Sports Injuries

Americans have a long history of participating in a wide variety of sports. In the most recent United States government census it was reported that there are approximately 297.6 million people residing in the United States. Recent studies suggest that the number of Americans participating in sports is staggering. In the year 2001, 50.6 million people over the age of 6 were frequent exercisers who participated in a single activity such as running, cycling or treadmill exercise on at least 100 occasions. In addition, 39.9 million were frequent participants in a recreational sport such as basketball, tennis, softball, or skateboarding, having participated at least 25 times, in most cases. Another 15.3 million were outdoors enthusiasts, participating in an active outdoor pursuit such as hiking, mountain biking, or skiing, at least 15 times during the year. A clear majority of the population (68% or 170 million people) participated at least once in a sport or activity.

More than 30 million individuals between the ages of 6 and 21 years are involved in non scholastic athletic programs, and an additional 7 million children and young adults participate in organized interscholastic sports.

Review of 2004—2005 Athletic Participation Statistics indicates that 7,018,709 high school boys and girls participated in sporting endeavors compared to 3,960,932 in 1971. In 2004—2005 there were 2,908,390 female athletes compared to 1971 when there were 294,015 female participants.

The National Federation Of State High School Associations 2004-05 High School Athletics Participation Survey

<table>
<thead>
<tr>
<th>Sport</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseball</td>
<td>460,732</td>
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<tr>
<td>Basketball</td>
<td>1,002,040</td>
</tr>
<tr>
<td>Cross Country</td>
<td>372,169</td>
</tr>
<tr>
<td>Field Hockey</td>
<td>63,065</td>
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<tr>
<td>Football — 11-Player</td>
<td>1,046,967</td>
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<tr>
<td>Golf</td>
<td>225,270</td>
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<tr>
<td>Gymnastics</td>
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<td>Ice Hockey</td>
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<tr>
<td>Lacrosse</td>
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<td>Soccer</td>
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<td>Softball — Fast Pitch</td>
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<td>Softball — Slow Pitch</td>
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<tr>
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<tr>
<td>Track And Field — Indoor</td>
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<tr>
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<td>Weight Lifting</td>
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<td>Wrestling</td>
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TEN MOST POPULAR SPORTS

<table>
<thead>
<tr>
<th>BOYS</th>
<th>GIRLS</th>
</tr>
</thead>
<tbody>
<tr>
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<td>1. Basketball</td>
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<tr>
<td>1,046,967</td>
<td>456,543</td>
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<td>2. Basketball</td>
<td>2. Track and Field — Outdoor</td>
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<tr>
<td>545,497</td>
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<tr>
<td>3. Track and Field — Outdoor</td>
<td>3. Volleyball</td>
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<td>516,703</td>
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<td>459,717</td>
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<td>354,587</td>
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<td>243,009</td>
<td>170,450</td>
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<td>7. Cross Country</td>
<td>7. Tennis</td>
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<tr>
<td>201,719</td>
<td>169,292</td>
</tr>
<tr>
<td>8. Golf</td>
<td>8. Swimming &amp; Diving</td>
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<td>161,025</td>
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<td>148,530</td>
<td>84,416</td>
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<tr>
<td>10. Swimming &amp; Diving</td>
<td>10. Golf</td>
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<tr>
<td>103,754</td>
<td>64,245</td>
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</table>

ATHLETICS PARTICIPATION SURVEY TOTALS

<table>
<thead>
<tr>
<th>Year</th>
<th>Boys</th>
<th>Girls</th>
<th>Total</th>
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<tbody>
<tr>
<td>1971-72</td>
<td>3,666,917</td>
<td>294,015</td>
<td>3,960,932</td>
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<td>1980-81</td>
<td>3,503,124</td>
<td>1,853,789</td>
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<tr>
<td>1990-91</td>
<td>3,406,355</td>
<td>1,892,316</td>
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<td>2004-05</td>
<td>4,110,319</td>
<td>2,908,390</td>
<td>7,018,709</td>
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</tbody>
</table>

Survey of Sports Injuries Necessitating Emergency Room Treatment

More sports-related non-fatal injuries are treated in hospital emergency departments than any other type of unintentional injury. Approximately 4.3 million sports and recreation-related injuries were treated in hospital emergency departments during July 2000-June 2001. This represents 15.7% of all non-fatal unintentional injuries, across all ages and genders. Among children aged 10-14 years, 46.3% of all non-fatal unintentional injury ED visits were a result of a sports- or recreation-related injury. Although this percentage was lower among adolescents 15-19 years old (31.4%), sports and recreation related injuries in this age group still represented nearly one-third of all emergency department visits.8

Other national surveys have highlighted the problem of sports injuries among children and adolescents. During the years 1997-1998, an estimated 4.5 million annual emergency departments visits were sports and recreation-related (1997-1998 National Hospital Ambulatory Medical Care Survey for people ages 5-24 years.)9

For boys, football and basketball had the highest percentage of emergency department treated injuries for an individual sport while for girls, basketball and bicycle injuries were the most commonly treated.10
Epidemiology Of Sports Injuries In Children & Adolescents

Bijur and coworkers studied 11,840 children and adolescents aged 5 to 17 years and found that 35.8% of all their injuries resulted from sports and recreational activities. According to Bijur and colleagues, within that same age group in the United States, more than 4.3 million sports and recreational injuries occur annually, with 1.9 million of these classified as serious injuries, defined as time lost from the sport or school or requiring a physician's evaluation. The distribution of injury type was similar in both sexes, with sprains and strains occurring most commonly, followed by fractures and/or dislocations. The most common causes of injury were found to be overexertion and strenuous movements, generally caused by overuse. Nearly half of all sports-related head injuries in adolescents and preadolescents were related to bicycle riding, skating, and skateboarding.

Axe and colleagues conducted a 1-year study of 691 adolescents presenting to a major Delaware sports clinic with sports injuries. Among boys, football accounted for the largest proportion (40.2%) of injuries, and basketball accounted for the greatest number of injuries in girls (23%). Girls missed an average of 7.7 days from sport per injury, whereas boys returned slightly earlier, at 6.6 days. Cheerleading had the highest average time loss from sport, at 28.8 days per injury. Of the 619 athletes, 27 (4%) required surgery.

In another study of high-school athletes, football was again the most common sport of injury identified in a study by DeHaven and Lintner, exceeding by more than 12-fold the number of injuries seen in basketball, the next most common sport of injury. Football accounted for 63.9% of all injuries, followed by basketball (5%), soccer (3.2%), and track or running (2.7%). Another high-risk sport in the preadolescent and adolescent age groups is gymnastics.

Lindner and Caine studied the injury patterns of female competitive club gymnasts. They observed 178 gymnasts (ages 8 to 15 years) during 3 years, amounting to 173,263 hours of practice. A total of 90 injuries were reported in those 3 years, and more than 44% of the injured athletes had more than one injury. At the collegiate level, women's gymnastics has the third highest injury risk (9.3 injuries per 1000 athletic exposures) behind only spring football and wrestling.

Common Anatomic Sites Injured Secondary to Children's Sports Participation

Lower Extremities

With respect to children, the lower extremity is the most commonly injured area. This is due to the emphasis of most sports on the lower extremities to provide locomotive power and speed to the entire body. For most sports, the knee and ankle are the joints most commonly injured. In the knee of a child the weak link is the open physis while ligaments are the weak link in the adult knee. Therefore, a physeal or avulsion...
injury is more common in children, whereas an anterior cruciate ligament (ACL) or medial collateral ligament injury is more common in adults.

Active bone growth precedes muscle and tendon lengthening, requiring each muscle tendon unit to lengthen or stretch out to keep up with the bone growth. Limited muscle and tendon flexibility predisposes to increased overuse injuries in puberty. In addition, active growth causes subtle changes in the overall alignment of the lower extremity.

Increased valgus seen in young children disappears with approaching adulthood, changing the stresses on both the patella and the medial aspect of the knee. Injuries of the lower extremity that occur more frequently in children include the following: slipped capital femoral epiphysis, distal femoral physeal fractures, tibial eminence fractures, and Osgood-Schlatter disease.

**Upper Extremities**

The specific skill demands of particular sports are the cause of most upper extremity sports injuries. Gymnastics and cheerleading demand that athletes use their upper extremities as weight-bearing structures during tumbling, apparatus work, or lifting a teammate. Consequently, gymnastics and cheerleading account for most upper extremity injuries in young female athletes. Sports that require throwing or use of a racquet demand repetitive high stresses on the shoulder and elbow, increasing the risk of injury in those areas. Baseball players, particularly pitchers, tend to have more upper extremity injuries than lower extremity injuries. These injuries include proximal humeral physeal injuries, ligamentous laxity of the shoulder, medial collateral ligament injuries of the elbow, and avulsion of the medial epicondyle of the elbow.

**Sports Injuries of the Trunk**

Sports or sports positions that demand repetitive low back extension, such as gymnastics, football (linemen), or cheerleading, can cause low back pain, muscle strains, and ligament sprains. A football lineman for example may have to raise from a three point stance and repetitively extend his low back 50-75 times per game.

**Common Injuries by Type in Adolescent and Preadolescent Athletes**

**Overuse Injuries**

Overuse injuries occur from the repetitive application of submaximal stresses to otherwise normal tissues. This type of injury is prevalent in the setting of organized sports. Overtraining and exposure to excessive levels of physical activity can present an increased risk of injury. If not managed properly and efficiently, overuse injuries can affect normal physical growth and maturation.

Certain intrinsic factors may predispose a young athlete to overuse injuries. Anatomic malalignments lead to abnormal stresses. Motor strength imbalance can result in muscular strains and overuse. Stress fractures are a form of overuse injury, and they occur most frequently in the tibia, fibula, and pars interarticularis in young athletes. Stress fracture occurs when the bone itself becomes overstressed and begins to fail. Pain with impact or activity is the primary complaint. The vibration of a tuning fork at the stress fracture site frequently exacerbates the pain. Technetium Tc 99m bone scans may be required to confirm the diagnosis. Tomographic bone scans (single photon emission computed tomography) are even more sensitive and may offer advantages for diagnosing subtle fractures in athletes. Treatment includes activity modification, immobilization with splinting or casting, and rest. In general, stress fractures will not heal until the offending stresses are reduced or completely eliminated.

Periostitis, also known as "shin splints," is an overuse injury that occurs in athletes involved in ballistic activities and those that involve rapid deceleration. It may be caused by a strain of the anterior or posterior tibialis muscles at their tibial origin. Pain is usually diffuse and less focal than the pain associated with a stress fracture. A bone scan may show diffuse uptake along the shin. Treatment includes activity modification, physical therapy, and rest. In rare cases, surgery may be indicated.
For young swimmers and throwing athletes, shoulder pain is a common complaint. The pain is exacerbated by repetitive overhead activities that cause stretching of the anterior capsule and musculature of the shoulder. Physical examination may show rotator cuff weakness, scapular motor weakness, and apprehension. Radiographs rarely reveal significant pathologic findings unless a traumatic injury occurred. The most common diagnosis is instability. Motor imbalance, scapular weakness, and capsular laxity usually play a role. Treatment is physical therapy, including stretching the posterior capsule and strengthening the anterior musculature, rotator cuff, and the muscles of the scapula. 

*Little League elbow (medial epicondylitis)* is a chronic overuse injury of a skeletally immature elbow. Repetitive throwing with valgus extension forces can lead to irritation of the medial epicondyle. The young athlete who presents with this condition is frequently a pitcher who has pain during the acceleration phase of throwing. Poor technique or excessive pitch counts and throwing curve balls are common causes of Little League elbow. Conservative treatment begins with rest and ice. In severe cases loose bodies should be removed, and avulsed bone should be repaired.

The extensor mechanism of the knee is the most common source of overuse complaints in the adolescent athlete. Increased stresses along the entire extensor mechanism occur with running, jumping, and squatting, which are key components of most sports. Osgood-Schlatter disease is a traction apophysitis of the tibial tubercle. It presents at about the age of 13 years in boys and 12 years in girls as a focal tenderness or prominence of the tibial tubercle. Radiographic studies may show ossification, sclerosis, prominence, or physeal irregularities of the tibial tubercle on the lateral aspect. Sinding-Larsen-Johansson is a similar syndrome that occurs at the distal pole of the patella. It is more commonly seen in male athletes between the ages of 11 to 13 years and presents as tenderness and mild swelling at the inferior pole of the patella. Both disorders are treated with rest, ice, hamstring stretching, and quadriceps strengthening. Typically, both are usually self-limiting and subside once the apophysis is closed.

**Strains, Contusions, and Sprains**

The athlete with open physeal plates is less susceptible to ligament and muscle-tendon injuries than to avulsion fractures and growth plate injuries. Nevertheless, strains and sprains, and more commonly contusions, do occur in the young athlete.

**Strains**

A strain is an injury to the muscle, near the musculotendinous junction, as a result of a forceful contraction of the muscle. Strains are unusual in early and middle childhood and are more common after the growth spurt. Acute muscle strain injury is highly associated with improper warm-up before sports, fatigue, and previous injury. These observations support the practice of preparticipation conditioning and stretching to reduce injury.

**Contusions**

Contact sports, such as soccer and football, are the cause of most clinically significant lower extremity contusions in the young athlete. Severe injuries with large hematomas and loss of motion are associated with an increased risk of short-term complications and long-term disability, such as myositis ossificans. For severe injuries, the best long-term results appear to be obtained when the affected muscle is initially immobilized under significant stretch for a short period (since stretch reduces the degree of bleeding and edema). Early mobilization after the injury, with passive range of motion within pain-free tolerance, has been shown to reduce scar tissue formation and provide a more rapid recovery of tensile strength. Massage therapy, ultrasound, and heat may cause further bleeding and damage and are contraindicated.
Sprains

Sprains occur less frequently in children because of the higher degree of elasticity of ligaments in children and because the adjacent epiphyseal plates are "the weak link." Children are more prone to physeal fractures than ligamentous sprains. Adolescents who are undergoing or have undergone the growth spurt are more prone to ligamentous injury. Treatment of low-grade sprains consists of rest, ice, and splinting. Joint dislocations are the most severe form of ligamentous injury. Knee and elbow dislocations can be associated with arterial injury, which places the entire distal limb at risk. Most joint dislocations are managed by manual reduction while severe cases may necessitate surgical intervention. Shoulder dislocations can lead to long-term disability in the child athlete. Age is an important factor in this injury. Very few patients older than 50 years who sustain a shoulder dislocation will have recurrent instability. However, among young athletes, 90% will have an associated Bankart lesion (avulsion injury of the labrum-ligament complex), and 90% will have recurrent instability if treated nonsurgically.

Fractures in the Child Athlete

The incidence of fractures is much greater in collision and contact sports. Plain radiographs, occasionally with stress views, establish the diagnosis. Displaced fracture injuries require anatomical reduction.

Sports-Specific Injuries

Baseball

The number of shoulder and elbow overuse injuries decreased in recent years when Little League baseball passed rules limiting the numbers of innings that a player can pitch per week. Although these rules help limit the amount of pitching during a game, they do not control how often each child throws during practice or at home.

Baseball overuse injuries include:

Proximal humeral physeal fractures.

- Little Leaguer’s shoulder is a term that describes pain due to a stress fracture of the physis or due to capsular laxity and instability. Rotator cuff strengthening, scapular stabilizer strengthening, balanced flexibility and motor strength, and muscular contractions are techniques to prevent overuse injuries of the shoulder.

- Little Leaguer’s elbow, also called pitcher’s elbow, is associated with children and adolescents between the ages of 12 and 16 who perform throwing motions. Improper throwing mechanisms lead to traction stresses on the medial aspect of the elbow, the medial collateral ligament, and the medial epicondyle. Also, poor throwing mechanics can result in compression stresses on the lateral aspect of the joint, leading to osteochondritis dessicans of the capitellum, loose bodies, and radial head overgrowth, and repetitive irritation of the olecranon in the olecranon fossa, which can also lead to impingement and the formation of loose bodies.

Football

Football is the ultimate collision sport. Tackling was responsible for 72% of the quadriplegic injuries to athletes at the high school level and for 58% at the college level. Cervical spine fracture can be caused by head, or spear tackling, which leads to cervical spine compression and hyperflexion. In 1973, tackling with the head was outlawed, and the incidence of significant neck injuries decreased. The most common neurologic injury in football is the "stinger" or "burner," which refers to symptoms caused by acute depression of the shoulder or extreme lateral flexion of the neck. The athlete feels burning pain or "lightening bolts" either in the entire upper extremity or following a radicular distribution that corresponds to the upper cord of the brachial plexus and may involve a nerve root, the brachial plexus, or a combination of both. Initial episodes may last only a few seconds or minutes, however, recurrence can lead to residual motor weakness and sensory loss.
Football players are considered to be at risk for low back pain secondary to microtrauma that results in spondylolysis or spondylolisthesis. Spondylolysis is a fracture of the pars interarticularis. Spondylolisthesis involves translation, or movement, of one vertebral body on an adjacent one in the coronal plane. Both conditions are thought to be sequelae of repetitive hyperextension. Presenting symptoms include low back pain that may radiate to one or both buttocks. The pain is exacerbated by lumbosacral twisting and hyperextension. Bone scan, computed tomography, or single photon emission computed tomography scans may be necessary to establish the diagnosis. Initial treatment involves restriction of activities. Knee injuries are the most common football-related injuries, followed by ankle injuries. Among knee injuries, medial collateral ligament injuries are the most prevalent, followed by meniscal tears and anterior cruciate ligament injuries. DeLee and Farney found that 63% of knee injuries that required surgery were anterior cruciate ligament tears, and 36% were meniscal or patellar lesions.

Basketball
Basketball is a sport that requires frequent twisting and cutting movements. All twisting and cutting sports are associated with a high incidence of knee injuries, because the repetitive impact and rotational demands place increased stresses on the anterior cruciate ligament and menisci. In anterior cruciate ligament injuries, the player may feel a "pop" or a tear before the knee gives way. Knee effusion frequently develops shortly thereafter. The most sensitive clinical test is the Lachman examination. If increased laxity is perceived when translating the tibia anteriorly on the femur while the knee is flexed 15° to 20°, the examination result is positive, and the clinical diagnosis of ACL tear is appropriate. If the physical examination result is equivocal, then magnetic resonance imaging can be performed to confirm the diagnosis and assist in the diagnosis of associated meniscal, bony, or ligamentous pathological abnormalities. Ankle sprains are also common among young basketball players. Inversion sprains are the most common in the age group. Radiographic studies, with or without stress testing, will help direct further management. Sprains are usually treated with rest, ice, compression, and elevation. Early mobilization and rehabilitation can be instituted if the ankle is stable and the level of pain is well controlled.

Gymnastics
Gymnastics is a sport that places high demands on the upper extremity. Gymnastics requires the athlete to repetitively use the upper extremities as weight-bearing structures. Consequently, upper extremity injuries are most common in gymnasts. The condition known as gymnast's wrist results from repetitive and excessive loading on the joint, leading to premature closure of the growth plates or other growth disturbances. Initial treatment includes rest and wrist splints, but resistant cases may successfully be treated with arthroscopic debridement. Some cases leave permanent deformity that can lead to chronic wrist complaints. Physeal injuries can also occur in the gymnast's shoulder and elbow. Another common site of injury for gymnasts, is the lower back. Lumbar spine injuries are common in gymnastics because of the repetitive hyperextension and excessive training. Initial complaints may be attributed to muscular strains, but persistent pain is frequently caused by stress fractures of the pars interarticularis. Disk herniation is rare in young athletes but must be considered. Prevention includes optimizing the level of conditioning of the back extensors and abdominal muscles and ensuring proper performance of technique. Limits on the number of extension elements in a given routine and immediate discontinuation of extension if pain develops can prevent more severe injuries.

Cheerleading
Cheerleading is an athletic activity that blends the athleticism of gymnastics, the power of weight lifting, and the coordination of dance. The most common site of injury in cheerleaders is the ankle, accounting for 22% of
all injuries.47 Although injury rates for cheerleaders are lower than those of most sports (0.67 injuries per 1000 athletic exposures), the average time lost from sport due to cheerleading injury (28.8 days) exceeds that of all other high school sports, including football, basketball, wrestling, and field hockey.48

**Tennis**

Tennis requires repetitive overhead upper extremity use and twisting and cutting demands on the lower extremity and torso. Lower extremity injuries are the most common type sustained by tennis players, and sprains of the ankle and knee ligaments are the most prevalent injuries. Injuries of the lower back are also common and have been associated with certain types of serves such as the American Twist, which requires hyperextension of the lumbar spine to place increased spin on the ball.49

**Epidemiology of Sports Injuries in Adults**

People in the 35-54 year old age group continue to drive sports and exercise participation, and as a corollary, are generating higher rates of sports injury. According to the U.S. Consumer Products Safety Commission, sports-related emergency room injuries in this group increased by 33% from 1991 – 1998. There has been phenomenal growth in the number of people over 55 that participate in sports and fitness endeavors. From 1987 - 2001, health club membership skyrocketed by 266%; and even after holding population constant, the increase was an astounding 219% — clearly depicting a vast change in lifestyle and cultural values for older Americans. This trend is not limited to health clubs — it extends to home/outdoors fitness, and also includes active recreational and outdoors sports. From 1990 - 1996, there was an increase of 54% in all sports injuries among people 65+ years of age.

**Biomechanical Causes of Sports Injuries**

Sports injuries are caused by compression, tension and shearing forces.

**Compression** - A compressive force can be caused by an impact injury such as the collision of two athletes. This type of injury mechanism can cause acute injuries such as dislocations, fractures, disc herniations and concussions.

**Tension** – A sports injury that occurs when a tissue is stretched beyond its normal limits. An example of a tension injury would be a Grade I sprain or strain injury.

**Shearing** - This type of sports injury can occur to the skin or other tissues such as ligaments and cartilages. A friction injury such as a turf burn can cause a shearing injury to the skin. Another type of injury caused by a shearing mechanism would be a Grade III sprain or strain injury where there is a complete tear of a ligament or tendon.

**Acute Injuries**

**Contusions**

Contusions result from a direct blow to tissues or capillaries. Bruises also known as purpura are caused by damage to capillary walls resulting in the presence of ecchymosis (discoloration / black and blue marks of the skin). Capillaries are blood vessels which connect arteries to veins. Capillaries deliver oxygen and nutrients and remove waste products. Capillary walls are susceptible to damage from a direct blow mechanism.

Deep contusions to bone or muscle can cause loss of function. A direct blow which contuses the heart, lungs, brain, or kidneys, can cause the damaged tissue to bleed heavily, reducing blood flow to the organ. Deep contusions can be life threatening.
Abrasions
Abrasions occur when tissue is injured by friction or scraping. An example would be an astro turf burn or a “strawberry” which is an abrasion of the leg caused by sliding on artificial turf or infield dirt.

Punctures
Punctures are narrow stab wounds to the skin and internal organs. Puncture wounds can result from being spiked by a baseball or track cleat. Puncture wounds are susceptible to infection because bacteria can be pushed deep into the wound.
Tissue Cuts

Laceration is a jagged and deep soft-tissue cut often caused by a sharp object or by a blow from a blunt object such as an elbow to the face.

Incisions—Smooth cuts caused by sharp objects like glass or metal

Avulsions—Complete tissue tears, such as tearing off the end of the ear lobe. These types of injuries could be avoided if athletes were forbidden from wearing jewelry during competition.
Tissue cut management begins with controlling the bleeding, cleaning the site, suturing if needed, the use of topical antibacterial medicine and the application of an appropriate dressing.

Eleven million traumatic wounds are treated by emergency physicians each year in the United States. The skin, the largest organ in the body, is involved in most of these traumas. For example, cuts are the most frequent cause of nonfatal injuries in 10- to 17-year-olds (with an incidence of over 59 per 1,000), and they account for more than a third of nonfatal accidents, injuries, and poisonings in this population.

**Stages of Healing for Musculoskeletal Soft Tissues**

The healing process is categorized into progressive stages that involve various cellular responses at particular timeframes.

I. Acute inflammatory Stage. This initial stage of response to injury lasts up to 72 hours and consists of two distinct stages. The first stage is called active congestion, which lasts for the first 24-48 hours and involves the initial cellular responses, resulting in the classic signs of inflammation (i.e., pain, swelling, redness and heat). The goal of clinical management during this stage of the healing process is to reduce or eliminate inflammation. The use of rest, ice, compression and elevation are common treatment methodologies.

The second stage, which lasts from 24-72 hours, is the passive congestion phase of healing. During this phase membrane osmolarity is controlled but the pain and swelling may still persist. The goal of clinical management in this phase is to increase the circulation to the area of the injury and to remove metabolites from the tissues. Treatment methodologies include alternating hot and cold therapies, massage, range of motion exercises and passive stretching.

II. Repair Stage. The repair stage lasts from 72 hours to 6 weeks and is characterized by the production, synthesis and deposition of the protein collagen. Collagen helps to regenerate damaged tissue. Granulocytes remove the cellular debris and capillaries form to bring oxygenated nutrients to the involved area. The oxygen and nutrients activate fibroblasts, which manufacture and secrete collagen. The collagen scar secreted by the fibroblasts will replace the damaged musculoskeletal soft tissue that has been injured from trauma. During the repair stage the fibers of the collagen are not fully oriented in the direction of tensile strength, and the collagen is of a mechanically inferior quality.

III. Remodeling Stage. This stage lasts from 3 weeks to 12 months or more depending upon the severity of the injury. During this stage the collagen scar is remodeled to increase the functional capabilities of the tissue. The goal of clinical management is to improve the quality, orientation and tensile strength of the collagen tissue fibers. Clinical management can include manipulation, rehabilitative exercise protocols and passive physiotherapy such as ultrasound and massage.
Sprains

Sprains are stretching or tearing injuries to ligaments and are classified from minor to serious as Grade I, II, or III. They are typically caused by compression or a twisting or torsion mechanism.

In general, a grade I or mild sprain causes overstretching or slight tearing of the ligaments with no joint instability. A person with a mild sprain usually experiences minimal pain, swelling, and little or no loss of functional ability. Bruising is absent or slight, and the person is usually able to put weight on the affected joint.

A grade II or moderate sprain causes partial tearing of the ligament and is characterized by bruising, moderate pain, and swelling. A person with a moderate sprain usually has some difficulty putting weight on the affected joint and experiences some loss of function. An x-ray or MRI may be needed.

A grade III or severe sprain is a complete tear or rupture of a ligament. Pain, swelling, and bruising are usually severe, and the patient is unable to put weight on the joint. An x-ray is usually taken to rule out a fracture.
Strains

If a muscle or tendon is forcefully and excessively shortened or stretched, it can become strained. A strain is a stretching or tearing injury to a muscle and or tendon. Strains are classified as Grade I (minor), Grade II (moderate), and Grade III (severe). In minor or Grade I strains, some of the muscle or tendon fibers will be stretched, but very few may be torn. Symptoms include mild pain, minimal to no swelling, and no loss of motion. In a Grade II or moderate strain, some muscle or tendon fibers are torn. These injuries cause some swelling, pain, loss of muscle or joint function, and possible indentation over the site of the injury. In severe or Grade III strains, a muscle or tendon tears completely. The athlete will likely experience extreme pain and will be unable to move the joint that is attached to the affected muscle or tendon. Torn muscles and tendons will roll up, causing a lump.

Strains can be acute or chronic. An acute strain is caused by trauma or an injury such as a blow to the body; it can also be caused by improperly lifting heavy objects or overstressing the muscles. Chronic strains are usually the result of overuse—prolonged, repetitive movement of the muscles and tendons.

Two common sites for a strain are the back and the hamstring muscle (located in the back of the thigh). Contact sports such as soccer, football, hockey, boxing, and wrestling put people at risk for strains. Gymnastics, tennis, rowing, golf, and other sports that require extensive gripping can increase the risk of hand and forearm strains. Elbow strains sometimes occur in people who participate in racquet sports, throwing, and contact sports.  

Treating Sprains and Strains

Treatment for sprains and strains has two stages. The objective of the first stage is to reduce swelling and pain. To reduce swelling it is recommended to use the ‘RICE’ formula for the first 24 to 48 hours after the injury. An over-the-counter or prescription nonsteroidal anti-inflammatory drug, such as aspirin or ibuprofen, may also be used to help decrease pain and inflammation.

RICE Therapy

Rest
Reduce regular exercise or activities of daily living as needed. Your doctor may advise you to put no weight on an injured area for 48 hours.

Ice
Apply an ice pack to the injured area for 20 minutes at a time, 4 to 8 times a day.

Compression
Compression of an injured ankle, knee, or wrist may help reduce swelling. Examples of compression bandages are elastic wraps, special boots, air casts, and splints.

Elevation
If possible, keep the injured ankle, knee, elbow, or wrist elevated on a pillow, above the level of the heart, to help decrease swelling.
The second stage of treating a sprain or strain is rehabilitation, whose overall goal is to improve the condition of the injured part and restore its function.

Another goal of rehabilitation is to increase strength and regain flexibility. Depending on the patient's rate of recovery, this process begins about the second week after the injury. The health care provider will instruct the patient to do a series of exercises designed to meet these goals. During this phase of rehabilitation, patients progress to more demanding exercises as pain decreases and function improves. The ultimate goal is the return to full daily activities, including sports when appropriate.

The amount of rehabilitation and the time needed for full recovery after a sprain or strain depends on the severity of the injury and the individual’s rate of healing. For example, a moderate ankle sprain may require 3 to 6 weeks of rehabilitation before a person can return to full activity. With a severe sprain, it can take 8 to 12 months before the ligament is fully healed.

**Cartilage Tears**

The primary function of cartilage (gristly tissue found between and on the ends of bones) is to absorb shock and reduce friction when bones approximate one another.

**Dislocations and Subluxations**

Dislocation is the displacement of any part of the body from its normal position. The term dislocation applies most often to a bone which has moved from its normal position with respect to a joint. This condition requires repositioning of the bone via manual reduction methods or surgery.

Subluxation refers to a bone being partially dislocated from a joint.

Vertebral subluxation is a condition in which a vertebra has lost its proper juxtaposition with respect to the vertebra above it and below it to an extent less than a luxation (dislocation).

**Fractures**

Fractures can be either closed or open. With a closed or simple fracture, the bone is broken, but the skin is not lacerated. With an open or compound fracture, the skin may be pierced by the bone or by a blow that breaks the skin at the time of the fracture. The bone may or may not be visible in the wound.

Particular types of fractures are:

- **Transverse fracture** - The fracture is at right angles to the long axis of the bone.
- **Greenstick fracture** - Fracture on one side of the bone, causing a bend on the other side of the bone.
- **Comminuted fracture** - A fracture that results in three or more bone fragments.
Avulsion fractures occur when sprained ligaments pull off a piece of bone. This often takes place in the ankle and finger.

Epiphyseal (growth plate) fractures result when the soft growth plates at the ends of bones are injured. These fractures most often occur to athletes before age 18 and can affect the bone’s growth. Growth plate fractures typically occur in the elbow of baseball pitchers.

Stress Fractures
Repeated stress or shock can eventually cause a bone to crack (stress fracture). Athletes involved in high-impact sports (running basketball, soccer, and gymnastics) and high-velocity activities (baseball pitching) are especially prone to these injuries.

Fracture Healing Process
As soon as a fracture occurs, the body acts to protect the injured area, forming a protective blood clot and callus or fibrous tissue. New "threads" of bone cells start to grow on both sides of the fracture line. These threads grow toward each other. The fracture is closed and the callus is absorbed.

Fracture Treatment
Doctors use casts, splints, pins or other devices to hold a fracture in the correct position while the bone is healing.
External fixation methods include plaster and fiberglass casts, cast-braces, splints and other devices.
Internal fixation methods hold the broken pieces of bone in proper position with metal plates, pins, or screws while the bone is healing.
Recovery and Rehabilitation

Fractures take several weeks to several months to heal, depending on the extent of the injury. Pain usually stops long before the fracture is solid enough to handle the stresses of normal activity.

Chronic Injuries

Chronic injuries occur over time and are often caused by repeated blows, overstretching, repeated friction, or overuse. Repetitive trauma can cause injuries to the muscles, tendons, bursas, and bones. These injuries typically occur in athletes who have a muscle strength and flexibility imbalance, or in athletes who exercise excessively.

Chronic Muscle Strain

This type of injury develops over a period of weeks or months. These strains are different from acute strains because they are not caused by one specific episode of injury.

Bursitis

A bursa can become swollen and sore if it suffers from repeated blows or irritation. Bursitis can also be caused by tendons rubbing back and forth across the bursa. Elbow and kneecap bursitis are the most common types in sports.

Tendinosis, Tenosynovitis, and Paratendinitis

Tendons can be irritated by repeated overstretching or overuse, especially if they are weak or tight. There are several types of tendon injuries. Although often known simply as tendinitis, these injuries are more accurately classified by different names based on the part of the tendon that is affected. For example, tendinosis is a condition in which microtears occur in the tendon. Tenosynovitis is an inflammation of the synovial sheath that surrounds the tendon. Paratendinitis is an inflammation or thickening of the tendon sheath (not a synovial sheath).

Tendinitis can be classified as mild, moderate, and severe. In mild cases, symptoms include slight pain that occurs with specific skills or activities during extreme exertion. The pain subsides once the painful activity stops. There is minimal to no swelling and no loss of motion. Moderate tendinitis may cause some swelling. Pain occurs with more activities and skills, limits extreme muscle exertion, and continues up to several hours after the activity stops. In severe tendinitis, the pain intensifies, occurring with any level of exertion, extending into daily activities, and lasting longer (sometimes more than 24 hours after activity stops). The pain of tendinitis can also limit muscle and joint function.

The tendons of the biceps, patella, Achilles, and rotator cuff are especially prone to repeated microtrauma in sports. Inflexible and weak patellar and Achilles tendons can be overstressed by repeated running and jumping activities. The biceps and rotator cuff tendons are usually overstressed when an athlete throws with a weak and inflexible shoulder. These types of injuries can also be caused by increasing an athlete’s workout or practice regimen too quickly.
Closed Head Trauma Injuries

In a study of high school athletic injuries conducted by the National Athletic Trainers’ Association (Powell and Barber-Foss 1999), from 1995 through 1997, 13.3% of all high school football injuries involved the head or spine. Wrestling was second with 9.5 percent of all reported injuries.

Closed Head Injuries

A closed head injury is an injury to the brain or skull. There are four types:
- **Concussion**—A temporary malfunction of the brain
- **Contusion**—Bleeding and possible swelling of the brain tissues
- **Hemorrhage and hematoma**—Bleeding or pooling of blood between the tissue layers covering the brain or within the brain.
- **Fracture of the skull**—basilar skull fractures are the most common relative to contact sports.

Causes of Closed Head Injuries

Head injuries are commonly caused by one of two mechanisms—a direct blow or a sudden and forceful whiplash movement. A direct blow to the head can injure the skull or brain tissue on the side of contact or the brain tissue on the side opposite the impact. In the case of whiplash without contact, the brain shifts back and forth in the skull. Whiplash injuries may cause fractures at the base of the skull.

Cerebral Concussion

A cerebral concussion is a clinical syndrome characterized by immediate, instant onset due to a mechanical force injury to the head. Cerebral concussion can result in transient impairment of neural function, such as disturbances of consciousness, visual disturbances, altered equilibrium, tinnitus, memory loss, and muscular weakness or flaccidity.

Additional Signs and Symptoms of Concussion

- Headache.
- Nausea.
- Vomiting.
- Inability or difficulty communicating.
- Decreased pulse rate.
- Confusion.
- Inappropriate behavior.
- Concussion is the most common athletic head injury. Approximately 10-20% of high school football players suffer a concussion during a football season.
Following a blow to the head the athlete may not have immediate symptoms.
Repeated brain injuries can result in patterns of brain damage and steady decline in information processing.
Repeated head injuries are cumulative.
The presence of a concussion does not require loss of consciousness. Following a blow to the head, the athletes reporting of seeing stars, a flash of light or blacking out, accompanied by dizziness, confusion, or loss of memory is highly suggestive of a concussion.

Chronic effects of repeated head trauma causes traumatic encephalopathy characterized by:
- Slow appearance of dementia.
- Emotional lability (rapidly shifting emotions).
- Deterioration of memory and speech.

American College of Sports Medicine

Concussion Grading

Grade 1 / First Degree Concussion
- No actual loss of consciousness.
- Blurring of consciousness (bell rung) lasting less than 10-20 seconds. Minimal or no signs are present.
- The only neurologic deficit is a brief period of post-traumatic amnesia lasting less than 30 minutes.
- EEG, CT or MRI is usually not necessary after a mild concussion. If post-concussion syndrome occurs, these studies should be done.

Grade 2 / Second Degree Concussion:
- Blurring or loss of consciousness lasting 20 seconds to 1-2 minutes. Minimal to moderate symptoms and signs are present.
- Will rarely occur without a loss of consciousness. Typically there will be a protracted period of post-traumatic amnesia lasting over 30 minutes and less than 24 hours.
- Generally overnight admission for observation and CT scan if necessary.

Grade 3 / Third Degree Concussion:
- Loss of consciousness lasting more than five minutes.
- There will be loss of consciousness with a sustained period of post-traumatic amnesia lasting longer than 24 hours.

Concussion Assessment
Most concussions do not result in unconsciousness. In fact, about 80 percent of concussions involve only minor symptoms and signs.
One way to assess the extent of these symptoms and signs is to use the SAC (Standardized Assessment of Concussion) evaluation.
The evaluation assesses the following:
1. Orientation—Ability to recall the day of the week, date, month, year, and time of day (to within one hour)
2. Immediate memory—Ability to immediately recall five words
3. Concentration—Ability to recall, in reverse order, increasingly longer series of numbers and then the months
4. Delayed recall—Ability to recall the original five words given to the athlete (in the immediate memory test). Can be performed after the concentration test or after the athlete has performed exertional maneuvers, such as jumping jacks, sit-ups, push-ups, and knee bends
5. Neurological screening:
a. Loss of consciousness: occurrence and duration—If athlete suffered any loss of consciousness, record the duration.

b. Retrograde or posttraumatic amnesia: recall of events pre- and post-injury—Is the athlete unable to remember events occurring before and after the injury?

c. Strength—Strength on opposing limbs should be equal (have the athlete squeeze your hands, then push down against your hand with the opposing foot).

d. Coordination—An athlete may be suffering from brain impairment if they have difficulty in performing equilibrium tests. First instruct the athlete to stand with their eyes closed and arms at their sides. If the athlete begins to sway, suspect some degree of brain impairment. If the athlete is able to stand on both feet without swaying, you can make the test more difficult by having the athlete balance on each leg separately (Rhombergs Test).

Administer the SAC test to your athletes before the season and record their scores. If an athlete suffers a suspected concussion, re-administer the SAC test and compare the score to the athlete’s preseason score. If the recent score is lower, the athlete has experienced some degree of brain impairment. Refer the athlete immediately to an emergency medical facility for neurological evaluation. Comparing your athletes’ scores to their previous scores is the best measure of brain impairment.

First Aid For Mild to Moderate Concussion Symptoms and Signs
1. Protect the athlete from further harm and remove them from the game.
2. Assign someone to monitor the athlete at all times, even if the athlete feels better.
3. Perform a SAC evaluation.
4. Continuously monitor for symptoms and signs of severe injury. If such occur, send for emergency medical assistance.
5. If symptoms and signs do not subside within 15 minutes, notify the parents and send the athlete to an emergency medical facility.
6. If symptoms and signs subside within 15 minutes, redo the SAC assessment.
7. If the SAC score is less than the preseason level, notify the parents and send the athlete to an emergency medical facility.

For Severe Symptoms and Signs
1. Send for emergency medical personnel.
2. Stabilize the head and neck (if there is the possibility of a spinal injury).
3. Monitor breathing and circulation and provide rescue breathing or CPR if needed.
4. Control any profuse bleeding.
5. Monitor for shock and treat as needed.
6. Immobilize any fractures or unstable injuries.

Playing Status
Minor to Moderate Symptoms and Signs
- If the SAC score is at the preseason score, the athlete can return to activity. However, you should continuously monitor for the return of signs and symptoms. Also inform the parents of the injury and provide a checklist of signs and symptoms of severe head injury.
- If the SAC score is less than the preseason score, the athlete cannot return to activity until after being examined by a neurologist.

Severe Symptoms and Signs
- The athlete cannot return to activity until they are cleared by a neurologist.

Prevention
- Prohibit players from using their helmet as a point of contact when tackling or checking.
Check the condition of all athletes’ helmets.

Make sure all football, hockey, baseball, softball, and lacrosse athletes wear appropriately fitted helmets.

Mandate protective mouth guards for athletes in high-contact sports, such as football, ice hockey, rugby, lacrosse, wrestling, basketball, and soccer. Mouth guards are believed to prevent head injuries by stopping blows to the chin from causing the jawbone to impact with the skull.

Prohibit diving into shallow water.

Require spotters for gymnasts practicing skills or routines.

Standardized Assessment of Concussion

1. Orientation (ability to recall).

   Month 0 1
   Date 0 1
   Day of week 0 1
   Year 0 1
   Time (within 1 hour) 0 1

   Orientation total score ___/5

2. Immediate memory (ability to recall five words). Repeat each word three times. Circle number correct for all three trials for each word.

   Word 1 0 1 2 3
   Word 2 0 1 2 3
   Word 3 0 1 2 3
   Word 4 0 1 2 3
   Word 5 0 1 2 3

   Immediate memory total score ___/15

3. Concentration

   Digits backward (ability to recall numbers). If correct go to next length; if incorrect, read trial 2. Stop after incorrect on both trials.

   Trial 1 Trial2
   4-9-3 6-2-9 0 1
   3-8-1-4 3-2-7-9 0 1
   6-2-9-7-1 1-5-2-8-6 0 1
   7-1-8-4-6-2 5-3-9-1-4-8 0 1

   Score ___/4

   Months in reverse order (from December to January). Gets 1 point if entire sequence is correct.

   Score ___/1

   Concentration total score ___/5

Exertional maneuvers (when appropriate)

5 jumping jacks 5 sit-ups
5 push-ups 5 knee bends
4. Delayed recall of words

<table>
<thead>
<tr>
<th>Word</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word 1</td>
<td>0</td>
</tr>
<tr>
<td>Word 2</td>
<td>0</td>
</tr>
<tr>
<td>Word 3</td>
<td>0</td>
</tr>
<tr>
<td>Word 4</td>
<td>0</td>
</tr>
<tr>
<td>Word 5</td>
<td>0</td>
</tr>
</tbody>
</table>

**Delayed recall total score** ___/5

**Summary of total scores**

| Orientation | ___/5 | Concentration | ___/5 |
| Immediate memory | ___/15 | Delayed recall | ___/5 |

**OVERALL TOTAL SCORE** ___/30

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### Types of Spine Injuries

The most common spine injuries in sports are sprains, strains, contusions, and fractures.

#### Causes of Spine Injuries

The spinal column can be injured in the following ways:

- **Direct blow** to the spine, such as by a helmet to the back, can cause fractures and contusions.
- **Compression** of the spine, which may occur, for example, when divers hit their head on the bottom of the pool, can result in fractures, contusions, and sprains. Repetitive hyperextension of the low back by football linemen can compress discs and possibly cause them to rupture.
- **Torsion or twisting** of the spine, which may occur, for example, when batting or golfing, can cause fractures, sprains, strains, and ruptured discs.

### NERVE INJURIES

Other sport-related spine injuries occur when nerves get impinged, stretched, or bruised. The most common of these is a burner or stinger.

#### Burner or Stinger

A burner, also called a stinger, is a stretching or pinching injury to the brachial plexus nerve group.

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**How to Determine A Brachial Plexus Lesion From A Nerve Root Lesion**

**Characteristics of a Brachial Plexus Lesion**

- Numbness and burning of the entire arm, hand and fingers.
- Sensation loss over two to four dermatomes.
- Complete transient paralysis of the arm.
Characteristics of a Nerve Root Lesion

- Numbness and burning are confined to one or more definable dermatomes.
- Sensation loss is confined to a definable dermatome.
- Partial transient paralysis of the arm.
- No tenderness over the brachial plexus.
- Tenderness over the posterior neck.
- Hyperflexion, extension, or lateral flexion of the neck to the same side as the symptoms causes symptoms.
- Symptoms occur with downward pressure on head.

Facial and Scalp Injuries

According to the National Athletic Trainers Association, in high school athletics, facial and scalp injuries are most prevalent in basketball 12.2%, followed by baseball 11.2%, softball 9.6% and football 2.9%.

Face and Scalp Laceration

Cuts are most common around the eyebrow, chin, forehead, nose, or scalp due to a direct blow or contact with an object such as a ball, elbow, or racquet.

Injury Evaluation and Treatment

Evaluation:
- History of a direct blow to the face or scalp.

Signs:
- Bleeding.
- Change in the appearance of the face, or some asymmetry that was not present before the injury.
- Swelling.

Testing:
- Have the player move their jaw in all directions.
- Have the player move their eyes in all directions, and make sure both eyes move evenly.

Cranial Nerve III (Oculomotor Nerve) - motor to pupillary constriction; controls elevation of the upper eyelid; controls extraocular movements of the eye up and inward, up and outward, inward and down and outward.

Cranial Nerve IV (Trochlear Nerve) — motor nerve which controls downward, inward movement of the eye. Responsible for conjugate eye movements (eyes moving together).

Treatment:
- For a nosebleed, apply compression to the nostrils. If the bleeding continues, gently pack the bleeding nostril with a sterile gauze or cotton, and continue compression.
Facial Fractures

Maxilla (facial bone above the mouth) and zygomatic (cheekbone) fractures are caused by a direct blow. Maxilla and zygomatic bone fractures may present with signs of:

- Pain
- Numbness

Check for Signs

- Inability to bring the teeth together properly
- Visual problems
- Nasal discharge (blood or other fluid)
- Bruising
- Deformity
- Tenderness when fractured area is touched

Jaw Injury

Fracture, contusion, or dislocation of the mandible. Caused by a torsion injury or a direct blow.

- Torsion injury or direct blow
- Deformity
- Discoloration
- Swelling
- Inability to close the mouth
- Occlusion (the inability of the upper and lower teeth to line up when the jaw is closed). May be seen with a mandible fracture.

Dental Injuries

Evaluation:

History of a direct blow to the mouth.
Complaints of pain or numbness.

Look for:

- The tooth or a fragment of the tooth on the ground.
- Missing teeth or fragments of teeth in the player's mouth.
- An uneven tooth that appears to have been driven into the gum.
- Cuts on lips, gums, mouth or tongue.

Treatment:

- Sterile gauze, pressure and ice as needed for bleeding and swelling.
- Immediate referral to a dentist.
- Be sure to send the tooth or the tooth fragment with the player.

Special Considerations:

- Proper handling and transportation of the tooth is important. It must be kept wet. The tooth should not be handled by the root. All dirt and other loose debris should be gently rinsed off with sterile water or tap water. The tooth may be transported wrapped in a sterile, moist gauze sponge or in a cup of water. One of the best solutions in which to place the tooth is fresh milk.
Eye Injuries

Evaluation:
• Complaints of sharp, stabbing or deep throbbing pain in the eye.
• Complaints of blurred vision.
• Complaints of double vision.
• Complaints of loss of part or all of the visual field.

Look for:
• One eye bulging or protruding more than the other.
• Cut or puncture on the eyeball.
• Unequal pupils.
• Blood in the eye.
• Foreign particle on the iris.
• Lacerated eyelid.
• Swelling, bruising, or discoloration around the eye.

Testing:
• Ask the player to move both eyes in all directions. Compare the movement of the injured eye to the movement of the uninjured eye.
• An inability to raise the eyelid suggests an orbital bone fracture or damage to the Oculomotor Nerve, Cranial Nerve III.

Treatment:
• Cover the eye with an eye shield.
• Ice is the only acceptable painkiller for an eye injury.
Special Considerations:

- Concussion. Remember that an athlete will not always have one injury alone. Any blow to the face that may create an eye injury may also cause a concussion.

The American Academy of Ophthalmology suggests that wearing protective eyewear could prevent 90 percent of eye injuries. Recommended eyewear contain polycarbonate lenses that are able to stop a sphere hurtling at 140 miles per hour or deflect an object impacting with over 1,200 pounds of force.55

**EAR INJURIES**

The external ear is vulnerable to contusions, lacerations, and avulsions. These injuries can be prevented with protective headgear and rules forbidding the wearing of jewelry during sports competition.

- An ear contusion (cauliflower ear) is caused by a direct blow to the ear or repeated rubbing of the ear against a hard surface.
- Symptoms include pain and burning of the ear. Common signs of cauliflower ear include: swelling of the outer ear with discoloration, warmth, redness, and deformity.

**Common Sites of Sports Injuries**

**Upper Extremity Musculoskeletal Injuries**

**Shoulder**

In a study by the National Athletic Trainers Association (1999) shoulder or arm injuries accounted for 18.9% of all total injuries in baseball, 17.3% in wrestling and 10.4% football.56

**Clavicle**

The most common injuries to the clavicle include acromioclavicular and sternoclavicular dislocations and clavicle fractures. While the most common cause of sternoclavicular (SC) injury is automobile accidents (47%), athletic injuries account for a sizable portion (31%). Acromioclavicular (AC) injuries are commonly associated with athletic activity and are about 5 times more common in males than females. In NCAA college sports men have a higher incidence of clavicle injuries than women in basketball, gymnastics, lacrosse, and soccer. Men and boys under 25 sustain most clavicle fractures, which occur in about 1 of every 1,000 people in the general population per year. The higher rate among young males is probably due to more exposure to high-risk activities.

Of the 14 sports surveyed by the NCAA, the stick sports of ice hockey and men's lacrosse have the greatest risk of clavicle injury. The contact sports of football, spring football, ice hockey, and wrestling are among the six sports with the highest rates of clavicle injuries.

The actual mechanism of injury can be direct or indirect. Direct injuries are associated with contact sports and stick sports in which the athlete sustains a direct blow to the clavicle. Fractures are the common result of direct injuries. Blows that direct a downward force at the superior aspect of the acromion may lead to AC injury or a shoulder separation.

Indirect injuries are due to falls onto the outstretched arm or onto the lateral border of the shoulder. Fractures of the middle third of the clavicle are most frequently seen in falls onto outstretched arms, while fractures of the distal third are most often associated with loads transmitted to the lateral border of the shoulder. If an athlete falls or is hit on the lateral border of the acromion, the force is transmitted first to the site of impact, then to the AC joint, then to the clavicle, and then to the SC joint.57
Clavicle Fractures

Clavicle fractures are classified by the location of the fracture (middle, distal, or proximal thirds) and further described by the amount of angulation, comminution, and displacement at the fracture site. Most clavicle fractures associated with athletic activities are caused by relatively low-energy impact and have little comminution. During clavicle displacement, the proximal segment is drawn superiorly by the sternocleidomastoid muscle, while the distal segment moves inferiorly from the force of gravity and the pull of the pectoralis major.

Nondisplaced or minimally displaced fractures of the medial clavicle or midclavicle can be treated symptomatically with a sling or a figure-of-eight harness for 4 to 6 weeks in young adults and 6 weeks or longer in adults. If significant displacement persists, open reduction and internal fixation may be indicated. For moderately displaced midshaft fractures with no neurovascular compromise a figure-of-eight harness serves to reduce the fracture by longitudinal traction.

Young and Rockwood recommend open reduction for any fracture site if complete displacement persists for longer than 3 weeks of figure-of-eight splinting. They further recommend primary open reduction and fixation if the patient has a failed closed reduction, or neurovascular injury. Athletes should not be allowed to return to play until the fracture is clinically and radiographically healed. Noncontact and throwing athletes should have a full, painless range of motion and at least 90% strength compared with the uninvolved arm. Contact sports should be avoided for 4 to 6 months.

Acromioclavicular Injuries

Acromioclavicular injuries are classified by the severity of ligament injury. Type 1 injuries consist of a mild sprain of the acromioclavicular ligament and are treated conservatively with ice, a sling for comfort, early motion, and NSAIDs. Athletes can return to play when they have no pain and a full range of motion (2 to 3 weeks).

Type 2 injuries involve a tear of the acromioclavicular ligament and a mild sprain of the costoclavicular ligament. Radiographic evaluation will show minimal displacement at the acromioclavicular joint and no separation of the costoclavicular space. Since the acromioclavicular joint remains stable, treatment is conservative, the same as for type 1 injuries.

Type 3 injuries consist of a complete acromioclavicular dislocation with complete tears of the costoclavicular and acromioclavicular ligaments. If the distal clavicle is completely displaced superiorly, the deltoid and trapezoid insertions may be avulsed and require surgical repair. If the distal clavicle is dislocated inferiorly below the coracoid, surgical repair is also indicated. Fortunately, these injury types are rare, and most type 3 acromioclavicular injuries can be treated conservatively with 90% to 100% satisfactory results. Return to sports, however, may take as long as 10 to 12 weeks.

Sternoclavicular Injuries

Sternoclavicular injuries occur once for every five acromioclavicular injuries reported. Like acromioclavicular injuries, sternoclavicular injuries can be classified into three types, with type 1 being a mild sprain, type 2 a moderate sprain, and type 3 a complete dislocation. Dislocations are classified as anterior or posterior, depending on whether the medial clavicle is anterior or posterior to the sternum. Anterior dislocations are much more common.

For type 1 and 2 injuries, treatment is symptomatic and conservative. A sling or figure-of-eight harness can reduce stresses on the sternoclavicular joint and prevent subluxation. After 7 to 10 days, range-of-motion exercise is initiated.

Conversely, type 3 injuries warrant closed reduction. Anterior dislocations can be easily reduced with the patient supine and a rolled towel placed between the scapulae. Traction and abduction on the arm with direct
pressure on the clavicle will generally reduce the dislocation. The reduction is often unstable, but an anterior dislocation can be left unreduced after an initial attempt with little functional deficit. Posterior dislocations can cause shortness of breath, dysphagia, and pressure on the heart vessels. If the patient is skeletally mature, closed reduction should be attempted in the operating room under regional or general anesthesia. In patients who have an open proximal physis (those younger than 22 years), surgery may not be needed because of bony remodeling potential. Following reduction, a figure-of-eight splint is used to allow healing of the ligaments.

Rotator Cuff Injuries

The rotator cuff is comprised of four muscles and their tendons which insert on the top of the humerus. They function along with the deltoid to elevate and rotate the arm. The four muscles, beginning in the front and moving up over the top to the back are the subscapularis, the supraspinatus, the infraspinatus and the teres minor. The subscapularis muscle inserts along the superior neck of the humerus at a bony prominence termed the lesser tuberosity. The supraspinatus, infraspinatus and teres minor insert in that order along individual ridges of another prominence termed the greater tuberosity. Rotator cuff tears may involve one or all of the aforementioned muscles and essentially involve separation of their attachment onto their respective bony prominences. The most commonly involved tendon in rotator cuff tears is the supraspinatus tendon. In athletics, a rotator cuff tear may occur by an overuse syndrome caused by throwing too many pitches, or excessive force placed against the shoulder in external rotation, as in football. Symptoms include pain along the outside aspect of the shoulder more significant at night and with attempts at raising the arm. Patients show traditional weakness in elevating and externally rotating the arm. Magnetic Resonance Imaging with intrarticular contrast can demonstrate tears in cases which are more difficult to diagnose. Treatment is directed toward elimination of pain. Repair of the cuff back to its normal attachment and removal of any associated bone spurs results in an approximate 85% success rate in relieving of pain.

Elbow Injuries

I. Tennis Elbow – Lateral Epicondylitis

II. Tommy John Ulnar Collateral Ligament Sprain Injury

I. Lateral Epicondylitis

Lateral epicondylitis, also referred to as 'tennis elbow,' is considered a cumulative trauma injury. This condition occurs in response to inflammation and degeneration of the tendon that attaches to the muscles of the forearm, specifically, the origin of the extensor carpi radialis brevis muscle. Lateral elbow pain during or after intense use, usually indicates lateral epicondylitis.

Causes of Lateral Epicondylitis

Overuse of the wrist extensors can create cumulative stress on the tendons that attach to the elbow at the lateral epicondyle. Generally, those who experience lateral epicondylitis perform activities with motion of the wrist and arm, or lifting while the palm is facing down. The condition is quite common in the late 30s and early 40s. In racket sports, intense gripping can lead to tennis elbow. It appears to be caused by lack of strength, inefficient technique, improper equipment or increasing playing time and intensity too quickly.

Treatment of Lateral Epicondylitis

Discontinuing activities that cause the pain is the first step to proper treatment of lateral epicondylitis. Using rest, ice, compression and elevation is extremely helpful to reduce pain and swelling.
II. Tommy John Ulnar Collateral Ligament Sprain Injury

Tommy John surgery is an ulnar collateral ligament replacement procedure that has saved the careers of hundreds of Major League players. The inventor of the procedure is Dr. Frank Jobe who initially performed the surgery on major league pitcher Tommy John approximately 30 years ago. Tommy John’s Major League pitching career spanned 26 years from 1963 through 1989. The elbow is a hinge joint which flexes and extends the humerus, ulna and radius bones. The humerus connects to the ulna and radius of the forearm by means of various connective tissues. For a pitcher, one of the most important of these connections is the ulnar collateral ligament (UCL). The UCL offers much of the stability that is necessary for the elbow to withstand the extreme stresses created by throwing a baseball at high velocity. Its function is to stabilize against lateral forces and to keep the arm connected across the joint space. Pitching overhand is a particularly stressful motion; the strain it puts on a player's joint is commonly injurious. Sometimes the UCL will weaken and stretch (technically a sprain), making it incompetent. Other times a catastrophic stress will cause the structure to completely tear. A damaged UCL will prevent a player from throwing at full velocity or with effective control.

In Tommy John surgery, Dr. Jobe began by harvesting a healthy tendon. In most cases the tendon of the palmaris longus muscle is utilized. This tendon is not crucial for anatomical function, and in fact, 15% of people do not have the tendon. To see your palmaris longus tendon, look at the palm-side of your forearm. Touch your thumb and little finger and then make as much of a fist as possible. Approximately 85% of the population is able to see this tendon running down their arm. San Francisco Giants team orthopedist Ken Akizuki reports that when the palmaris longus tendon is unavailable, the surgeon will often use the plantaris tendon in the ankle or a small part of the hamstring tendon in the leg. Usually this tendon will be harvested from the leg that is not used as the plant foot in the pitcher's delivery. The removal of either of these tendons has a negligible effect on function.

Prominent Major League pitchers Kerry Wood, Matt Morris, John Smoltz, Mariano Rivera, Tom Gordon, and Eric Gagne have undergone the Tommy John surgical procedure. *USA Today* reports that in the 2002 and 2003 seasons, 75 of the almost 700 pitchers who appeared in the majors were Tommy John surgery survivors. That's approximately one in every nine pitchers. 60

Forearm, Wrist, And Hand

Almost all of the sports injuries involving the forearm, wrist, and hand are acute. Forearm, wrist, and hand injuries are the most common of all injuries in softball (25.1 percent), baseball (24.2 percent), volleyball (15.8 percent), and wrestling (14.1 percent). 61 Injury types include dislocations, sprains, strains, and fractures.

The Effects of Pitching on the Shoulder and Elbow

Throwing an excessive number of pitches coupled with pitching frequency, inadequate conditioning and poor biomechanics are primary reasons for shoulder and elbow injuries among youth and high school pitchers. USA Baseball developed pitching recommendations for pitchers ages 9 to 18.

1. Pitchers should not throw curveballs or sliders competitively until the age of 13-15 depending on their physical development.
2. Pitch count limits for high school pitchers are 100 pitches per game; 150 pitches per week; 1500 pitches per season and 3500 pitches per year. These figures do not include throws during practice.
Return to Throwing Program (Baseball Players)

<table>
<thead>
<tr>
<th>Step</th>
<th>Progression Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short toss</td>
<td>Toss a ball 10-15 feet for accuracy using good throwing mechanics.</td>
</tr>
<tr>
<td>Long toss</td>
<td>Stand in short center field. Throw the ball so that it rolls to second base. Then throw so that the ball reaches second base in four bounces, then three bounces, then two and finally one. Use good mechanics and throw for accuracy.</td>
</tr>
<tr>
<td>Mound toss</td>
<td>From the mound throw at 1/2 speed toward the plate. Emphasize accuracy and mechanics.</td>
</tr>
<tr>
<td>Straight throws</td>
<td>Throw straight pitches progressively faster up to 3/4 speed.</td>
</tr>
<tr>
<td>Breaking throws</td>
<td>Throw curve balls progressively faster up to 3/4 speed.</td>
</tr>
<tr>
<td>Speed</td>
<td>Increase speed on all pitches toward full speed while maintaining good mechanics and accuracy.</td>
</tr>
<tr>
<td>Special pitches</td>
<td>Add any specialty pitches to the program.</td>
</tr>
<tr>
<td>Fielding</td>
<td>Work on fielding ground balls and throwing to various bases with the throwing arm in awkward positions.</td>
</tr>
</tbody>
</table>

Lower Extremity Musculoskeletal Injuries

Hip And Thigh

Hip and thigh strain and contusion injuries are common to most sports. In the high school sports study by the National Athletic Trainers Association soccer reported a high incidence of hip, thigh, and leg injuries at 29.1 percent of all injuries followed by football at 17.3 percent baseball at 16.8 percent and basketball at 16.6 percent.

Hip Dislocation and Subluxation

70 to 80 percent of all hip dislocations are caused by the head of the femur dislocating backward out of the acetabulum. Typically, these occur when an athlete lands on a bent knee while the thigh is rotated inward and positioned close to the midline of the body.

Hip Contusion (Hip Pointer)

Is a bruise to the anterior and superior portion of the hip caused by compression. An individual with a hip pointer will have an inability to raise the thigh forward, swelling, moderate to severe pain when walking, or an inability to ambulate.
Hamstring Strain is a stretch or tear of the hamstring muscles caused by forceful contraction of the hamstring muscles and/or weak or inflexible hamstrings.

**Grading Characteristics**

**Grade I**
- Mild pain on the back of the thigh when trying to extend thigh backward or bending the knee.

**Grades II and III**
- Moderate to severe pain on the back of the thigh.
- Moderate to severe pain when trying to extend thigh backward or bend knee.
- Moderate to severe pain when walking.
- Moderate to severe pain when flexing the thigh forward while straightening the knee.

**Knee**

The knee is the second most commonly injured area in all of sport. In high school football and boys' soccer, knee injuries occur at a 14.5 percent and 14 percent rate, respectively, among all injuries. Knee injuries occur at an even higher rate (17.6 percent) among high school girl soccer athletes.
Acute Knee Injuries

Stretch or tear of the ligaments that hold the knee bones in place.
Knee sprains of the (a) anterior cruciate ligament (ACL), (b) posterior cruciate ligament (PCL), (c) lateral collateral ligament (LCL), and (d) medial collateral ligament (MCL).

Causes
- Compression to either the front, side, or back of the knee.
- Twisting or torsion injury.
- Hyperextension or hyper flexion of the knee.
- Weak thigh muscles.

Grading Characteristics
Grade I
- Mild pain when straightening or bending the knee.

Grades II and III
- Moderate to severe pain straightening or bending the knee.
- Feeling of looseness or instability
- Report of hearing or feeling a pop.

Dislocated or Subluxated Patella
In a dislocation, the patella slips out of the groove on the femur. In a subluxation, the patella slips out of the groove on the femur and then spontaneously shifts back into the groove. These conditions are caused by compression to the inside of the kneecap, forceful contraction of the outside quadriceps muscles, twisting or torsion or weak inside quadricep muscles.
Cartilage Injuries and Disorders of the Knee

Chondromalacia Patella

Chondromalacia patellae, refers to softening of the articular cartilage of the kneecap. The disorder occurs most often in young adults and may be caused by trauma, overuse, improper alignment, or muscle weakness. Instead of gliding smoothly across the lower end of the femur, the kneecap rubs against it, thereby roughening the cartilage underneath the kneecap. The damage may range from a slight abnormality of the surface of the cartilage to a surface that has been worn away completely to the bone. Traumatic chondromalacia occurs when a blow to the knee cap tears off either a small piece of articular cartilage or a large fragment containing a piece of bone (osteochondral fracture).

The most frequent symptom of chondromalacia is a dull pain around or under the kneecap that worsens when walking down stairs or hills. A person may also feel pain when climbing stairs or during other activities when the knee bears weight as it is straightened. The disorder is common in runners and is also seen in skiers, cyclists, and soccer players.

Recommended treatment for chondromalacia include low-impact exercises that strengthen muscles, particularly the inner part of the quadriceps, swimming and riding a stationary bicycle as long as the knee is not bent more than 90 degrees. Electrical stimulation may also be used to strengthen the muscles. If these treatments fail to improve the condition, the physician may perform arthroscopic surgery to smooth the surface of the articular cartilage and remove cartilage fragments that cause the joint to catch during bending and straightening. In more severe cases of chondromalacia, surgery may be necessary to correct the angle of the kneecap and relieve friction involving the cartilage or to reposition parts that are out of alignment.

Meniscus Injuries

The medial and lateral menisci are easily injured by the force of rotating the knee while bearing weight. A partial or total tear of a meniscus may occur when a person quickly twists or rotates the upper leg while the foot stays still (for example, when dribbling a basketball around an opponent). If the tear is tiny, the meniscus stays connected to the front and back of the knee; if the tear is large, the meniscus may be left hanging by a thread of cartilage. The seriousness of a tear depends on its location and extent.

Generally, when people injure a meniscus, they feel some pain, particularly when the knee is straightened. Severe pain may occur if a fragment of the meniscus catches between the femur and tibia. Swelling may occur soon after injury if blood vessels are disrupted, or swelling may occur several hours later if the joint fills with fluid produced by the joint synovium as a result of inflammation. If the synovium is injured, it may become inflamed and produce fluid to protect itself. This causes swelling of the knee. After any injury the knee may click, lock, or feel weak.
Chronic Knee Injuries

Patellar Tendinitis
Inflammation of the tendon that attaches the kneecap to the tibia caused by forceful contraction of the quadriceps muscles and weak quad muscles and inflexible quadriceps, hamstring, and calf muscles.

LOWER LEG, ANKLE, AND FOOT

Ankle and foot injuries are probably the most common injuries in sports. In the National Athletic Trainers’ Association study\(^{64}\), in basketball, the ankle and foot accounted for 38.3 percent (boys) and 36 percent (girls) of injuries to these athletes. And in high school volleyball, the ankle was the site of 35.6 percent of all injuries.

Shin Splints

- The term *shin splints* refers to several conditions in front of or along side the shin bone which usually are not serious but can be: inflammation of a tendon, muscle tears or strains, or stress fractures of the tibia or fibula.

  These conditions are caused by one of the following reasons or a combination of them: inadequate or no warm-up, running or jumping on hard surfaces or uneven ground, poor shoes, the sudden addition of sprinting to a workout or training program, introducing hill training to a jogging program (including downhill), and jogging with ankle weights.

Ankle Sprain

An ankle sprain involves stretching or tearing of ankle ligaments. In an inversion ankle sprain, the foot rolls in and damages the outside ankle ligaments and sometimes the inside ligaments. This is the most common type, occurring in about 80 percent of ankle sprains. In an eversion ankle sprain, the foot rolls out and damages the inside ankle ligaments and sometimes the outside ligaments. Most ankle sprains are caused by compression and twisting or torsion.
Grading Characteristics

**Grade I**
- Mild pain around the inside or outside ankle bones
- Mild pain when flexing the foot up or pointing it down

**Grades II and III**
- Moderate to severe pain around the inside or outside ankle bones
- Moderate to severe pain when flexing the foot up or pointing it down
- Ligament laxity on orthopedic testing.

In an inversion sprain, the outside ankle ligaments are damaged.  
Ankle sprain areas of pain.

Internal Organ Injuries

**Ruptured Spleen**
A ruptured spleen can be caused by a direct blow to the left side of the body, underneath the stomach and lower ribs.
A ruptured spleen can cause profuse internal bleeding.
A severe ruptured spleen can be life threatening.
A life threatening ruptured spleen injury can result in referred pain to the left shoulder and neck area.

In the Advanced (LifeThreatening) Stage a ruptured spleen will result in the presence of the following signs or symptoms:

- Pale skin, rapid pulse, vomiting, rigid abdominal muscles, low blood pressure, and shortness of breath.

With respect to prevention, require athletes to wear appropriate protective padding in contact sports and do not allow athletes who have mononucleosis to participate until they are examined and cleared by a physician to continue to participate in sports. Mononucleosis can cause the spleen to enlarge and be at risk of contusion injuries.
Kidney Contusion

A contusion to the kidney can be caused by a direct blow to either side of the midback.

In the advanced (life-threatening) stage, pain moves to the low back, lateral thighs, or anterior pelvic area. The injured athlete will often complain of feeling faint and dizzy.

In the advanced stage, common signs and symptoms include: abdominal swelling, increased heart rate, frequent and burning urination, cloudy or bloody urine, vomiting, rigid back muscles over the injury site, and pale skin.

Sports Hernia

A sports hernia occurs when there is a weakening of the muscles or tendons of the lower abdominal wall. This part of the abdomen is the same region where an inguinal hernia occurs, called the inguinal canal. When an inguinal hernia occurs there is sufficient weakening of the abdominal wall to allow a pouch, the hernia, to be felt. In the case of a sports hernia, the problem is due to a weakening in the same abdominal wall muscles, but there is no palpable hernia.

The inguinal canal is a region in the lower abdomen, just above the groin. The canal is formed by the insertions of abdominal muscles and tendons, as well as several ligaments. Within the inguinal canal travels the spermatic cord (in males) or the round ligament (in females). This area of the abdomen is prone to weakening of the abdominal wall, allowing an outpouching, or hernia, to form.

The problem with the abdominal wall in people with a sports hernia is not a muscle strength issue, but rather, the abdominal wall is too thin, allowing the hernia to form. The sports hernia does not occur in the area of the large, thick part of the muscle.

A sports hernia typically begins with a slow onset of aching pain in the lower abdominal region. Symptoms may include: Pain in the lower abdomen, groin, and testicles. Typically the symptoms are exacerbated with activities such as running, cutting, and bending forward. Patients may also have increased symptoms when coughing or sneezing. Sports hernias are most common in athletes that have to maintain a bent forward position, such as hockey players.

There are no diagnostic tests that can be used to detect a sports hernia. The diagnosis is made by the patient's history and physical examination.

There are no treatments that have been shown to be effective for sports hernia other than surgery. That said, the initial treatment of a sports hernia is always conservative in hopes that the symptoms will resolve. Resting from activity, anti-inflammatory medications, ice treatments, and physical therapy can all be tried in an effort to alleviate the patient's symptoms.

If these measures do not relieve the symptoms of a sports hernia, surgery may be recommended to repair the weakened area of the abdominal wall. A number of studies have shown between 65% and 90% of
Environmental Factors Affecting Athletes

Heat

- Four physical processes remove excess heat from the body: radiation, conduction, evaporation, and convection.

Radiation
- If the body temperature is higher than the air temperature, the human body radiates heat rays to the environment.
- If the air temperature is greater than the body temperature, heat is absorbed by the body through radiation.

Conduction
- There are two kinds of heat loss through conduction (to the air and to objects). With the exception of swimmers losing body heat to the water, very little heat is lost through conduction during exercise.

Convection and Evaporation
- Convection is the term applied to air movement (wind). It plays a major role in heat loss by both conduction and evaporation.
- During exercise sweat conducts an enormous amount of heat from within the body to the skin surface. The heat dissipates when the convection currents (wind) evaporate the sweat.
- In the presence of high environmental temperatures, evaporation and convection provide the only relief from heat stress.
- On hot days when the humidity is high and there is little or no wind, evaporation is greatly reduced. Metabolic heat generated during exercise is denied release and the body temperature rises, sometimes resulting in heat sickness.
- Heat exhaustion, (a less serious form of heat ailment), may be accompanied by decreased motor ability.
- Coast Guard studies have shown that three hours of sun exposure can slow reaction time just as drunkeness can.
- To avoid heat sickness, drink plenty of fluids, six to eight glasses a day, including 13 to 17 ounces just before an exercise session.
- Train in the morning or evening to avoid the heat of the day (before 9 A.M. and after 6 P.M.). The body usually becomes acclimated to heat and humidity within two weeks.
- The athletes cardiovascular system is able to dissipate heat more efficiently, and they tolerate heat better than the unfit. They also become acclimated more quickly. Losing weight will increase heat tolerance. Overweight individuals suffer more in heat and humidity because their fat insulates them and interferes with heat loss.
Cold

Two common cold related conditions include hypothermia and frostbite.

**Hypothermia**
- Hypothermia (abnormally low body temperature). Hypothermia should always be treated before frostbite. Warm a suspected hypothermia victim. Rewarming may be accompanied by coronary dysrhythmia (irregular heartbeat) that can progress to fibrillation and cardiac arrest (arrhythmia), the usual cause of death in hypothermia.

**Frostbite**
- Frostbite - Frostbite is the destruction of body tissue by freezing. Ice crystals form in the fluid surrounding cells and frozen blood vessels prevent blood from circulating.
- Frostbitten skin appears red, feels warm, burns and stings, then progresses to numbness and a white, waxy appearance.
- Frostbite - This condition is accompanied by poor hand and foot coordination.
- With frostbite attempt to thaw the frozen tissue only when you reach shelter and can prevent the frostbitten area from being refrozen. Refreezing poses a greater risk of severe injury.
- Protect the frozen part. Do not rub it, especially with snow. Massaging increases the injury. If possible, avoid walking on frostbitten feet. Immerse the frozen area in 100-110°F water.
- Avoid alcoholic beverages. By dilating surface blood vessels, alcohol promotes heat loss.
- Smoking constricts blood vessels in the hands and feet, increasing the chance of frostbite by reducing the flow of warm blood to these areas.

**Asthma**
- Bronchial asthma affects approximately nine million Americans and may be responsible for more than 2,000 deaths annually.
- The number-one chronic illness of childhood as well as the greatest cause of school absenteeism in those 17 years old and younger. Asthmatics suffer from chronic fatigue, which leads to inattention in school.
- Many asthmatics suffer from increased airway obstruction after exercise. This condition is referred to as either *exercise-induced asthma* or *exercise-induced bronchoconstriction*.
- Exercise-induced asthma attacks are similar to those induced by other types of asthma. It's usually most extreme 5 to 10 minutes after the completion of exercise; breathing may not return to normal for up to an hour.
- Swimming is the exercise of choice for asthmatics and the one most frequently prescribed by physicians. Patients in a five-month swimming training program demonstrated a significant decrease both in the number of asthma attacks and their medication requirements.
- In swimming, the horizontal position, effects of water pressure, inhaling moisture saturated air and rhythmic breathing reduce the incidence and severity of asthma attacks.
- 15% to 20% of chronic asthmatics have eczema which can be aggravated by exposure to chlorinated water.
- Those with *severe* asthma should avoid contact sports.
- Short intervals of exercise (one to two minutes) promote lung ventilation in asthmatics, but periods of four to twelve minutes appear to cause wheezing, especially in those who are deconditioned or inactive. For this reason, interval training is usually more effective than continuous exercise.
Common Skin Conditions Affecting the Athlete

Noncontagious Skin Conditions

**Blisters**
With open blisters the skin is torn. In the case of closed blisters the skin is still intact. Blisters are caused by friction between the skin and a surface which results in skin layers separating or filling with fluid.

**Poisonous Plant Rash**
Skin reactions caused by contact with the oil from the sap of a poison ivy, poison oak or poison sumac plant. Symptoms include burning and itching with signs of redness, rash, swelling, blisters and high fever in severe cases.

Contagious Skin Diseases

**Impetigo**
An infection of the skin beginning as a redness and progressing to itching blisters, breakdown of the skin, and honey-colored crusts. Lesions usually form on the face and spread locally. The disorder is highly contagious by contact with the discharge from the lesions. Acute kidney trouble is an occasional complication.

**Tinea**
A group of fungal skin diseases. They are caused by several kinds of parasitical fungi. They are marked by itching, scaling, and, sometimes, painful sores. Tinea is a general term that refers to infections of various causes, which are seen on several sites. The specific type is usually designated by a modifying term. Diagnosis is made by demonstrating fungus on a smear or by culture. Tinea is also called ringworm.

**Tinea Cruris**
A fungal infection of the groin. It is caused by species of Trichophyton or Epidermophyton floccosum. It is most common in the tropics and among males. Topical antifungals, as miconazole and clotrimazole, are often given. The antibiotic griseofulvin is used only for severe, resistant cases. Also called jock itch.

**Tinea Pedis**
A long-term fungal infection of the foot. It occurs especially on the skin between the toes and on the soles. It is common world wide. It is usually caused by Trichophyton mentagrophytes. T. rubrum, and Epidermophyton floccosum. Also called athlete’s foot.

**Scabies**
A contagious disease caused by Sarcoptes scabiei, the itch mite, marked by intense itching of the skin and damage to the skin from scratching. The mite, passed by close contact with infected humans or domestic animals, burrows into the layers of the skin where the female lays eggs. Two to 4 months later, the eggs hatch and the itching begins. A rash often occurs on the fingers, wrists and thighs. This disease is treated with drugs and lotions.
** Conjunctivitis  
Swelling in the front of the white of the eye (conjunctiva). This is caused by infection, allergy, or outside factors. Red eyes, a thick discharge, sticky eyelids in the morning, and swelling without pain are the symptoms. Treatment depends on the cause. It may include antibiotics, drugs to fight bacteria, or corticosteroids. Also called pinkeye.

** Molluscum Contagiosum  
A disease of the skin and mucous membranes. It is caused by a virus found all over the world. It is marked by scattered white pimples. Palms of the hands and soles of the feet are not affected. The disease occurs most often in children and in adults with a likelihood of getting an infection. It is carried from person to person by direct or indirect contact. It lasts up to 3 years, although individual tumors last for only 6 to 8 weeks. Untreated, the tumors eventually disappear by themselves without scarring.

** Certified Chiropractic Sports Medicine Specialist  
With the ever increasing number of people participating in sports comes the increased probability of the presence of sports injuries necessitating evaluation and treatment by a physician. The Doctor of Chiropractic who is aware of the unique needs of the athlete and who has specialized training can play a vital role in the care of the injured athlete. Before treating injured athletes it is advised that the Doctor of Chiropractic become certified by an accredited Chiropractic college, undergo 100 hours of training and become a Certified Chiropractic Sports Medicine Specialist.

The Chiropractic Sports Medicine Specialist can play vital and diverse roles on the Athletic Health Care Team. A primary role includes the implementation of sport injury prevention methodologies such as the performance of preseason physicals. Another vital role involves the ability to recognize and differentiate specific sports injuries and provide on-site emergency first aid care at sporting events. Additional roles performed by the Chiropractic Sports Medicine Specialist involve assessment, treatment and rehabilitation of the injured athlete. With respect to assessment and treatment, the Chiropractic Sports Medicine Specialist will order appropriate diagnostic tests, prescribe appropriate treatment and make referrals for specialty consultations when needed. With regards to rehabilitation, the Chiropractic Sports Medicine Specialist may recommend, prescribe and or personally monitor the athletes performance of specific rehabilitation exercises and provide final clearance for the return to full athletic participation.

** The Role of the Certified Chiropractic Sports Medicine Specialist  
The Certified Chiropractic Sports Medicine Specialist performs diverse roles to include the following:

** Preseason Athlete Examinations Prior To Sports Participation.  
- The purpose of the preseason athletic examination is to determine the athlete's health status, preparedness for participation in a particular sport, and their performance potential.
- The preseason athlete examination is performed to garner information regarding the athletes present health status which can then be used for comparison with subsequent examination findings.
- The preseason examination is further performed to rule out or detect conditions that would preclude or restrict their participation in sports.
- The ultimate question which must be answered by the preseason examination is whether or not the athlete is ready to play.
Preseason Screening To Determine The Athlete's Fitness Level

Preseason screening is typically conducted in the off season to determine an athlete’s fitness level and preparedness for participation in sports. Components which are tested include strength, flexibility, endurance in muscles that undergo repetitive or sustained contraction, cardiovascular endurance, body composition or percent of body fat, and upper and lower body coordination.

Preseason Conditioning / Establishing the Strength and Endurance Base

The Chiropractic Sports Medicine Specialist can play an important role in getting the athlete in top physical condition by starting them on an exercise strength and conditioning program at least six weeks before the season.

Emphasis should be placed on increasing the athlete’s muscle strength, muscle endurance, cardiovascular endurance capabilities, flexibility, power and speed.

To improve or maintain muscular strength or endurance, the average individual would need to exercise on alternate days or approximately three to four days per week. Generally, each major muscle group should be overloaded every 36 to 48 hours. Exercise repetitions will determine the type of adaptation. For example, an increased weight load with low exercise repetitions will result in muscle hypertrophy. A decreased weight load with high exercise repetitions is best for achieving muscle endurance.

Exercise Protocols for Children

I. Use of Body Weight for Resistance

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Sets and repetitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Push up</td>
<td>3 x 10-20</td>
</tr>
<tr>
<td>Bent leg sit up</td>
<td>3 x 15-30</td>
</tr>
<tr>
<td>Squats</td>
<td>3 x 10-20</td>
</tr>
<tr>
<td>Toe Raises</td>
<td>3 x 20-30</td>
</tr>
<tr>
<td>Self resistance arm curls</td>
<td>10 - Contractions of 6 seconds duration</td>
</tr>
<tr>
<td>Partner resisted lateral arm raise</td>
<td>10 - Contractions of 6 seconds duration</td>
</tr>
<tr>
<td>Back hyperextension</td>
<td>3 x 10-15</td>
</tr>
</tbody>
</table>

II. Resistance With Machines or Free Weights

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Sets and repetitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leg Press</td>
<td>3 x 10</td>
</tr>
<tr>
<td>Bench Press</td>
<td>3 x 10</td>
</tr>
<tr>
<td>Leg curls</td>
<td>3 x 10</td>
</tr>
<tr>
<td>Arm curls</td>
<td>3 x 10</td>
</tr>
<tr>
<td>Leg extensions</td>
<td>3 x 10</td>
</tr>
<tr>
<td>Military press</td>
<td>3 x 10</td>
</tr>
</tbody>
</table>

Beginner Exercise Program Fundamentals

- Starting out a strength and conditioning program too aggressively can lead to injury, excessive delayed muscle soreness, and psychological maladjustment to training.
- Underestimate physical abilities rather than overestimating them when prescribing exercise for beginners.
- Evaluate and upgrade the program weekly in order to maintain exercise stimulus.
- Perform 10-12 repetitions.
● Progress from 1 to 3 sets.
● Exercise large muscle groups first, gradually adding small muscle group exercises.
● Perform upper extremity exercises before lower extremity exercises. This differs from the experienced lifter who performs lower extremity exercises first then upper extremity exercises.
● Rest 3-4 minutes between sets and 48 hours between body parts.
● Inexperienced trainees have been reported to make strength gains with loads as low as 45% of their 1 repetition maximum lifting capability. Conversely, elite athletes require a load of at least 80% of a 1 repetition maximum lift for strength gains.

**Beginner Program**

**Frequency**: 2-3 days per week  
**Duration**: 60 minutes (30 cardiovascular/warm-up, 30 resistance training/stretching)  
**Recovery**: 60-90 seconds between sets  
48 hours between workouts

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Volume (Sets-Repetitions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm-up stationary bike - 10 min</td>
<td></td>
</tr>
<tr>
<td>Squats</td>
<td>1 – 3 x 10 – 12 reps</td>
</tr>
<tr>
<td>Leg press</td>
<td>1 – 3 x 10 – 12 reps</td>
</tr>
<tr>
<td>Hamstring flexion</td>
<td>1 – 3 x 10 – 12 reps</td>
</tr>
<tr>
<td>Hip abduction</td>
<td>1 – 3 x 10 – 12 reps</td>
</tr>
<tr>
<td>Leg raise</td>
<td>1 – 3 x 10 – 12 reps</td>
</tr>
<tr>
<td>Seated lat row</td>
<td>1 – 3 x 10 – 12 reps</td>
</tr>
<tr>
<td>Bench press</td>
<td>1 – 3 x 10 – 12 reps</td>
</tr>
<tr>
<td>Side deltoide abduction</td>
<td>1 – 3 x 10 – 12 reps</td>
</tr>
<tr>
<td>Shoulder internal rotation</td>
<td>1 – 3 x 10 – 12 reps</td>
</tr>
<tr>
<td>Shoulder external rotation</td>
<td>1 – 3 x 10 – 12 reps</td>
</tr>
<tr>
<td>Trunk extensions</td>
<td>1 – 3 x 10 – 12 reps</td>
</tr>
<tr>
<td>Cardiovascular stationary bike - 10 min</td>
<td></td>
</tr>
<tr>
<td>Stretching 5-10 min</td>
<td></td>
</tr>
</tbody>
</table>

**Aerobic Training**

The Chiropractic Sports Medicine Specialist can recommend aerobic conditioning programs to enhance the athlete’s cardiovascular endurance capabilities.
In aerobic training, such as walking, jogging, running, or bicycling, the activity should be performed continuously for 15-20 minutes at 70-90% of the maximal heart rate with a minimum of 3 training sessions per week. Athletes requiring higher aerobic fitness may train 4-6 days per week and may train for 20-30 minutes.
Endurance athletes should train 5-7 days per week, 1-2 hours duration. Healthy individuals should train 3-5 days per week, 15-60 minutes duration.
Cardiovascular ability is being able to maintain a sustained activity (like running), for a relatively long time (15 minutes or more). Aerobic training, unlike anaerobic training, utilizes oxygen and helps to metabolize fat.

**Instruction on Correct Sports Skills**

The Chiropractic Sports Medicine Specialist should be knowledgeable when it comes to correct sports skills instruction methods. While increased strength, power, endurance and flexibility are the key components to injury prevention the importance of correct skill instruction cannot be understated. For example, football coaches that teach spear tackling will dramatically increase their athlete’s chances of
sustaining head and neck injuries. Additionally, youth baseball players who are taught to slide headfirst into a base instead of sliding feet first are more prone to tooth, head, neck and internal organ injuries.

**Medical Decision-Making Regarding The Injured Athlete's Ability To Return To Athletic Competition.**

The Chiropractic Sports Medicine Specialist possesses the training, skills, and ultimate authority to determine the athlete's ability to participate in a contest and the date of return to competition following injury.

**Management Of Sports Related Injuries**

The Chiropractic Sports Medicine Specialist has the ability to differentiate one sports injury from another, provide on field assessment of athletic injuries, on field trauma care prior to the arrival of emergency medical personnel, appropriate in office treatment methodologies to enhance the return to active sports participation and the knowledge to refer the injured athlete for appropriate ancillary diagnostic testing procedures.

**Sources**

1. www.uscensus.gov
2. www.americansportsdata.com


52. www.americancollegeofsportsmedicine.com
53. www.americancollegeofsportsmedicine.com
54. (Journal of Athletic Training 36(5): 276, Joel McCrea, 2001)
61. Powell and Barber-Foss 1999.
63. Powell and Barber-Foss 1999.
64. Powell and Barber-Foss 1999
65. http://orthopedics.about.com/od/sportsinjuries/a/hernia.htm