosis is made, the child should return to play in a graduated process. If the child continues to have headaches or dizziness

or if he has ongoing symptoms cognitively, academically, emotionally or physically, his return to sports will be less than optimal because he will not be at 100%.

Since many of these kids want to get back into play, the best idea is to gradually return them as their symptoms desist. First, put them in a noncompetitive environment where they can do conditioning or sport specific training that is not going to exaggerate or cause any further problems. The child, parents and coaching staff all need to understand exactly what the child can and cannot do during these conditioning sessions.



For example, if your daughter is a lacrosse player with continuing cervical strain and headaches, a conditioning program where the neck is turning constantly will likely increase her problems and decrease her ability to return to formal competitive play. In this case, you want to gradually return your daughter to a noncompetitive environment. Once the symptoms are better, you will want to put her into a more advanced conditioning program where she can begin to work on endurance and activities where you put more stresses and strains on how the neck and the shoulders and the upper body are moving. As your daughter is graduated from that, you can start to return her to noncompetitive play with teammates and more sport specific events. If she remains symptom free in that environment, you can return her to an aggressive conditioning sport-specific practice. Once her symptoms have completely resolved in an aggressive practice, and as long as her physician, coach, parents, and she, herself, has no concerns about her health, then she can return to full competition.

Remember, children consider their sport or their academic life a return to their "work" much as return to a job would be for an adult. When we are talking about returning back to play, there is also an academic arena in which your child is functioning and you cannot ignore that. When they return back to school, they may not be optimally able to learn and that return to the school environment is as crucial as the return to play. After a concussion, be cautious about returning your child back into an environment where there is fast-paced learning and multiple noises and

activities going on. With a concussion in which your child is not processing well, he may also have difficulties retaining or retrieving information. In this kind of competitive environment, you should view the child's return to school in much the same way that you would return him to sports play. Put him in a slow return back to school. Modify how much homework he might have, control the test taking environment and provide a quiet environment for completing school work. Teachers should be aware that the child with a concussion may need an extension on the time to complete a task. The child, his parents, the school and teachers, the coaching staff, and the physician must all work together to help the child succeed in all aspects of his life.

Think of this “return to work” process as a 7-step return to the sport (or to the classroom if you are talking about academic performance).

ALPINER’S RULES ON RETURN TO PLAY

1. Begin with a slow-paced conditioning schedule in a non-competitive environment where the child can work out even if not in the sports specific area.
2. When the child no longer has symptoms with the slow-paced conditioning, increase the pace of the conditioning but still in a non-competitive environment.
3. As the child gets stronger, and the increased-pace conditioning does not cause symptoms, increase to a slow GAME pace exertion schedule – still in a non-competitive environment.
4. Gradually advance the game pace exertion in the non-competitive environment using more advanced drills.
5. Begin to add the game pace exertion in a team practice environment where the team is fully aware that they need to be watching the child for signs and symptoms.
6. When the child can tolerate the game pace without symptoms, advance the game pace exertion but still in team practice only.
7. Finally, when cleared by the physician, coach, parent and the child, it is time to return to full play in inter-team competition.

When trying to determine a schedule for return to play or studies after a concussion, it is important to recognize that in each of these environments there are physical, cognitive, and behavioral stressors that must be taken into account. A child who has symptoms when he is at rest should not

be returned to a more exertional performance level; any change from the child's baseline behavior or performance should be considered a symptom. Any adult who does not recognize or understand this danger is a weak link in the chain of care for the child -- and may cause long-term problems for the child.

Given the significant concern for concussion, The American Academy of Neurology came out with a position statement in October of 2010. Recognizing the importance of immediate action and concern for the child, the recommendations of the AAN are based on the Grade of the concussion and an accurate evaluation of the child's condition.

Important take away points

- ✓ If you think your child had a concussion, then, until proven otherwise, they have.
- ✓ A child does not have to lose consciousness to have a concussion.
- ✓ Concussions occur not only by a violent blow to the head, they can happen by the head being twisted, flexed or extended in the wrong way for that individual.
- ✓ Symptoms of concussion may develop over 1-2 weeks; therefore, children need to be followed closely by trained professionals even if no symptoms are apparent early on.
- ✓ Children are more susceptible to concussions due to their brain's ongoing neurodevelopment and growth risks.
- ✓ Not all children require CT scans. When seen through the Emergency Department most major Medical Centers have strict protocols and criteria when to scan.
- ✓ Common symptoms of concussion in children are divided into 3 categories of symptoms: Physical, Cognitive and Behavioral/Emotional.
- ✓ Many times children with concussion have an associated neck injury, much like a 'whiplash' that can further add to symptoms and needs to be diagnosed and treated separately from the concussion.
- ✓ All professionals who interact with your child need to be informed of your child's concussion and to be observant of any changes. These include teachers, coaches, musical personal, tutors...

- ✓ The majority of all children with concussions will have a full and complete recovery if managed appropriately and not expose the child to a second injury before the first has cleared (second impact syndrome).
- ✓ Return to play needs to be carefully matched to each child's injury, symptomatology and further risk of injury.

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BOARD DOUBLE CERTIFIED
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About Dr. Alpiner

A native of Detroit, Michigan, Dr. Alpiner received his Bachelor's Arts Degree from the University of Michigan in Ann Arbor, and received his Medical Degree from Wayne State School of Medicine. Post graduate training was completed at the Detroit Medical Center where he received dual degrees in Pediatrics from Children's Hospital of Michigan, and in Physical Medicine and Rehabilitation from Rehabilitation of Michigan. His post graduate work was highlighted by receiving the Lender F. Bender Award for exceptional accomplishment during training.

Dr. Alpiner is Double Board Certified in Pediatrics and Physical Medicine and Rehabilitation. Dr. Alpiner received the Golden Tassel Award for Outstanding Attending Physician Award at William Beaumont Hospital in the Department of Physical Medicine and Rehabilitation in June 2009. Dr. Alpiner is also the recipient of the Patient's Choice Award, On-Time Physician Award and was voted a Metropolitan Detroit "SuperDoc" as well as being voted a Metro Parent "Mom Approved" Doc.

As a Neuroscientist, Dr. Alpiner, has devoted his career to identifying how the brain and body adapt and react to stressors. Dr. Alpiner develops treatment options for patients so they can regain motor, cognitive and sensory success.

Dr. Alpiner has written two books. **The Parent Principle: Prescription for Childhood Success & Lunchroom Jungle: Taming Childhood Stress**

Resources and Support for Concussive Syndrome

Centers for Disease Control -- <http://www.cdc.gov/concussion/>

American Academy of Neurology -- <http://www.aan.com/go/practice/concussion>

National Collegiate Athletic Association (NCAA) --

http://www.ncaa.org/wps/portal/ncaahome?WCM_GLOBAL_CONTEXT=/ncaa/NCAA/Academics+and+Athletes/Personal+Welfare/Health+and+Safety/Concussion