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Cervical Spine Injuries in Sports

Cervical spine, or neck, injuries are one of the most traumatic injuries an athlete can experience. Although they are rare, when cervical injuries occur, they tend to grab major headlines, especially in athletes at the collegiate and professional levels. One reason the injury gets significant attention is that it has the potential to be irreversible and life-changing. An athlete's career can be completely or nearly completely destroyed by such an injury. Even individuals who do not typically watch sporting events can remember instances in which famous athletes and celebrities have experienced catastrophic injuries. Actor Christopher Reeve, who was well known for his role as Superman, sustained a spinal cord injury because of 2 fractures in his neck while competing in an equestrian contest in 1995. He was thrown from his horse and landed directly on his head. He was immediately paralyzed from the neck down. Reeve ultimately became a spokesperson for spinal cord injury patients and research before his death.

As with Mr. Reeve's injury, cervical spine injuries are often devastating to the athlete. It is rare for patients with a catastrophic cervical injury to return to their previous level of play. However, the inability to return to performing any activity, including something as simple as breathing, drives us to prevent these injuries.

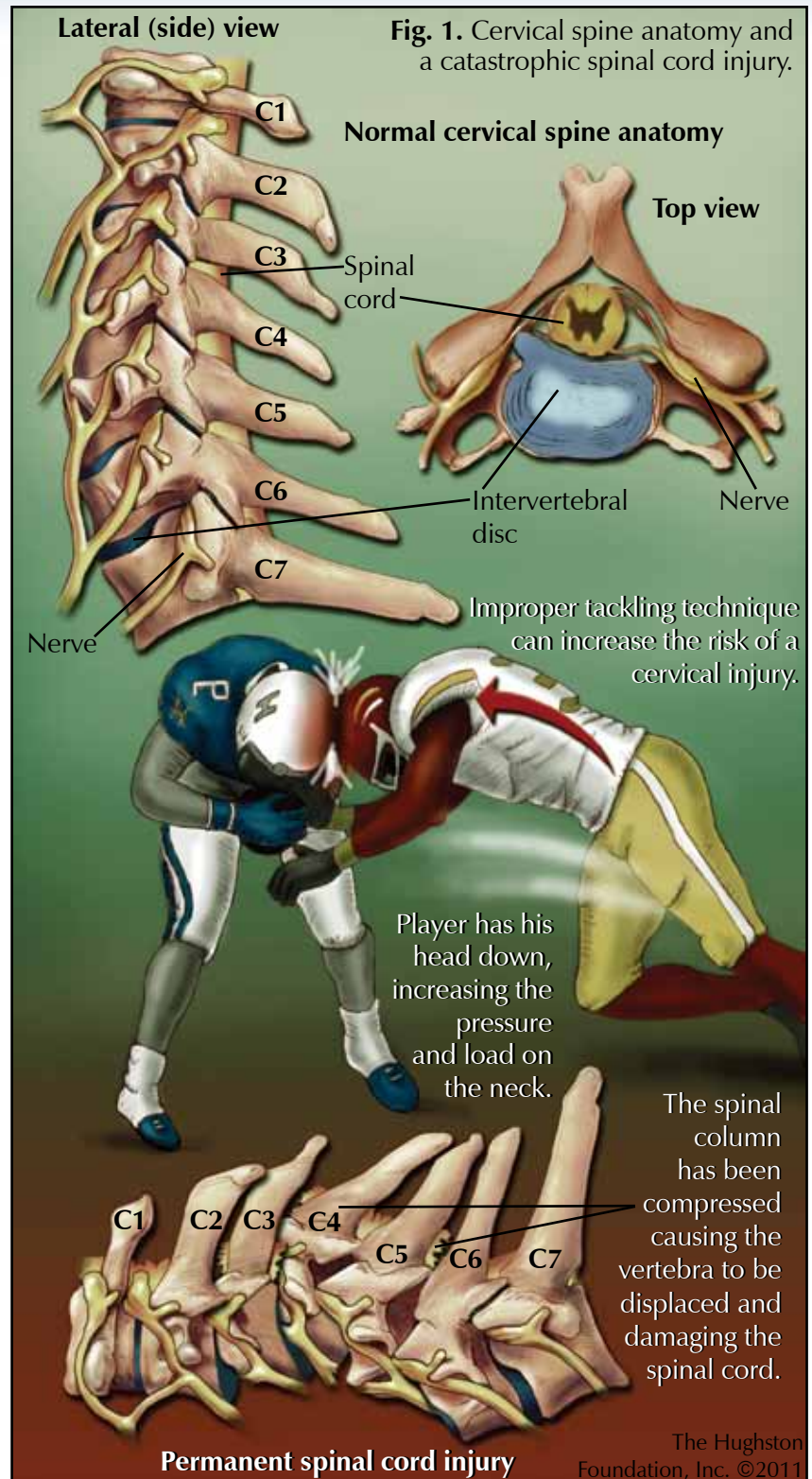


Fig. 1. Cervical spine anatomy and a catastrophic spinal cord injury.

Normal cervical spine anatomy

Top view

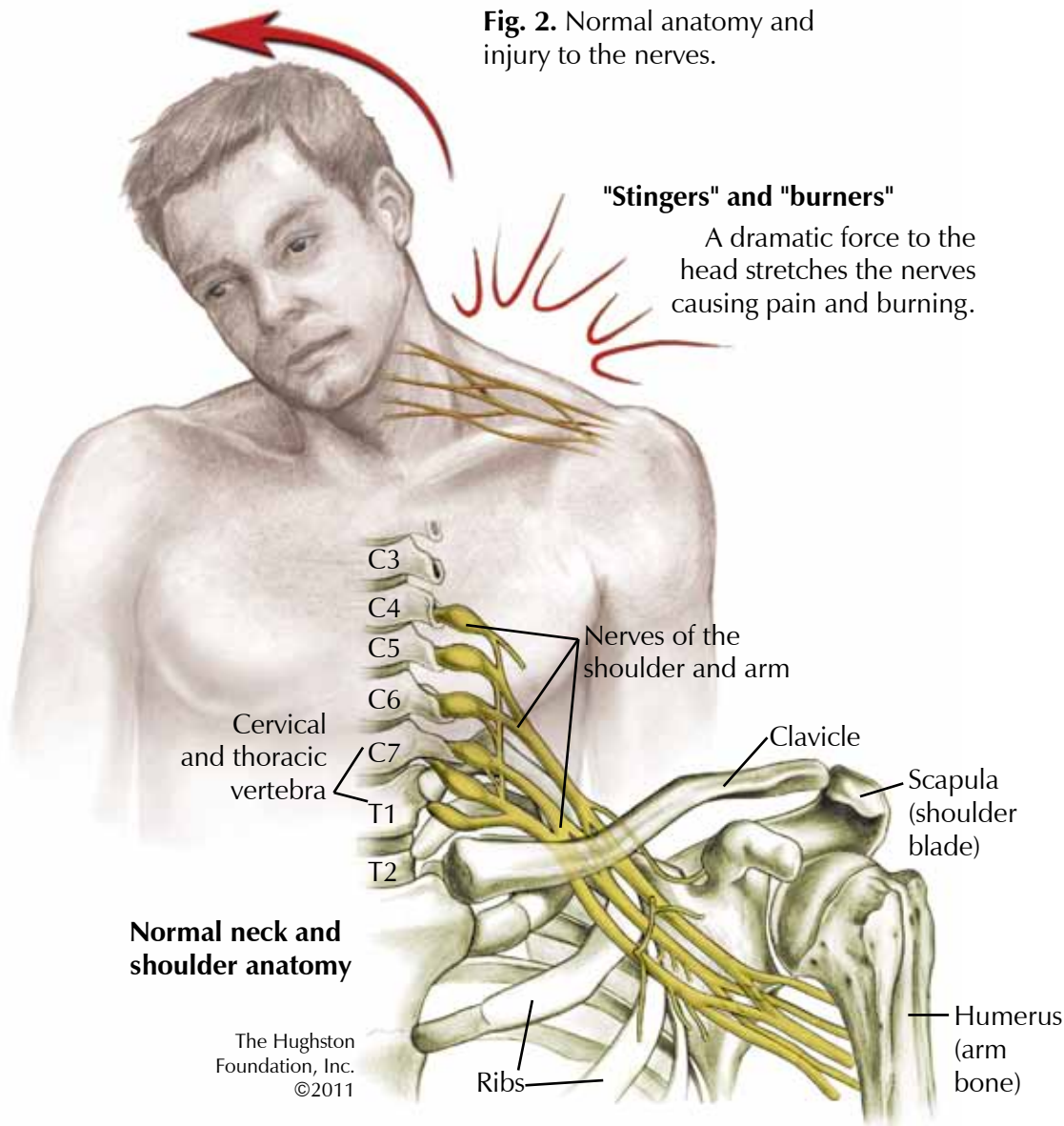
Improper tackling technique can increase the risk of a cervical injury.

Player has his head down, increasing the pressure and load on the neck.

The spinal column has been compressed causing the vertebra to be displaced and damaging the spinal cord.

Permanent spinal cord injury

Fig. 2. Normal anatomy and injury to the nerves.



Normal neck and shoulder anatomy

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Types of injuries

Cervical spine injuries include whiplash injuries (violent back-and-forth motions of the neck), fractures, and spinal cord injuries (Fig. 1). Twisting, bending, or direct blows to the top of the head, such as those that can occur when diving head first into a shallow pool, can cause a cervical spine injury. "Stingers" and "burners" in collision sports, such as hockey and football, are neck injuries that can cause brief periods of paralysis in the upper or lower extremities (Fig. 2). Most cervical spine injuries are preventable, but despite advances, they still occur.

Research

On review of the data from the National Center for Catastrophic Injury Research from the University of North Carolina, the highest rate of cervical spine injuries in high school sports occurs in ice hockey with 2.39 occurrences per 100,000 participants per year. Football and gymnastics were tied for second at 1.78, followed by wrestling, cheerleading, and lacrosse—all less than 1 occurrence per 100,000 participants per year.

With regard to injury rates in pediatric patients, the data reveals higher rates with trampoline use and diving activities. The Centers for Disease Control and Prevention states that 18% of all pediatric spinal cord injuries that occur each year happen during sporting events. The approximate annual number of spinal cord injuries is 11,000, which equates to nearly 2,000 spinal cord injuries occurring in sport activities every year.

Safety measures

When catastrophic injuries occur, the damage is typically caused from the injury itself; however, additional damage can occur while administering aid to an injured athlete or while the athlete is being moved from the field of play to a medical center. If the spine becomes unstable due to a fracture or broken bone, the spinal cord has lost its protective shell. When the injury occurs, the athlete is often unconscious and essentially at the

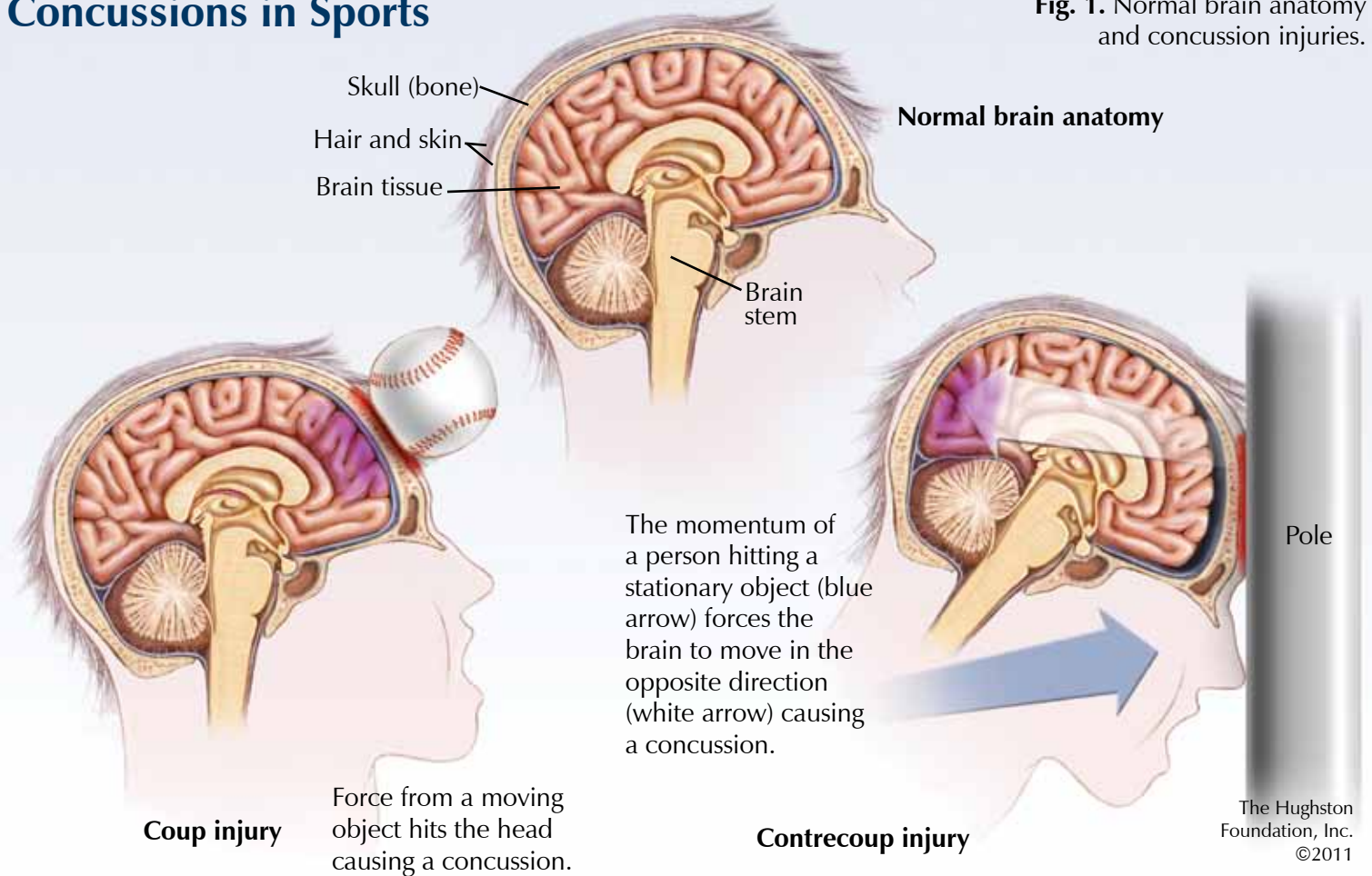
mercy of the person tending to him or her. Numerous safety protocols have been established to help prevent a secondary injury. After an injury, the best method to prevent additional injury is to maintain control of the entire spine with the use of a hard cervical collar and long spine board. Rigid maintenance of spinal alignment is necessary, which is why injured athletes are often taped down to spine boards before moving them. Uncontrolled movement of an injured athlete with an unstable spine can cause a preventable spinal cord injury.

To reduce the risk of cervical spine injuries, athletes should use proper equipment, such as helmets and headgear. When possible, avoid head-first movements during collision sports, and use spotters during gymnastic events. Fortunately, cervical spine injuries are rare, but without proper gear and appropriate safety measures, the athlete is at a higher risk for a catastrophic injury.

*Douglas W. Pahl, MD
Columbus, Georgia*

Concussions in Sports

Fig. 1. Normal brain anatomy and concussion injuries.



A concussion causes a temporary change in consciousness immediately after a blow to the head. When an athlete experiences a concussion his or her motor skills, coordination, balance, and cognitive abilities can be impaired. Concussions range in severity. In fact, a head injury can be so slight the athlete may not know that he or she has a concussion or it can be so severe the athlete is rendered unconscious. In addition to the severity, more than one concussion can cause serious effects. An athlete who has had more than one concussion has an increased risk of another concussion and the cumulative effect can be permanently damaging or deadly.

Causes of concussions

Concussions can be caused by a direct blow or by indirect trauma to the head. The way in which the trauma occurs can be categorized as coup, contrecoup, repeated subconcussive forces, and rotational or shear forces (Fig. 1). Coup injuries occur when an object moving at a high velocity strikes a stationary head. With a coup injury, the injured area is on the same side as the impact. A contrecoup injury occurs when a moving skull hits a stationary object such as a pole. With contrecoup injuries the injured area is on the opposite side of the impact. Athletes who receive numerous nontraumatic blows

to the head often experience repeated subconcussive forces. The repeated trauma can result in disruption of electroencephalographic (EEG) activity in the brain. The final cause of a concussion is a sudden twisting force or acceleration and deceleration that can disrupt neurologic activity. Any of these types of trauma can result in unconsciousness, disorientation, or amnesia.

Signs and symptoms of concussions

An athlete can experience many different signs and symptoms after a head injury. When an athlete sustains a head injury there can be acute and late (delayed) symptoms. Acute symptoms occur immediately following the head injury while late symptoms can take hours or even days to appear in an athlete. Lightheadedness, disorientation, headache, balance problems, loss of consciousness, nausea, or tinnitus (ringing in the ears) are some examples of acute symptoms. Sleep irregularities, depression or anxiety, lethargy, memory dysfunction, personality changes, or irritability are some of the late signs and symptoms of concussion.

Management of concussions

Concussions range in severity, but are best described as mild, moderate, or severe. A mild concussion disrupts

Range of severity and symptoms for concussions.	
Mild <ul style="list-style-type: none"> • Momentary confusion • Lightheadedness • Short span of disorientation 	<ul style="list-style-type: none"> • Remains conscious • Short recovery time
Moderate <ul style="list-style-type: none"> • Longer span of confusion • Disorientation • Loss of balance • Slight amnesia • Headache 	<ul style="list-style-type: none"> • Remains conscious • Recovery takes longer
Severe <ul style="list-style-type: none"> • Nausea • Balance problems • Tinnitus (ringing in the ears) 	<ul style="list-style-type: none"> • Loss of consciousness
Late <ul style="list-style-type: none"> • Sleep irregularities • Depression/anxiety • Lethargy • Memory dysfunction • Personality changes 	
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function and can cause momentary confusion, but does not render the athlete unconscious. A moderate concussion causes longer lasting confusion and slight amnesia. A severe concussion results in loss of consciousness.

After determining the severity of the concussion, the athlete may or may not need to be referred to a physician or emergency medical facility. With any head injury precautions must be taken including rest from physical activity until the athlete shows no signs and symptoms or until a physician clears him or her for return to play.

Second Impact Syndrome (SIS)

Athletes who have had a prior concussion are at an increased risk for having another one and it can take longer to recover from additional concussions. Second impact syndrome occurs when an athlete who has sustained an initial head injury, usually a concussion, sustains a second head injury before the symptoms associated with the prior injury have totally resolved. Second impact syndrome can be life threatening, which is why even minor head injuries should not be taken lightly.

The signs and symptoms from the first impact often involve visual, motor, or sensory changes. The athlete can also experience problems with thought and memory. When the athlete returns to play while still experiencing symptoms and sustains a second impact to the head, the intracranial pressure builds up due to vascular enlargement and the brain stem can become compressed. Within the skull, the brain can be under a lot of stress with swelling after an injury; but, on the outside the athlete can appear to be only a little shaken up. With second impact syndrome the emergency medical services should be contacted immediately and the athlete's vital signs should be closely watched.

After a head injury, the athlete can recover within a few days. However, because there is a chance that a second

impact can occur, it is imperative that an athlete becomes asymptomatic before being allowed to return to play. If an athlete has sustained several head injuries during his or her sport career, it can take longer for the symptoms to resolve and for him or her to return to play.

To help prevent a concussion, wear a good helmet and mouthpiece, strengthen the neck muscles, and follow the safety rules for the sport. For a safe and healthy recovery, follow an established return to play protocol.

*Lindsey Sharpe, ATC and Terri Van Horne, ATC
Columbus, Georgia*

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Return to play protocol following a concussion.

First few days following injury it is important to emphasize physical and mental rest.

- Stay off feet as much as possible
- No loud music or video games

Return to play steps:

1. No activity (complete rest) until all symptoms have resolved. Once asymptomatic *without medication* for a complete 24-hour period, proceed to step 2.
2. Light aerobic exercise such as walking or stationary cycling. No weight lifting or resistance training. If still asymptomatic *without medication* the athlete can proceed to step 3 the next day.
3. Sport specific exercises such as throwing a baseball or going through passing routes. Can also begin light weight training. If asymptomatic *without medication* can proceed to step 4 the next day.
4. Non-contact training drills. If still asymptomatic *without medication* proceed to step 5.
5. Full-contact training after medical clearance. If athlete has made it through all the steps without a return of symptoms and has been granted clearance for return to activity by their physician, then and only then, can the athlete return to competition.
6. Game play.

If any post-concussive symptoms occur, stop all activity until asymptomatic for 24 hours without medication and then the athlete can resume at level 2.

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Ear Injuries in Sports and Benign Positional Vertigo

Injuries to the ear can occur in many different sports and in all levels of athletes, from weekend warriors to professionals. Although extremity injuries often receive more attention, anyone participating in a sport should be aware of the basics of ear injuries and their prevention.

Outer ear injuries

The auricle, or outer ear, is the most commonly injured structure in the ear. The auricle is often vulnerable when the head reflexively turns to the side when a player expects a collision. Cauliflower ear, or traumatic auricular hematoma, is common among boxers, mixed martial artists, amateur and professional wrestlers, and participants in jujitsu and rugby. A single or multiple blows can lead to a hematoma (blood clot) forming between the outside and inside of the auricle. If such an injury occurs, it can be treated by draining the fluid and applying antibiotic medication. Letting the injury go untreated can allow pressure to build, causing permanent eardrum injury.

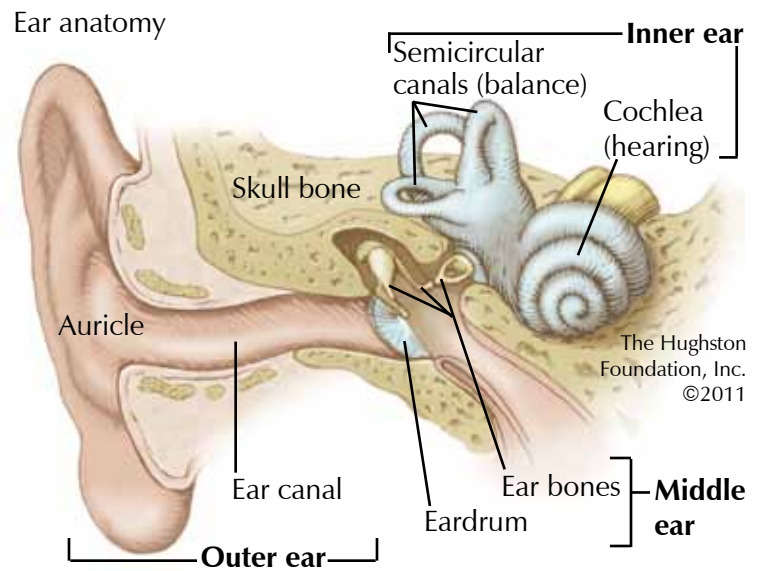
Lacerations (cuts) to the ear are also common. Most lacerations to the outer ear can be successfully treated with general wound care or sutures. Cuts around the ear should be cleaned to ensure that no debris gets entrapped beneath the skin. Minor cuts within the ear canal itself can be treated with antibiotic drops, while more significant lacerations need to be sutured and often packed to help control swelling. Very serious cuts involving the ear canal are best evaluated and treated by an otolaryngologist (ear, nose, and throat specialist).

Swimmer's ear

Injuries to the ear need not necessarily be traumatic. External otitis, known as swimmer's ear, is a microbial infection that causes inflammation of the outer ear canal. It can be caused by trapped water after swimming, but it can also be started by seemingly innocuous causes like prolonged showering or overzealous use of cotton swabs to clean the ear. Your physician can diagnose otitis externa by examining your ear canal. Most mild cases can be treated with cleaning the outer ear canal and debris removal; often treatment can be supplemented with topical Burrow's solution. Once the condition has resolved, the ear once again becomes "self cleaning" and the condition becomes unlikely to recur.

Eardrum injuries

Perforations of the eardrum in sport usually occur following a direct blow to the head. The use of helmets in most organized contact sports has reduced the occurrence of eardrum injuries, but they do occur nonetheless. Often, eardrum perforations heal without treatment. Once an



eardrum injury is diagnosed, the athlete should observe commonsense precautions like avoiding swimming or submersions to reduce the risk of an infection.

Benign Positional Vertigo (BPV)

BPV is a disorder of the inner ear that affects the vestibular (balance) system and alters how we perceive our position in space. In the athlete, BPV can interfere with the ability to perform sporting tasks requiring balance and coordination. BPV causes brief, dizzy episodes, often after an abrupt change in position. The person can feel nauseated, although vomiting is uncommon. Treatment for the disorder can include medications and a mechanical technique. Medications can include scopolamine or meclizine, which are prescriptions for motion sickness to help with nausea and dizziness. Definitive treatment includes a mechanical repositioning maneuver, such as the Epley maneuver, which is a series of carefully sequenced motions to move the inner ear calcium buildup causing the vertigo. With successful use of the Epley maneuver, many patients' vertigo symptoms are completely resolved.

Whether an athlete suffers from a traumatic ear injury, an infection, or a syndrome affecting balance, problems of the ear clearly can affect the athlete's ability to play and compete at their usual level. Like most sporting injuries, the ear can be effectively managed with diligent attention and prompt treatment. If medical attention is required, your team of sports physicians, including your family physician, orthopaedist, and otolaryngologist, stand ready to provide the expertise and care to help you successfully recover and return to play. If you have injured your ear, do not hesitate to consult your certified athletic trainer or your family physician, who can evaluate your injury and make sure you get the most appropriate and timely care possible.

*R. Grant Mostak, MD
Columbus, Georgia*



Protecting Your Eyes During Sports

Most athletes practice injury prevention to some extent by stretching or wearing protective gear such as pads or helmets. Although athletes use basic prevention techniques out of habit or sport requirement, how much thought goes into protecting your eyes?

Athletes often overlook eye protection, although injuries to your eyes have consequences that affect more than just your sport involvement. Eye injuries can range from mild to severe and can interfere with participation in school and work-related activities. Additionally, serious eye injuries can have long-lasting effects on your social, psychological, and occupational wellbeing.

Just the facts

Annually, there are over 600,000 sports-related eye injuries. Of those, 42,000 require emergency room evaluation and 13,500 result in permanent loss of sight. These numbers roughly translate to 1 sports-related eye injury seen by an ER physician every 13 minutes. Eye injuries are the leading cause of blindness in children and sports are the leading cause of eye injuries in children under the age of 16. Treatment of sports-related eye injuries cost on average \$175 to \$200 million each year. Of all eye injuries, 90% could be prevented with appropriate protection.

Sports having the highest frequency of eye injuries.

Basketball	Baseball
Ice hockey	Court sports
Combat sports	

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Types of injuries

Most eye injuries that occur during sporting activity can be classified as blunt, penetrating, or radiation injuries. Blunt, or impact, injuries occur from a direct blow to your eye. These injuries can be caused by equipment, such as a ball, stick, or racket, or by another athlete. Injuries can range from a bruised or black eye to an orbital fracture (broken eye socket bone). Penetrating, or piercing, injuries occur when an object cuts into or pierces the globe of your eye. Sharp objects such as broken glass, fishing hooks, debris, or fingernails can cause these types of injuries. Penetrating injuries can be severe and require immediate medical evaluation. Radiation eye injuries, caused by intense sunlight, are common in water and snow sports. Goggles, sport glasses, or face shields can help protect your eyes from blunt or penetrating injuries and wearing eyewear with SPF protection will protect your eyes from radiation.

What are the most common sports-related eye injuries?

Corneal abrasions are scrapes or scratches to the surface layer of your eye. They often heal by themselves, but can be treated with antibiotic drops to prevent infection.

Traumatic iritis is inflammation within the iris that occurs after blunt trauma. Traumatic iritis is treated with steroid drops and medication to dilate the pupil.

Traumatic hyphema, or blood in the front chamber of the eye, is a serious injury that requires immediate evaluation because it can result in a permanent loss of vision.

Orbital fractures are breaks in the bones that surround your eye socket. These types of fractures require further evaluation for associated injuries and sometimes need surgery to heal.

Sports and the relative risks for eye injuries.

Low-risk: cycling, running, track sports, swimming, and singles tennis.

High-risk: football, hockey, basketball, baseball, softball, doubles tennis and racket sports, water polo, fencing, lacrosse, and rugby.

Very high-risk: boxing, martial arts, wrestling, and ultimate fighting. *These sports do not offer the ability to use eye protection due to the nature of the sports.*

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When should you seek medical attention?

Often, eye injuries can be treated at home, but a physician or other healthcare provider should immediately assess any penetrating eye injury. Other signs and symptoms that can indicate a serious injury are: sudden decrease or loss of vision, pain with eye movement, light sensitivity (photophobia), double vision, protrusion of the eye, lightning flashes, an irregularly shaped pupil, foreign body sensation, red eye, and blood in the front chamber of the eye.

Prevention

You can prevent an injury by wearing protective eyewear, but not all eyewear is protective. Contact lenses offer no protection and street-wear glasses and sunglasses can be more dangerous since they can break and cause a penetrating eye injury. The lenses in protective eyewear are made of polycarbonate, which is a versatile tough plastic that is 20 times stronger than regular lenses. It can withstand the force of a projectile traveling 90 miles per hour. The frames in protective eyewear must be sturdy and contain a posterior rim so that the lens cannot dislodge backward into your eye. The frames themselves can also be made of polycarbonate. For the best result, a licensed optometrist or optician should fit your protective eyewear.

Jaclyn Jones, DO
Columbus, Georgia

Dental Injuries and Prevention

At any sporting or athletic event, from the recreational to the professional level, there is always a chance of injury to the teeth and mouth of participants. Dental injuries can range from a chipped tooth to fractured and displaced teeth. Although dental injuries are quite common, most can be easily prevented with the simple use of a mouth guard.

Tooth fractures

A tooth fracture, one of the most common injuries to the teeth, often occurs during a blow to the upper or lower jaw. Fractures of the teeth can result in bleeding, which is often a sign of the severity of the fracture. Uncomplicated fractures occur when a small piece of the tooth breaks, but it does not result in bleeding. This kind of fracture does not require immediate evaluation by a dentist, but the athlete should see the dentist within 24 to 48 hours after injury. To save the fractured portion, the broken piece can be stored in a clean plastic bag and taken to the dentist for possible gluing back in place or the tooth can be capped.

Complicated fractures occur when a large portion of the tooth breaks and the pulp becomes exposed (Fig. 1). Typically, a complicated fracture results in bleeding, and the exposed pulp chamber causes a great deal of pain. A rare but serious, root fracture occurs below the gum line and may not result in displacement of the tooth, but will cause bleeding and a great deal of pain. Use gauze to help control the bleeding and if the tooth is pushed back, it should be left in that position for the dentist to reposition.

Tooth displacements

Subluxation, luxation, and avulsion tooth displacements occur during a direct blow to the mouth as well. A subluxation occurs when the tooth remains in its normal place and is only slightly loose. A luxation occurs when the tooth becomes extremely loose and has been pushed forward or back. The athlete should see a dentist as soon as possible after a subluxation or luxation injury. An avulsion occurs when the tooth has been knocked all the way out of the socket (Fig. 2). If the tooth has been

Fig. 1. Tooth anatomy (cross section)

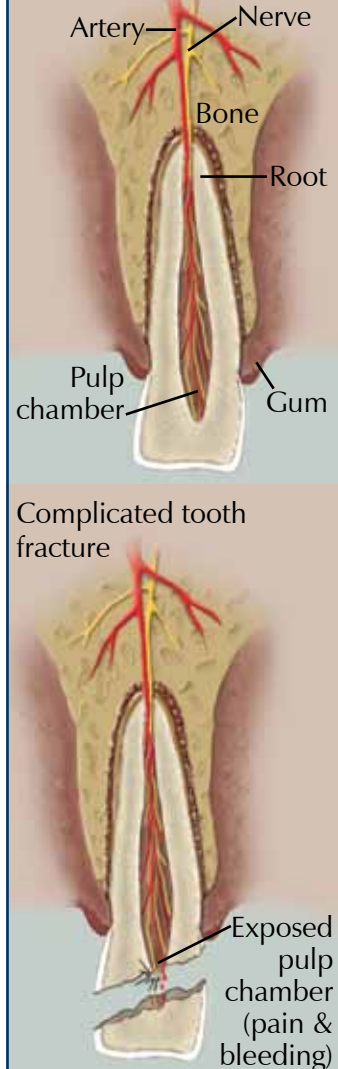
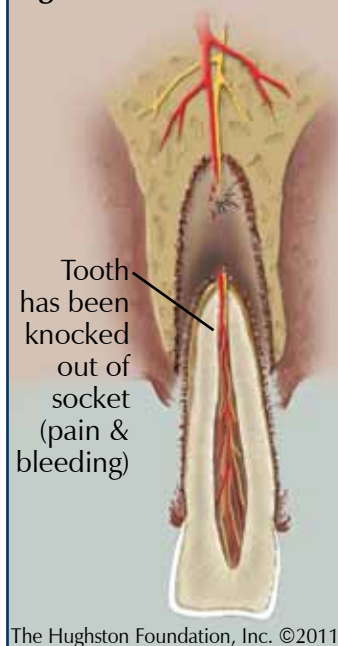


Fig. 2. Tooth avulsion



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knocked out of the mouth it should be rinsed with clean water or saline, but it should not be scrubbed or wiped off. The tooth should be stored in a commercial product, such as Save-A-Tooth® or EMT Tooth Saver®, or if those are not available, it should be stored in milk or saline. If none of these options are available and the athlete is conscious, the tooth can be placed inside the cheek. With an avulsed tooth, the athlete should immediately be transported to a dentist because the longer the tooth remains out, the less chance it has of surviving.

The mouth guard

All of the above dental injuries can be prevented with the use of one simple piece of equipment, the mouth guard. There are 3 main varieties of mouth guards. The first and least ideal, ready-made mouth guards are relatively inexpensive, but they offer the least amount of protection and are typically uncomfortable for the athlete. Often, the athlete must clench his or her teeth together to keep the mouth guard in place, which limits the athlete's ability to speak and breathe properly. The next option, the self-adapting or boil-and-bite mouth guards are relatively inexpensive, but they have a better form and are more comfortable to wear. Although they are inexpensive, they do offer better protection than the stock model but over time the self-adapting mouth guard begins to lose its shape and effectiveness. The final option, custom-made mouth guards, are the most highly recommended but also the most expensive option. A dentist forms a custom mouth guard by taking an impression of the mouth and then forming the mouth guard to fit the mold. The custom fit mouth guard is the most protective as well as the most durable. Regardless of the type of mouth guard used, it should not be cut down or altered because modifications can ruin the protective design.

Although dental injuries make up a small percentage of athletic injuries, the cost of treating these injuries is high and disproportionate to the number of injuries. Since mouth guards became mandatory for football players in both high school and college in 1962 and 1974, respectively, the rate of injuries to the face and mouth dropped from up to 50% of all injuries to .5%.

*Eric North, ATC
Columbus, Georgia*



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