Patient Information

Sports-Related Head Injury

Updated December 2011

Although sports injuries contribute to fatalities infrequently, the leading cause of death from sports-related injuries is traumatic brain injury. Sports and recreational activities contribute to about 21 percent of all traumatic brain injuries among American children and adolescents.

Traumatic Brain Injury

A traumatic brain injury (TBI) is defined as a blow or jolt to the head, or a penetrating head injury that disrupts the normal function of the brain. TBI can result when the head suddenly and violently hits an object, or when an object pierces the skull and enters brain tissue. Symptoms of a TBI can be mild, moderate or severe, depending on the extent of damage to the brain. Mild cases may result in a brief change in mental state or consciousness, while severe cases may result in extended periods of unconsciousness, coma or even death.

Incidence


According to an American Association of Neurological Surgeons (AANS) study utilizing CPSC data, there were an estimated 446,788 sports-related head injuries treated at U.S. hospital emergency rooms in 2009. This number represents an increase of nearly 95,000 sports-related injuries from the prior year. All of the 20 sports noted below posted increases in the number of injuries treated in 2009, except for trampolines, which posted 52 fewer injuries in 2009. Sports that exhibited substantial increases from 2008 to 2009 included water sports (11,239 to 28,716*), cycling (70,802 to 85,389), baseball and softball (26,964 to 38,394) and basketball (27,583 to 34,692).

*Four categories were tabulated by the AANS in the current analysis that were not reflected in the 2008 injury data analysis, but together, these account for only 1,397 injuries.

The actual incidence of head injuries may potentially be much higher for two primary reasons. 1). In the 2009 report, the CPSC excluded estimates for product categories that yielded 1,200 injuries or less, those that had very small sample counts and those that were limited to a small geographic area of the country; 2). Many less severe head injuries are treated at physician's offices or immediate care centers, or are self-treated.

Included in these statistics are not only the sports/recreational activities, but the equipment and apparel used in these activities. For example, swimming-related injuries include the activity as well as diving boards, equipment, flotation devices, pools and water slides.

The following 20 sports/recreational activities represent the categories contributing to the highest number of estimated head injuries treated in U.S. hospital emergency rooms in 2009.

Cycling: 85,389
Football: 46,948
Baseball and Softball: 38,394
Basketball: 34,692
Powered Recreational Vehicles (ATVs, Dune Buggies, Go-Carts, Mini bikes, Off-Road): 26,606
Soccer: 24,184
Skateboards/Scooters: 23,114
Fitness/Exercise/Health Club: 18,012
Winter Sports (Skiing, Sledding, Snowboarding, Snowmobiling): 16,948
Horseback Riding: 14,466
Gymnastics/Dance/Cheerleading: 10,223
Golf: 10,035
Hockey: 8,145
Other Ball Sports and Balls, Unspecified: 6,883
Trampolines: 5,919
Rugby/Lacrosse: 5,794
Roller and Inline Skating: 3,320
Most recently, the report says:

brace. Recovery was complete.

UNC also reports that college cheerleading was associated with one direct injury during 2009-2010, when a female collided with a male cheerleader from the other school while both were tumbling. The female suffered a fractured cervical and thoracic vertebrae, but did not undergo surgery. Treatment included the wearing of a neck brace. She has recovered, but will not participate in cheering again.

In March 2006, a 16-year-old high school female cheerleader suffered spinal shock on Sept. 24, 2005, after falling onto her back from the shoulders of a teammate. She had a full recovery.

A male 18-year-old high school cheerleader landed on his neck after performing a standing back tuck on Sept. 12, 2005, during a practice session. The injury was a fractured cervical vertebra, and he is recovering.

A 14-year-old high school female cheerleader fell on her head during a cheerleading stunt on Oct. 27, 2005, and was taken to the hospital. No other information was available.

A 14-year-old high school female cheerleader suffered a fractured skull on Nov. 15, 2005, when her teammates did not catch her during a stunt. She has recovered.

A female high school cheerleader fractured her skull on Jan. 2, 2006, during a basket toss in the school cafeteria. She landed on her head and was taken to the hospital. She has recovered.

On March 5, 2006, a college female cheerleader fractured a cervical vertebra and suffered a concussion while performing a stunt during a basketball game. She fell 15 feet onto her head. A recovery was expected.

In January of 2007, a 15-year-old high school cheerleader was performing a double front flip into a cushioned landing when she took an odd bounce and landed on her neck. She had damage to cervical vertebrae 6-7 and underwent a five- to six-hour surgery. She has a permanent titanium plate and screws along her spine. She has recovered, but will not participate in cheering again.

In March of 2007, a college cheerleader fractured her neck, had a concussion and bruised a lung after falling 15 feet from a pyramid during a basketball game. She lost her balance and fell to the floor.

According to the Journal of Combative Sport, from January of 1960 to August of 2011, there were 488 boxing-related deaths. The journal attributes 66 percent of these deaths to head, brain or neck injuries; one was attributed to a skull fracture.

Most recently, the report says:

- During the 2001-2002 academic year, three high school cheerleaders and one college cheerleader had catastrophic injuries. All four involved fractured skulls.
- In 2002, a 16-year-old male high school cheerleader was injured during a practice session. He fractured a cervical vertebra and is quadriplegic.
- A 16-year-old high school female cheerleader suffered spinal shock on Sept. 24, 2005, after falling onto her back from the shoulders of a teammate. She had a full recovery.
- A male 18-year-old high school cheerleader landed on his neck after performing a standing back tuck on Sept. 12, 2005, during a practice session. The injury was a fractured cervical vertebra, and he is recovering.
- A 14-year-old high school female cheerleader fell on her head during a cheerleading stunt on Oct. 27, 2005, and was taken to the hospital. No other information was available.
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A 2009 study by the Center for Injury Research and Policy of the Research Institute at Nationwide Children's Hospital yielded the following head-injury statistics:

- The majority (96 percent) of the reported concussions and closed-head injuries were preceded by the cheerleader performing a stunt.
- Nearly 90 percent of the most serious fall-related injuries were sustained while the cheerleaders were performing on artificial turf, grass, traditional foam floors or wood floors.
Cycling

Every year, more than 500,000 people visit emergency rooms in the United States with bicycle-related injuries. Of those, nearly 85,000 were head injuries in 2009. There are about 600 deaths a year, with two-thirds being attributed to TBI. It is estimated that up to 85 percent of head injuries can be prevented through proper usage of The Snell Memorial Foundation, American National Standards Institute (ANSI) or American Society for Testing and Materials (ASTM)-approved helmets. It is essential that the helmet fit properly so that it doesn't fall off while the user is riding or if he or she takes a fall.

The following facts/statistics are from Safe Kids USA:

- Head injury is the leading cause of wheeled sports-related death and the most important determinant of permanent disability after a crash.
- Without proper protection, a fall of as little as two feet can result in a skull fracture or other TBI.
- Approximately 50 percent of U.S. children between 5- and 14-years-old own a helmet, and only 25 percent report always wearing it while bicycling.
- Universal use of bicycle helmets by children ages 4 to 15 could prevent 45,000 head injuries.
- Helmet use can reduce the risk of head injury by 85 percent and severe brain injury by 88 percent.
- Eight states and the District of Columbia require children to wear a helmet while participating in wheeled sports such as riding on scooters, in-line skates or skateboards.
- One study found that the rate of bicycle-helmet use by children ages 14 and under was more than twice as high in a county with a fully comprehensive bike-helmet law than in a similar county with a less comprehensive law.

Football

The National Center for Catastrophic Sport Injury Research also tracks a number of statistics for "catastrophic" football injuries, which it defines as those that resulted in brain or spinal cord injury; or skull or spine fracture. Recent findings in the Annual Survey of Catastrophic Football Injuries, 1977-2010, include the following:

- During the 2010 football season there were a total of seven cervical cord injuries with incomplete neurological recovery. Five of the injuries occurred at the high school level and two at the college level. The 2010 number is seven fewer than the 14 in 2008 and two fewer than the nine in 2009.
- The incidence of catastrophic injuries is very low on a 100,000-player exposure basis. For the approximately 1,800,000 participants in 2010, the rate of injuries with incomplete neurological recovery was 0.39 per 100,000 participants.
- The rate of injuries with incomplete neurological recovery in high school and junior high school football was 0.33 per 100,000 players, and the rate at the college level was 2.66.
- A majority of catastrophic spinal cord injuries usually occur in games. During the 2010 season, five injuries took place in games and two occurred in practice.
- Tackling and blocking have been associated with the majority of catastrophic football injuries. In 2010, one injury was caused by tackling, three by tackling on a kick-off two by being tackled, and one in a tackling drill. Tackling has been associated with 67.8 percent of catastrophic injuries since 1977.
- A majority of catastrophic injuries occur while playing defensive football. In 2010, five players were on defense, and two on offense. Since 1977, 221 players with permanent cervical cord injuries were on the defensive side of the ball, and 52 were on the offensive side, with 41 being unknown. Defensive backs were involved with 110 (35 percent) of the permanent cervical cord injuries followed by members of the kick-off team (9.6 percent) and linebackers with 9.2 percent.
- During the 2010 football season, there were no four brain injuries that resulted in incomplete recovery. All four were at the high-school level. That is a reduction of five compared to 2009 data.
- In 2010, there were 13 injuries that involved either a head or neck injury, but the athletes had full neurological recoveries. High school football was associated with three cervical vertebrae fractures, three brain injuries and one lumbar vertebra fracture. College football was associated with two cervical vertebrae injuries. Youth football was associated with one spinal cord transient injury. It should be emphasized that the researchers are not confident concerning the number of injuries with full recovery, but data collection in 2007, 2008 and 2009 produced the highest number of catastrophic recovery injuries since the National Center for Catastrophic Sport Injury Research initiated its study of catastrophic injuries in 1977.
- For the past 34 years, there have been a total of 314 football players with incomplete neurological recovery from cervical cord injuries. Two hundred-and-fifty-eight of these injuries have been to high school players, thirty-six to college players, six to sandlot players and fourteen to professionals. This data indicate a reduction in the number of cervical cord injuries with incomplete neurological recovery when compared to data published in the early 1970s. The 2005 data showed a major reduction to five from the 13 injuries in 2004, but the 2008 data shows a major increase to 14.
- The numbers for 2010 show seven cervical cord injuries. The 13 cervical cord injuries with incomplete recovery in 2004 was a dramatic increase from the years of single digits. Since 1984, there also have been 145 brain injuries with incomplete recovery. If the cervical cord injuries and the cerebral injuries with incomplete recovery are combined, the number of incomplete recovery injuries is 459 — that is an average of approximately 13.5 injuries with incomplete recovery for the past 34 years.
- When comparing cervical cord injuries to offensive and defensive players, it is safer playing offensive football. During the 34-year period from 1977-2010, 221 (70.4%) of the 314 players with cervical cord injuries were playing defense.

In addition, the National Center for Catastrophic Sport Injury Research reported the following incidences: (For a full listing of incidences, read the Annual Survey of Catastrophic Football Injuries, 1977-2010.)

- A high school sophomore was injured in a game on Sept. 3, 2010, when he was tackled, but continued to play after the injury. A few days after the game, he experienced symptoms which required hospitalization. He had a lacerated pancreas and underwent pancreatic surgery. He was in intensive care for a week. The long-term effects of the injury are unknown at this time.
- A 16-year-old high school football player was injured in a game on Oct. 8, 2010. He was making a tackle on a kick-off in the first quarter and had a fractured C-5 vertebra and crushed C-4. At the time of this writing, the player has paralysis and is confined to a wheelchair.
- A 14-year-old high school football player fractured a cervical vertebra during a game on Sept. 17, 2010. He was making a tackle from behind and hit the ground, face mask first, when his neck buckled under the pressure. He had surgery, and recovery was incomplete.
- A 15-year-old sophomore high school football player was injured during practice on August 14, 2010. He was involved in a tackling drill and had head contact with his opponent. He fractured his 5th cervical vertebra, had surgery, and recovery was complete. He came home after three months in the hospital following surgery and rehabilitation.
- A high school football player was injured on Aug. 23, 2010, while participating in a tackling drill as the tackler. He remembers first a hit to the head and then a second hit, which sent a shock to his head. He suffered a subdural hematoma and had emergency surgery; recovery was incomplete. A 17-year-old high school football player suffered a subdural hematoma during a game on Sept. 24, 2010. He was a running back and had helmet-to-helmet contact with the tackler. He had a five-hour surgery, and recovery was incomplete.
brain injury (subdural hematoma). The autopsy report showed that he had a re-bleed of an earlier subdural suffered in a game on Oct. 1, 2010. The original diagnosis was a concussion. He complained of headaches during the time of his first injury and his final injury. He was cleared by a physician to play in the game on Oct. 28, 2010.

- A 16-year-old high school football player was injured in a game and died on Nov. 15, 2010. He caught a pass and was hit in the chest by an opposing player. While on the field, he was administered CPR and use of an AED. Cause of death was commotio cordis.
- Since 1960, most direct fatalities have been caused by brain and neck injuries; in fact, since 1990, all but six head and neck deaths have been the result of brain injuries.
- A 16-year-old high school football player died on Oct. 14, 2011. He collapsed on the field after a hit, and while the player was coherent after trainers were able to get the player to sit up, he complained of a headache and collapsed again when trying to stand up. Autopsy results showed he died of bleeding in the brain, due to blunt force trauma as the result of a football injury.

According to the same report by NCCSIR, a number of the players associated with brain trauma complained of headaches or had a previous concussion prior to their deaths.

The National Federation of State High Schools released the following statement on February 23, 2010: "Effective with the 2010 high school football season, any player who shows signs, symptoms or behaviors associated with a concussion must be removed from the game and shall not return to play until cleared by an appropriate health-care professional." The new concussion language has been placed in all NFHS rules books for the 2010-2011 season as well as the "NFHS Suggested Guidelines for Management of Concussion."

**Horseback Riding**

While head injuries comprise about 18 percent of all horseback riding injuries, they are the No. 1 reason for hospital admission. A 2007 study by the Centers for Disease Control and Prevention found that horseback riding resulted in 11.7 percent of all traumatic brain injuries in recreational sports from 2001 to 2005, the highest of any athletic activity. Of the estimated 14,446 horseback-related head injuries treated in 2009, 3,798 were serious enough to require hospitalization, for an estimated 4,958 concussions and 97 skull fractures. Subdural hematomas and brain hemorrhages comprised many of the serious injuries. According to the Equestrian Medical Safety Association, head injuries account for an estimated 60 percent of deaths resulting from equestrian accidents.

There are factors that may increase the risk of falling, such as a green horse, slippery footing or bareback riding, but it is the height from which the rider falls that most significantly impacts the severity of the injury. According to the Ontario Equestrian Federation, a rider sitting on a horse is elevated eight feet or more above the ground, and a fall from just two feet can cause permanent brain damage. Riders ages 10-14 are most likely to be involved in an accident with a horse.

While serious head injury can occur while wearing a helmet, the data very clearly shows that the severity of the head injury can be decreased through helmet wear. While helmets are required in equestrian sports that involve jumping, including eventing and show jumping, in high-level dressage competitions, the riders generally wear top hats, which provide no protection. Accidents are less common in competitive dressage, but accidents can occur. While most dressage riders do not wear helmets even when practicing, they are allowed both during practice and competition.

The United States Equestrian Federation strongly encourages all riders while riding anywhere on the competition grounds to wear protective headgear with harness secured which passes or surpasses ASTM (American Society for Testing and Materials)/SEI (Safety Equipment Institute) standards for equestrian use and carries the SEI tag.

**Snow Skiing/Snowboarding**

Severe head trauma accounts for about 15 percent of all skiing- and snowboarding-related injuries, but is the most frequent cause of death and severe disability.

According to the National Ski Areas Association's (NSAA's) 2011 NSAA National Demographic Study, 61 percent of skiers and snowboarders now wear helmets while on the slopes at U.S. ski areas, up from 57 percent during the 2009-2010 season. Helmet usage among those interviewed nationwide has increased 140 percent since the 2002-2003 season, when only 25 percent of skiers and snowboarders were wearing a helmet at the time of being interviewed. More importantly, nearly 80 percent of children ages 17 and younger now wear helmets on the slopes. The NSAA National Demographic Study was compiled from more than 130,000 interviews of skiers and snowboarders nationwide over the course of the 2010-2011 season.

The NSAA Demographic survey also revealed that:

- 93 percent of children 9-years-old or younger wear ski/snowboard helmets.
- 79 percent of children between 10 and 14 wear ski/snowboard helmets.
- 73 percent of adults over the age of 65 wear ski/snowboard helmets.
- Skiers and snowboarders ages 18 to 24 traditionally have represented the lowest percentage of helmet use among all age groups. This year, 48 percent of all 18- to 24-year-olds interviewed wore helmets, representing a 166-percent increase in usage for this age group since the 2002-2003 season, when only 18 percent wore helmets.

NSAA recently launched a revamped Lids on Kids website designed to provide parents with pertinent helmet-safety information; it includes simple helmet-sizing instructions to help ensure a proper fit.

**Helmet Usage**

There are no state laws mandating helmets for skiing or any winter sports. Ski resorts in Aspen, Colo., mandate that skiers under age 12 wear helmets. Following the high-profile skiing-related deaths of Michael Kennedy in December of 1997, and Sonny Bono in January of 1998, an increase in the number of skiers wearing helmets has been noted in several studies.

Meanwhile, helmet use has been mandatory for snowpark users in Quebec, Canada, since the winter of 2006-2007, according to the Quebec Ski Areas Association (ASSQ). And in January of 2010, the Canadian Ski Council (CSC) issued the following national policy:

"The Canadian Ski Council recommends wearing helmets for skiing and riding. Skiers and snowboarders are encouraged to educate themselves on the benefits and limitations of helmet usage. The primary safety consideration, and obligation under the Alpine Responsibility Code, is to ski and ride in a controlled and responsible manner."

Said policy was developed after research undertaken by the CSC showed that helmet usage in Canada is increasing steadily, with more than 50 percent of Canadian skiers and boarders wearing helmets; usage is much greater among youth, reaching 90 percent in many areas. In order to further ensure compliance with this initiative,
the CSC notes that Canadian ski areas have invested heavily in making the sport safer, with improved signage, better grooming and safer equipment; areas have purchased more than 50,000 rental helmets to include in their rental packages, which are available at nearly all Canadian ski areas.

In a February 2010 release from Quebec’s Trauma Centres and the ASSQ, Dr. Tarek Razek, director of the Montreal General Hospital Trauma Program, said, "Wearing a helmet reduces the risk of head injuries in skiers and snowboarders by approximately 35 percent." Dr. Razek also advocates helmet use in other sports, including cycling and rollerblading.

As part of a recent survey of 80 Canadian ski areas:

- Area operators estimated that 55 percent of all skiers and boarders wore helmets. Quebec had the highest rate of usage at 65 percent, with the lowest rate in Western Canada at 50 percent.
- The Grade 4/5 Snowpass program, which had 41,000 youth participants in 2008-2009, provides reduced-cost lift tickets and other specials for participants. Fifty-four percent of the parents of Snowpass holders reported wearing helmets regularly, and 93 percent of youth participants reported wearing helmets on a regular basis.
- A survey of 1,500 attendees conducted at the Toronto Ski Show in October of 2008 found that 55.3 percent of men and 57.6 percent of women wore helmets all or most of the time. Older skiers and boarders had a higher usage of helmets than younger adults.

Meanwhile, according to a 2007-2008 survey of skiers and boarders, the National Ski Area Association in the U.S. found the following:

- Forty-three percent of survey respondents were wearing a helmet when interviewed, up from 40 percent in the previous season.
- Helmet usage increases with ability level, rising from 26 percent usage by beginners, to 38 percent by intermediates, to 55 percent by advanced/expert participants.
- Helmet usage is higher for children ages 9 and under (70 percent) and 10-14 (60 percent), and adults ages 55-64 (51 percent) and 65+ (59 percent), than for other age groups. Helmet usage is lowest among 18-24-year-olds (32 percent).

According to the 2008/09 NSAA National Demographic Study:

- Forty-eight percent of U.S. skiers and boarders overall wore helmets, up from 43 percent the year before. Comparatively, in the 2002/03 season, only 25 percent of skiers and boarders wore helmets.
- Seventy-seven percent of children nine years old or younger wore ski helmets.
- Sixty-six percent of children between ages 10 and 14 wore ski helmets.
- Sixty-three percent of adults ages 65 and older wore ski helmets.
- Helmet usage by skiers and boarders ages 18 to 24 currently is 32 percent, representing a 78 percent increase in usage for this age group since the 2002/03 season, when only 18 percent wore helmets.
- Notably, helmet usage increases with the skier's ability level. Twenty-six percent of beginners wore helmets, and 38 percent of intermediates wore helmets, while 55 percent of advanced skiers and riders wore helmets.

Soccer

Protection against head injuries in soccer is complicated by the fact that heading is an established part of the game, and any attempt to protect against head injuries must allow the game to be played without modification. Several head guards have been developed to reduce the risk of head injuries in soccer. One independent research study found that none of the products on the market provided substantial benefits against minor impacts, such as heading with a soccer ball.

A McGill University study found that more than 60 percent of college-level soccer players reported symptoms of concussion during a single season. Although the percentage at other levels of play may be different, these data indicate that head injuries in soccer are more frequent than most presume.

According to CPSC statistics, 40 percent of soccer concussions are attributed to head to player contact; 10.3 percent are head to ground, goal post, wall, etc.; 12.6 percent are head to soccer ball, including accidents; and 37 percent are not specified.

Types of Head Injuries

Concussions

Cerebral concussions frequently affect athletes in both contact and non-contact sports. Cerebral concussions are considered diffuse brain injuries and can be defined as traumatically induced alterations of mental status. A concussion results from shaking the brain within the skull and, if severe, can cause shear injuries to nerve fibers and neurons.

Grading the concussion is a helpful tool in the management of the injury (see Cantu below) and depends on: 1) Presence or absence of loss of consciousness, 2) Duration of loss of consciousness, 3) Duration of posttraumatic memory loss, and 4) Persistence of symptoms, including headache, dizziness, lack of concentration, etc.

Some teams physicians and trainers evaluate an athlete's mental status by using a five-minute series of questions and physical exercises known as the Standardized Assessment of Concussion (SAC). This method, however, may not be comprehensive enough to pick up subtle changes. More recently, teams have employed ImPACT, a 25-minute computer-based testing program specifically designed for the management of sports-related concussion. A player who has sustained a concussion is three to six times more likely to sustain another one. While the decision on when an athlete is ready to return to play isn't straightforward, every player should receive baseline neurological testing before the season so that the results can be used for comparison in the event the athlete receives a blow to the head.

According to the Cantu Guidelines, Grade 1 concussions are not associated with loss of consciousness, and posttraumatic amnesia is absent or is less than 30 minutes in duration. Athletes may return to play if no symptoms are present for one week.

Players who sustain a Grade II concussion lose consciousness for less than five minutes or exhibit posttraumatic amnesia between 30 minutes and 24 hours in duration. They also may return to play after one week of being asymptomatic.

Grade III concussions involve posttraumatic amnesia for more than 24 hours or unconsciousness for more than five minutes. Players who sustain this grade of brain injury should be sidelined for at least one month, after which they can return to play if they are asymptomatic for one week.

Following repeated concussions, a player should be sidelined for longer periods of time and possibly not allowed to play for the remainder of the season.

Second Impact Syndrome (SIS) results from acute, sometimes fatal brain swelling that occurs when a second concussion is sustained before complete recovery from a previous concussion. This causes vascular congestion and increased intracranial pressure, which may be difficult or impossible to control. The risk for SIS is higher for
sports such as boxing, football, ice or roller hockey, soccer, baseball, basketball and snow skiing.

In September of 2011, the AANS issued a Powerpoint presentation entitled "Concussion and Sports: Useful prevention and treatment information for your community from America's neurosurgeons" to help prepare and educate the public on this critical issue. The issue of concussion is covered further within the AANS Patient Information section as well. To view that page, click here.

Coma

The word coma refers to a state of unconsciousness. The unconscious state has variability and may be very deep, where no amount of stimulation will cause the person to respond or, in other cases, a person who is in a coma may move, make noise or respond to pain, but is unable to obey simple, one-step commands such as "hold up two fingers" or "stick out your tongue." The process of recovery from coma is a continuum along which a person gradually regains consciousness.

For people who sustain severe injury to the brain and are comatose, recovery is variable. The more severe the injury, the more likely the result will include permanent impairment.

The Glasgow Coma Scale usually is administered upon admission to establish a baseline level of consciousness, motor function and eye findings. Frequent evaluations of the patient are imperative to help assess neurologic improvement or deterioration.

Brain-imaging technologies, particularly computerized axial tomography (CT or CAT scan), can offer important immediate information about a person's status. The purpose of performing an emergency CT scan is to rule out a large mass lesion (hematoma) compressing the brain that requires immediate surgical removal. Magnetic Resonance Imaging (MRI) is used in a more elective setting to image subtle changes that are not picked up by CT.

Brain Injury Symptoms

- Pain: Constant or recurring headache
- Motor Dysfunction: Inability to control or coordinate motor functions, or disturbance with balance
- Sensory: Changes in ability to hear, taste or see; dizziness; hypersensitivity to light or sound
- Cognitive: Shortened attention span; easily distracted; overstimulated by environment; difficulty staying focused on a task, following directions or understanding information; feeling of disorientation and confusion and other neuropsychological deficiencies
- Speech: Difficulty finding the "right" word; difficulty expressing words or thoughts; dysarthric speech

Head Injury Prevention Tips

Buy and use helmets or protective head gear approved by the ASTM for specific sports 100 percent of the time. The ASTM has vigorous standards for testing helmets for many sports; helmets approved by the ASTM bear a sticker stating this. Helmets and head gear come in many sizes and styles for many sports and must properly fit to provide maximum protection against head injuries. In addition to other safety apparel or gear, helmets or head gear should be worn at all times for:

- Baseball and Softball (when batting)
- Cycling
- Football
- Hockey
- Horseback Riding
- Powered Recreational Vehicles
- Skateboards/Scooters
- Skiing
- Snowboarding
- Wrestling

Head gear is recommended by many sports safety experts for:

- Bull Riding
- Martial Arts
- Pole Vaulting
- Soccer
- Vintage Motor Sports

General Tips

- Supervise younger children at all times, and do not let them use sporting equipment or play sports unsuitable for their age.
- Do not dive in water less than 12 feet deep or in above-ground pools.
- Follow all rules at water parks and swimming pools.
- Wear appropriate clothing for the sport.
- Do not wear any clothing that can interfere with your vision.
- Do not participate in sports when you are ill or very tired.
- Obey all traffic signals, and be aware of drivers when cycling, skateboarding or rollerblading.
- Avoid uneven or unpaved surfaces when cycling, skateboarding or rollerblading.
- Perform regular safety checks of sports fields, playgrounds and equipment.
- Discard and replace sporting equipment or protective gear that is damaged.

Rule Changes in College Football to Prevent Head and Neck Injuries

The National Athletic Trainers' Association (NATA) and the American Football Coaches Association (AFCA) Task Force, headed by Ron Courson, director of sports medicine for the University of Georgia, has focused on two primary problems associated with head contact.

- Head-down contact still occurs frequently in intercollegiate football
- Helmet-contact penalties are not adequately enforced.

Rule changes implemented by the National Collegiate Athletic Association (NCAA) related to head-down contact and spearing in collegiate football have been distributed to all coaches and officials throughout the country. The objective is to eliminate injuries resulting from a player using his helmet in an attempt to punish an
With the rule changes and more diligent enforcement of the rules, there is hope that a significant reduction in head and neck injuries will result.

The NCAA revised its 16-year-old guidelines on treatment of concussion in the NCAA Sports Medicine Handbook to better provide member institutions with appropriate responses to concussion injuries and procedures for returning athletes to competition or practice. According to page 55 of the 2011-2012 edition, "It is essential that no athlete be allowed to return to participation when any symptoms persist, either at rest or exertion." The "Concussion or Mild Traumatic Brain Injury (mTBI) in the Athlete" section details circumstances in which an athlete should be withheld from competition pending clearance by a physician.

Football-related Head and Neck Injury Prevention Tips:

- All players should receive pre-season physical exams, and those with a history of prior brain or spinal injuries, including concussions, should be identified.
- Football players should receive adequate preconditioning, and strengthening of the head and neck muscles.
- Coaches and officials should discourage players from using the top of their football helmets as battering rams when blocking, hitting, tackling and ball carrying.
- Coaches, physicians and trainers should ensure that the players' equipment is properly fitted, especially the helmet, and that straps are always locked.
- Coaches must be prepared for a possible catastrophic spinal cord injury. The entire staff must know what to do in such a case; being prepared and well informed might make all the difference in preventing permanent disability.
- The rules prohibiting spearing (hitting another player with the crown of the helmet) should be enforced in practice and games.
- Ball carriers should be taught to not lower their heads when making contact with the tackler to avoid helmet-to-helmet collisions.