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Introduction

As sports participation rates increase, so does the occurrence of sport-related injury. As a consequence, there is a need for detailed, easy-to-understand reference books on the prevention, treatment and management of sports injury.

Whilst there are many books dealing with this subject, very few present detailed anatomical information in a way that is easy to understand for everyone from the weekend warrior to the professional athlete; from the first-year personal trainer to the seasoned sports coach or from the recent university graduate to the accomplished sports doctor.

Combining real-life practical experience with detailed theory, Brad Walker presents complex prevention, treatment and management strategies in a way that everyone can understand. Full-colour illustrations provide a visual aid to the workings of the human body during the sports injury management process. The expert yet easy-to-follow information will help the reader prevent sports injury, and in the event that an injury does occur help to treat it effectively, allowing a return to activity in as little time as possible.

The Anatomy of Sports Injuries looks at sport-related injury from every angle. Chapter 1 introduces the concept of sports injury. It explains the different classifications and grades of sports injury and describes the structures and tissues involved. In Chapter 2 key prevention strategies are explained to help reduce the occurrence of sport-related injury. In Chapter 3 a comprehensive treatment and rehabilitation process is outlined to ensure a quick and complete recovery.

Chapters 4–17 provide a detailed overview of 120 sports injuries in an easy-to-locate format. Divided into key areas of the body, each sports injury is described by: the anatomy and physiology involved, possible causes, signs and symptoms, complications, immediate treatment, rehabilitation procedures and long-term prognosis.

Aimed at fitness enthusiasts and health-care professionals of all levels, The Anatomy of Sports Injuries also provides strength and flexibility exercises to aid with sports injury prevention, treatment and rehabilitation. These exercises are by no means exhaustive and merely provide guidance. Consult a healthcare professional for a tailor-made programme to suit your individual needs.

Explanation of Sports Injury

No one doubts the benefits of regular structured exercise: elevated cardiovascular fitness, improved muscular strength and increased flexibility all contribute to an enhanced quality of life. However, one of the very few drawbacks of exercise is an increased susceptibility to sports injury.

While sport and exercise participation rates are increasing (a good thing!) injury rates are also on the rise. In fact the US Consumer Product Safety Commission estimates: "between 1991 and 1998, golf and swimming injuries increased 110 percent; ice hockey and weightlifting injuries, 75 percent; soccer injuries, 55 percent; bicycling, 45 percent; volleyball, 44 percent; and football 43 percent" (*Consumer Product Safety Review, 2000*).

WHAT CONSTITUTES A SPORTS INJURY?

Physical injury generally can be defined as any stress on the body that prevents the organism from functioning properly and results in the body employing a process of repair. A sports injury can be further defined as any kind of injury, pain or physical damage that occurs as a result of sport, exercise or athletic activity.

Although the term sports injury can be used to define any trauma sustained as a result of sport and exercise, it usually describes injuries that affect the musculoskeletal system. More serious injuries, such as head, neck and spinal cord trauma, are usually considered separate to common sports injuries like sprains, strains, fractures and contusions.

WHAT IS AFFECTED IN A SPORTS INJURY?

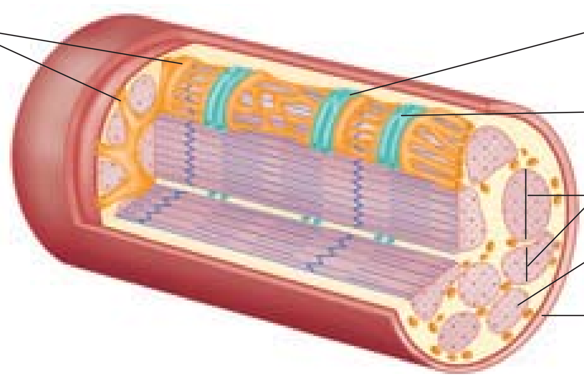
Sports injuries are most commonly associated with the musculoskeletal system, which includes the muscles, bones, joints and associated tissues such as ligaments and tendons. Below is a brief explanation of the components that make up the musculoskeletal system.

Muscles

Muscle is composed of 75% water, 20% protein and 5% mineral salts, glycogen and fat. There are three types of muscle: skeletal, cardiac and smooth. The type of muscle involved with movement is skeletal (also referred to as striated, somatic or voluntary). Skeletal (somatic or voluntary) muscles make up approximately 40% of the total human body weight. Skeletal muscles are under voluntary control, and attach to, and cover over, the bony skeleton. They are capable of powerful, rapid contractions and longer, sustained contractions. Skeletal muscles enable us to perform both feats of strength and controlled, fine movements. They are attached to bone by tendons. The place where a muscle attaches to a relatively stationary point on a bone, either directly or via a tendon, is called the origin. When the muscle contracts, it transmits tension to the bones across one or more joints and movement occurs. The end of the muscle that attaches to the bone that moves is called the insertion.

Overview of Skeletal Muscle Structure

The functional unit of skeletal muscle is known as a muscle fibre, which is an elongated, cylindrical cell with multiple nuclei, ranging from 10–100 microns in width, and a few millimetres to 30+ centimetres in length. The cytoplasm of the fibre is called the sarcoplasm, which is encapsulated inside a cell membrane called the sarcolemma. A delicate membrane known as the endomysium surrounds each individual fibre.

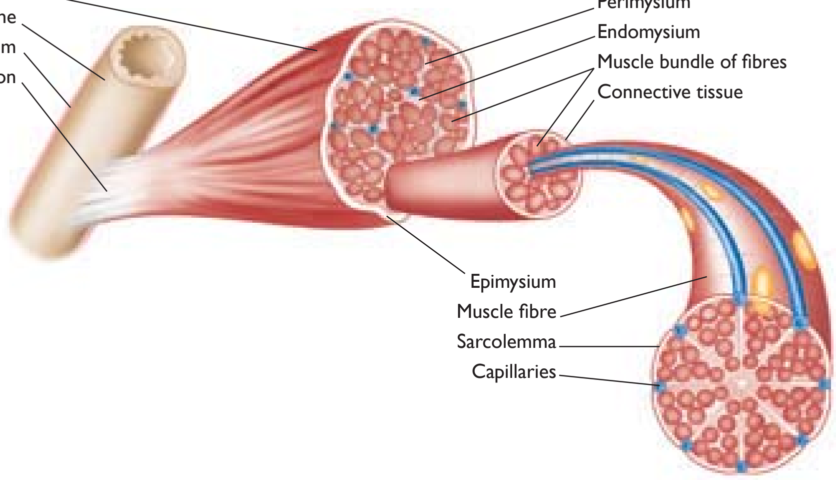


Each skeletal muscle fibre is a single cylindrical muscle cell.

Muscle fibres are grouped together in bundles covered by the perimysium. These bundles are themselves grouped together, and the whole muscle is encased in a sheath called the epimysium. These muscle membranes run through the entire length of the muscle, from the tendon of origin to the tendon of insertion. This whole structure is sometimes referred to as the musculo-tendinous unit.

> *NOTE: As they contract, all muscle types generate heat, and this heat is vitally important in maintaining a normal body temperature. It is estimated that 85% of all body heat is generated by muscle contractions.*

Major muscles include the quadriceps of the thigh and the biceps brachii of the upper arm.



Cross-section of skeletal muscle tissue.

Bones

We are born with approximately 350 bones, but gradually they fuse together until by puberty we have only 206. Bones form the supporting structure of the body and are collectively known as the endoskeleton. (The exoskeleton is well developed in many invertebrates but exists in humans only as teeth, nails and hair). Fully developed bone is the hardest tissue in the body and is composed of 20% water, 30–40% organic matter and 40–50% inorganic matter.

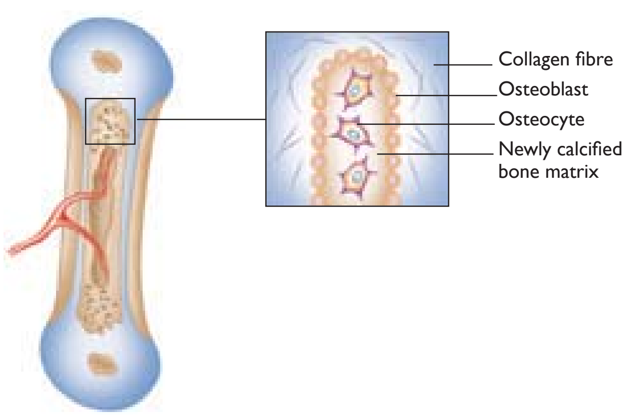
Bone Development and Growth

The majority of bone is formed from a foundation of cartilage, which becomes calcified and then ossified to form true bone. This process occurs through the following four stages:

1. Bone building cells called osteoblasts become active during the second or third month of embryonic life.
2. Initially, the osteoblasts manufacture a matrix of material between the cells, which is rich in a fibrous protein called collagen. This collagen strengthens the tissue. Enzymes then enable calcium compounds to be deposited within the matrix.
3. This intercellular material hardens around the cells, which become osteocytes, living cells that maintain the bone but do not produce new bone.
4. Other cells called osteoclasts break down, remodel and repair bone. This process continues throughout life but slows down with advancing age. Consequently, the bones of elderly people are weaker and more fragile.

In brief, osteoblasts and osteoclasts are the cells that lay down and break down bone respectively, enabling bones to very slowly adapt in shape and strength according to need.

Bone cells sit in cavities called lacunae (singular: lacuna) surrounded by circular layers of very hard matrix that contains calcium salts and larger amounts of collagen fibres. Bones protect internal organs and facilitate movement. Together they form a rigid structure called the skeleton. Major bones include the femur in the thigh and the humerus in the upper arm.



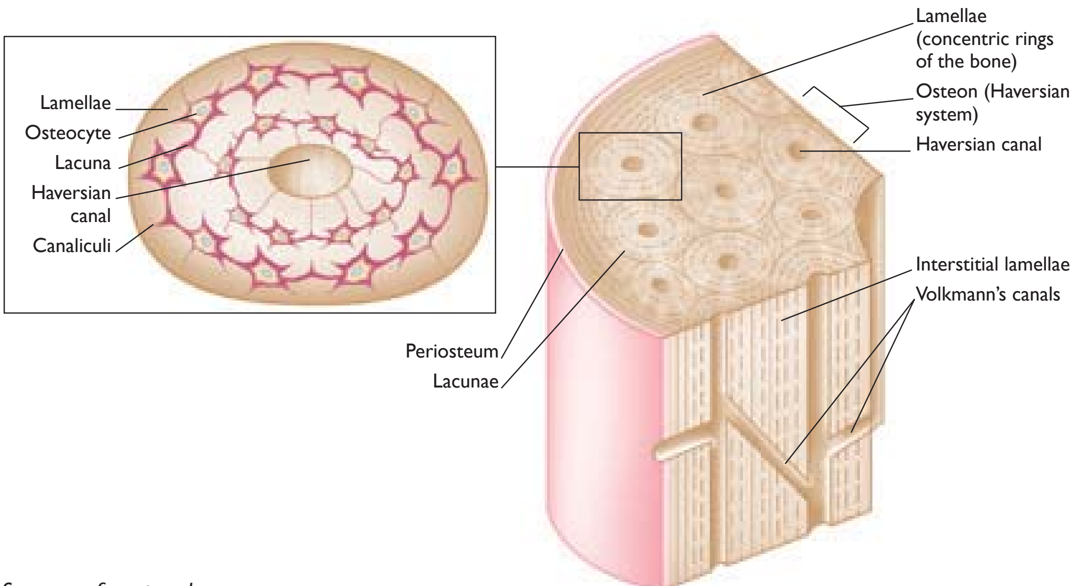
Bone development and growth.

Types of Bone According to Density

Compact Bone

Compact bone is dense and looks smooth to the naked eye. Through the microscope, compact bone appears as an aggregation of Haversian systems called osteons. Each system is an elongated cylinder oriented along the long axis of the bone, consisting of a central Haversian canal containing blood vessels, lymph vessels and nerves surrounded by concentric plates of bone called lamellae. In other words, each Haversian system is a group of hollow tubes of bone matrix (lamellae) placed one inside the next. Between these lamellae there are spaces (lacunae) that contain lymph and osteocytes. The lacunae are linked via hair-like canals called canaliculi to the lymph vessels in the Haversian canal, enabling the osteocytes to obtain nourishment from the lymph. This tubular array of lamellae gives great strength to bone.

Other canals called perforating, or Volkmann's, canals run at right angles to the long axis of the bone, connecting the blood vessels and nerve supply within the bone to the periosteum.

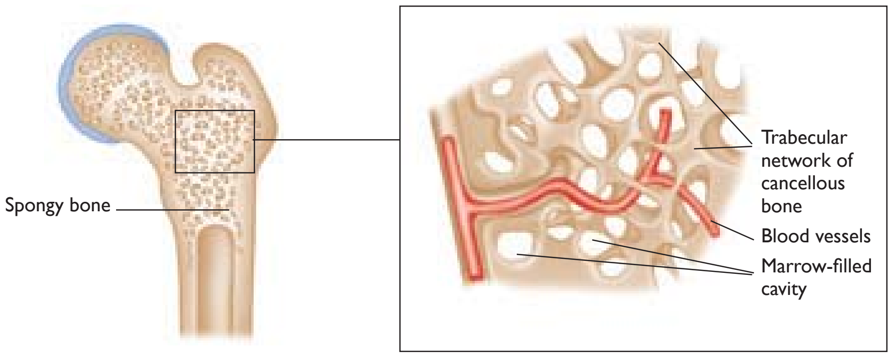


Structure of compact bone.

Spongy Bone (Cancellous Bone)

Spongy bone is composed of small, needle-like trabeculae (singular: trabecula; literally, 'little beams') containing irregularly arranged lamellae and osteocytes interconnected by canaliculi. There are no Haversian systems but rather lots of open spaces, which can be thought of as large Haversian canals, giving a honeycombed appearance. These spaces are filled with red or yellow marrow and blood vessels.

This structure forms a dynamic lattice capable of gradual alteration through realignment in response to stresses of weight, postural change and muscle tension. Spongy bone is found in the epiphyses of long bones, the bodies of the vertebrae and other bones without cavities.



Structure of spongy (cancellous) bone.

Types of Bone According to Shape

Irregular Bones

Irregular bones have complicated shapes; they consist mainly of spongy bone enclosed by thin layers of compact bone. Examples include: some skull bones, the vertebrae and the hip bones.

Flat Bones

Flat bones are thin, flattened bones and are frequently curved; they have a layer of spongy bone sandwiched between two thin layers of compact bone. Examples include: most of the skull bones, the ribs and the sternum.

Short Bones

Short bones are generally cube-shaped; they consist mostly of spongy (cancellous) bone. Examples include: the carpal bones in the wrist and tarsal bones in the ankle.

Sesamoid Bones

From the Latin, meaning 'shaped like a sesame seed', sesamoid bones are a special type of short bone that are formed and embedded within a muscle tendon. Examples are: the patella (kneecap) and the pisiform bone of the wrist.

Long Bones

Long bones are longer than they are wide; they have a shaft with heads at both ends, and consist mostly of compact bone. Examples include: the bones of the limbs, except those of the wrist, hand, ankle and foot (although the bones of the fingers and toes are effectively miniature long bones).

Components of a Long Bone

The transformation of cartilage within a long bone begins at the centre of the shaft. Secondary bone-forming centres develop later, across the ends of the bones. From these growth centres the bone continues to grow through childhood and adolescence, finally ceasing in the early twenties, whereupon the growth regions harden.

Diaphysis

The diaphysis (from Greek, meaning 'a separation') is the shaft or central part of a long bone. It has a marrow-filled cavity (medullary cavity) surrounded by compact bone. It is formed from one or more primary sites of ossification and supplied by one or more nutrient arteries.

Epiphysis
The epiphysis (from Greek, meaning 'excrescence') is the end of a long bone, or any part of a bone separated from the main body of an immature bone by cartilage. It is formed from a secondary site of ossification. It consists largely of spongy bone.

Epiphyseal Line
The epiphyseal line is the remnant of the epiphyseal plate (a flat plate of hyaline cartilage) seen in young, growing bone. The epiphyseal plate is the site of growth of a long bone. By the end of puberty, long bone growth stops and the plate is completely replaced by bone, leaving just the line to mark its previous location.

Articular Cartilage
Articular cartilage is the only remaining evidence of an adult bone's cartilaginous past. It is located where two bones meet (articulate) within a synovial joint. It is smooth, slippery, porous, malleable, insensitive and bloodless. It is massaged by movement, which circulates synovial fluid, oxygen and nutrients.

NOTE: The degenerative process of osteoarthritis (and the latter stages of some forms of rheumatoid arthritis) involves the breakdown of articular cartilage.

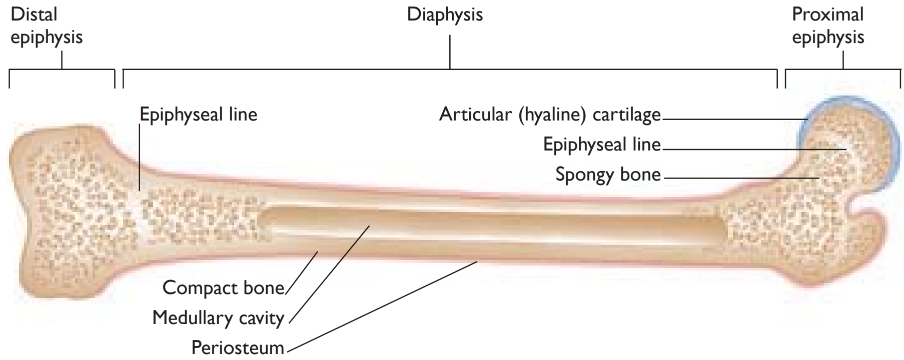
Periosteum
The periosteum is a fibrous connective tissue membrane enveloping the outer surface of bone. It is vascular and provides a highly sensitive, double-layered life support sheath. The outer layer is made up of dense irregular connective tissue. The inner layer, which lies directly against the bone surface, mostly comprises the bone-forming osteoblasts and the bone-destroying osteoclasts.

The periosteum is supplied with nerve fibres, lymphatic vessels and blood vessels that enter the bone through nutrient canals. It is attached to the bone by collagen fibres known as Sharpey's fibres. The periosteum also provides the anchoring point for tendons and ligaments.

Medullary Cavity
The medullary cavity is the cavity of the diaphysis (i.e. the central section of a long bone). It contains marrow: red in the young, turning to yellow in many bones in maturity.

Red Marrow
Red marrow is a red, gelatinous substance composed of red and white blood cells in a variety of developmental forms. Red marrow cavities are typically found within the spongy bone of long bones and flat bones. In adults the red marrow, which creates new red blood cells, occurs only in the head of the femur and the head of the humerus and, much more importantly, in the flat bones such as the sternum and irregular bones such as the hip bones. These are the sites routinely used for obtaining red marrow samples when problems with the blood-forming tissues are suspected.

Yellow Marrow
Yellow marrow is a fatty connective tissue that no longer produces blood cells.



Components of a long bone.

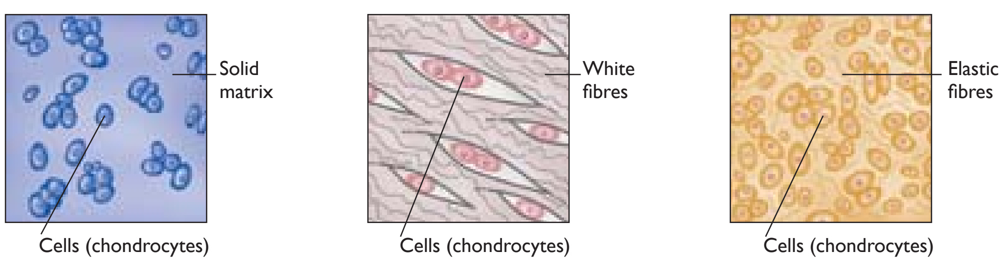
Cartilage

Cartilage is a specialized fibrous connective tissue. Its main purpose is to provide a smooth surface for the movement of joints, and absorb impact and friction when bones bump and rub together. It exists either as a temporary formation that is later replaced by bone, or as a permanent supplementation to bone; it is not as hard or as strong as bone. Cartilage strength comes mainly from the strength of the collagen it contains. Cartilage is relatively non-vascular (not penetrated by blood vessels) and is mainly nourished by surrounding tissue fluids. Types include: hyaline cartilage, fibrocartilage and elastic cartilage.

The most important is hyaline (articular) cartilage, which is made up of collagen fibres and water. Hyaline cartilage forms the temporary foundation of cartilage from which many bones develop, thereafter existing in relation to bone as:

- The articular cartilage of synovial joints.
- Cartilage plates between separately ossifying areas of bone during growth.
- The xiphoid process of the sternum (which ossifies late or not at all) and the costal cartilages.

Hyaline cartilage also exists in the nasal septum, most cartilages of the larynx, and the supporting rings of the trachea and bronchi.



Structure of cartilage; a) hyaline cartilage, b) white fibrocartilage, c) yellow elastic cartilage.

Ligaments

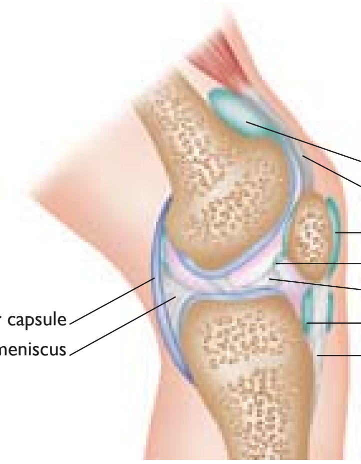
Ligaments are the fibrous connective tissues that connect bone to bone. Composed of dense regular connective tissue, ligaments contain more elastin than tendons and so are more elastic. Ligaments provide stability for the joints and, with the bones, either allow or limit movement of the limbs.

Tendons

Tendons are the fibrous connective tissues that connect muscle to bone. Their collagen fibres are arranged in a parallel pattern, which enables resistance to high, unidirectional tensile loads when the attached muscle contracts. Tendons work together with muscles to exert force on bones and produce movement.

Joints

Joints (also called articulations) enable movement, giving the rigid bony skeleton mobility. They are also sites where forces are absorbed and transmitted and where growth takes place. There are three main types of joint: fibrous joints, which have very little or no movement; cartilaginous joints, which are either immovable or only slightly movable; and synovial joints, which are freely moveable.



The knee joint; right leg, mid-sagittal view.

As synovial joints are freely movable, they are the joints most often involved with sports injuries. Major synovial joints include: the knee, hip, shoulder and elbow. Synovial joints share the following features, all of which can be damaged in a sports injury:

Articular capsule

The articular capsule surrounds and envelopes the entire synovial joint. It consists of an outer layer of fibrous tissue and an inner layer, the synovial membrane, which secretes synovial fluid to lubricate and nourish the joint. The joint capsule is strengthened by strong bands of ligament (see above).

Joint cavity

Neither fibrous nor cartilaginous joints have a joint cavity, while synovial joints possess a joint cavity that contains synovial fluid.

Hyaline articular cartilage

Hyaline cartilage covers the end of bones and provides a smooth, slippery surface that allows the joint to move freely. The job of articular cartilage is to reduce friction during movement and absorb shock.

Bursa

A bursa (plural bursae) is a small sac filled with viscid fluid. Bursae are most commonly found at the point in the joint where the muscle and tendon slide across the bone. The job of a bursa is to reduce friction and provide smooth movement for the joint.

The Seven Types of Synovial Joint

Plane or Gliding
Movement occurs when two generally flat or slightly curved surfaces glide across one another. Examples: the acromioclavicular joint and the intercarpal joints of the wrist.

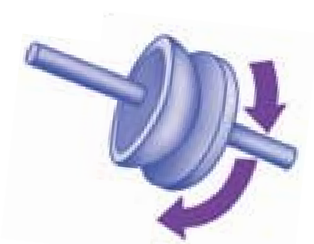
Hinge
Movement occurs around a transverse axis, as in the hinge of the lid of a box. A protrusion of one bone fits into a concave or cylindrical articular surface of another, permitting flexion and extension. Examples: the interphalangeal joints of the digits and the elbow.

Pivot
Movement takes place around a vertical axis, like the hinge of a gate. A more or less cylindrical articular surface of bone protrudes into and rotates within a ring formed by bone or ligament. Example: the proximal radioulnar joint at the elbow.

Spheroidal or Ball-and-Socket
Consists of a 'ball' formed by the spherical or hemispherical head of one bone which rotates within the concave 'socket' of another, allowing flexion, extension, adduction, abduction, circumduction and rotation. Thus, they are multi-axial and allow the greatest range of movement of all joints. Examples: the glenohumeral joint and the hip.

Ellipsoid
Have an ellipsoid articular surface that fits into a matching concavity, which permits flexion, extension and some abduction and adduction. Example: the metacarpophalangeal joints of the hand (but not the thumb).

Saddle
Articulating surfaces have convex and concave areas, and so resemble two 'saddles' that accommodate each other's convex to concave surfaces. Similar to ellipsoid joints, they allow flexion, extension, abduction and adduction but more rotational movement, for example, allowing the 'opposition' of the thumb to the fingers. Example: the carpometacarpal joint of the thumb.



Condylar/bicondylar
Reciprocal convex / concave joint surface(s) allow flexion, extension and limited rotation around a longitudinal axis. Example: the tibiofemoral joint of the knee.

IS THE SPORTS INJURY ACUTE OR CHRONIC?

Regardless of where the injury occurs within the body, or the seriousness of the injury, sports injuries are commonly classified in one of two ways: acute or chronic.

Acute Injuries

These refer to sports injuries that occur in an instant. Common examples of acute injuries are bone fractures, muscle and tendon strains, ligament sprains and contusions. Acute injuries usually result in pain, swelling, tenderness, weakness and the inability to use or place weight on the injured area.

Chronic injuries

These refer to sports injuries that occur over an extended period of time and are sometimes called overuse injuries. Common examples of chronic injuries are tendinitis, bursitis and stress fractures. Chronic injuries, like acute injuries, also result in pain, swelling, tenderness, weakness and the inability to use or place weight on the injured area.

HOW ARE SPORTS INJURIES CLASSIFIED?

As well as classifying a sports injury as acute or chronic, sports injuries are also classified according to their severity. Injuries are graded into one of three classifications: mild, moderate or severe.

Mild

A mild sports injury will result in minimal pain and swelling. It will not adversely affect sporting performance and the affected area is neither tender to touch nor deformed in any way.

Moderate

A moderate sports injury will result in some pain and swelling. It will have a limiting affect on sporting performance and the affected area will be mildly tender to touch. Some discoloration at the injury site may also be present.

Severe

A severe sports injury will result in increased pain and swelling. It will not only affect sporting performance but will also affect normal daily activities. The injury site is usually very tender to touch, and discoloration and deformity are common.

HOW ARE SPRAIN AND STRAIN INJURIES CLASSIFIED?

The term sprain refers to an injury of the ligaments, as opposed to a strain, which refers to an injury of the muscle or tendon. Remember ligaments attach bone to bone, whereas tendons attach muscle to bone.

Injuries to the ligaments, muscles and tendons are usually graded into three categories. These types of injury are referred to as: first-, second- or third-degree sprains and strains.

First-degree

A first-degree sprain/strain is the least severe. It is the result of some minor stretching of the ligaments, muscles or tendons and is accompanied by mild pain, some swelling and joint stiffness. There is usually very little loss of joint stability as a result of a first-degree sprain/strain.

Second-degree

A second-degree sprain/strain is the result of both stretching and some tearing of the ligaments, muscles or tendons. There is increased swelling and pain associated with a second-degree sprain/strain and a moderate loss of stability around the joint.

Third-degree

A third-degree sprain/strain is the most severe of the three. A third-degree sprain/strain is the result of a complete tear or rupture of one or more of the ligaments, muscles or tendons and will result in massive swelling, severe pain and gross instability.

One interesting point to note about a third-degree sprain/strain is that shortly after the injury most of the localized pain may disappear. This is a result of the nerve endings being severed, which causes a lack of feeling at the injury site.

5 Sports Injuries of the Head and Neck

THE HEAD

The cranium (Greek: kranion) is made up of eight large flat bones comprising two pairs plus four single bones. These form a box-like container that houses the brain. These bones are:

Frontal: which forms the forehead, the bony projections under the eyebrows and the superior part of the orbit of each eye.

Parietal: a pair of bones that form most of the superior and lateral walls of the cranium. They meet in the midline at the sagittal suture, and meet with the frontal bone at the coronal suture.

Temporal: a pair of bones that lie inferior to the parietal bones. There are three important markings on the temporal bone: (a) the styloid process, a sharp, needle-like projection to which many of the neck muscles attach; (b) the zygomatic process, a thin bridge of bone that joins with the zygomatic bone just above the mandible; (c) the mastoid process, a rough projection posterior and inferior to the styloid process (just behind the lobe of the ear).

Occipital: the most posterior bone of the cranium. It forms the floor and back wall of the skull, and joins the parietal bones anteriorly at the lambdoid suture. In the base of the occipital bone is a large opening, the foramen magnum, through which the spinal cord passes to connect with the brain. To each side of the foramen magnum are the occipital condyles which rest on the first vertebra of the spinal column (the atlas).

Sphenoid: a butterfly-shaped bone that spans the width of the skull and forms part of the floor of the cranial cavity. Parts of the sphenoid can be seen forming part of the eye orbits and the lateral part of the skull.

Ethmoid: a single bone in front of the sphenoid bone and below the frontal bone. Forms part of nasal septum and superior and medial conchae.

The Facial Bones

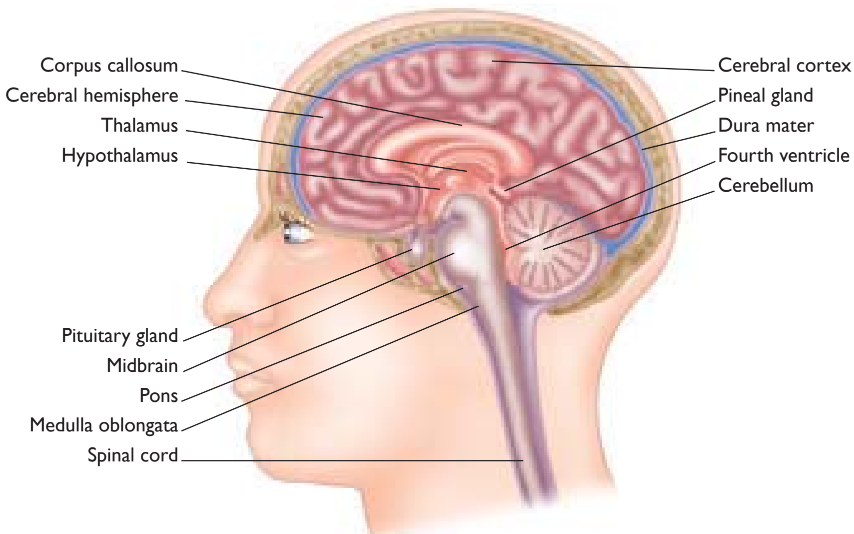
Fourteen bones compose the face, twelve of which are paired. The main bones of the face are:

Nasal: a pair of small rectangular bones that form the bridge of the nose (the lower part of the nose is made up of cartilage).

Zygomatic: a pair of bones commonly known as the cheekbones. They also form a large portion of the lateral walls of the eye orbits.

Maxillae: the two maxillary bones fuse to form the upper jaw. The upper teeth are embedded in the maxillae.

Mandible: the lower jawbone is the strongest bone in the face. It joins the temporal bones on each side of the face, forming the only freely movable joints in the skull. The horizontal part of the mandible, or the body, forms the chin. Two upright bars of bone, or rami, extend from the body to connect the mandible with the temporal bone. The lower teeth are embedded in the mandible.



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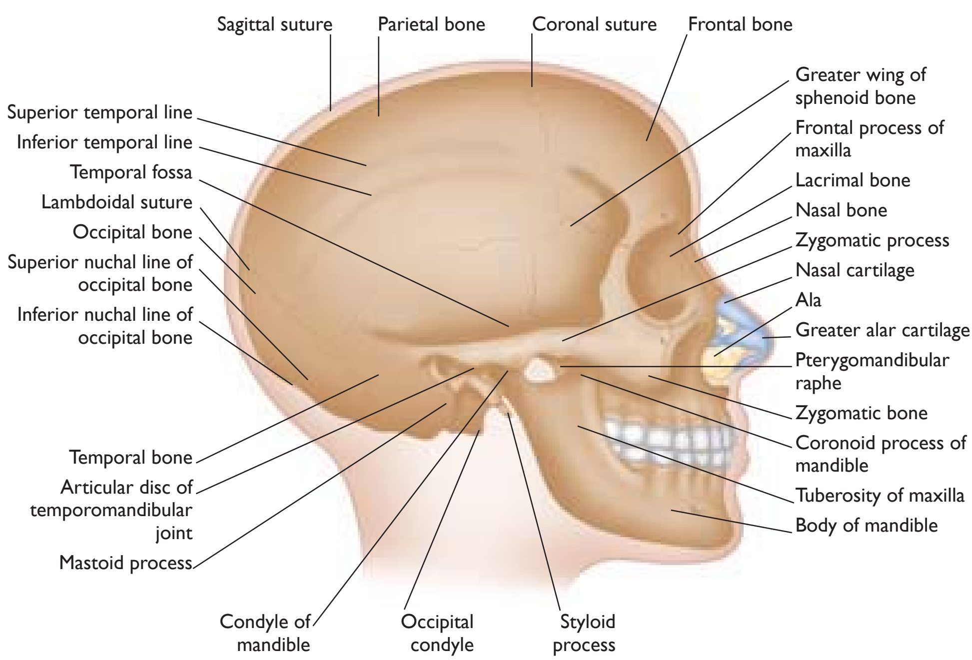
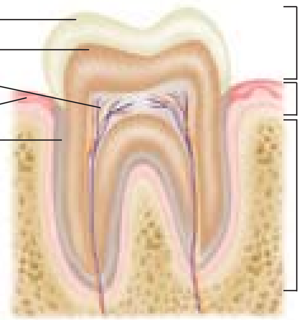


b)

The head, lateral view, and b) the skull, lateral view.

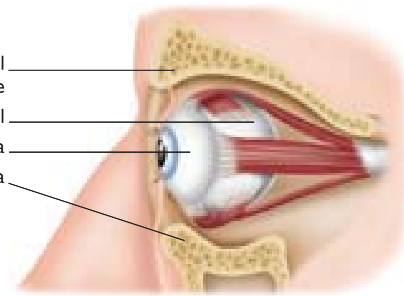
Teeth

Teeth are hard, calcified structures set in the alveolar processes of the mandible and maxilla. Each tooth consists of a crown, a neck and a root. The solid part includes dentin, which forms most of the tooth; enamel, which covers the crown; and cementum covering the root. In the centre is the soft pulp containing arteries, veins, and lymphatic and nerve tissue.



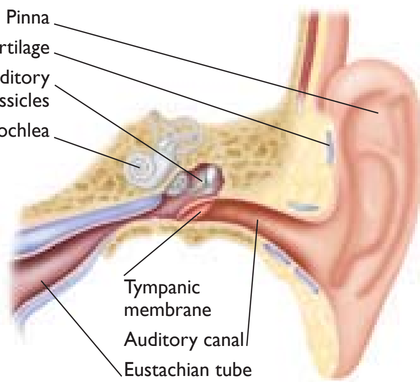
Eyes

The eyes, among the body's most delicate structures, are protected by design from injury. The eyeball is a large sphere, and is recessed in a socket surrounded by a strong, bony ridge, with the segment of a smaller sphere, the cornea, in front. The eyelids can close quickly, protecting the eyeball from foreign objects. Furthermore, the eye is designed to withstand some impact without serious damage.



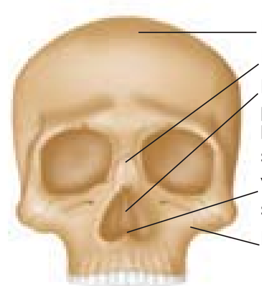
Ears

The ear is the organ responsible for hearing, also playing a critical role in balance (equilibrium). Injury to the ear can affect either or both of these senses. The outer ear consists of the outer cartilage (pinna) and the auditory canal. The middle ear consists of the tympanic membrane (or eardrum); the auditory ossicles or bones of the ear; the middle ear cavity and the Eustachian tube.



Nose

The nose is comprised of bone and cartilage. The nasal septum is often injured in sports. It consists of the vomer, a perpendicular plate of the ethmoid, and the quadrangular cartilage. A pair of protrusions from the frontal bones and the ascending processes of the maxilla complete the bony component, while the upper lateral and lower lateral cartilages, as well as the cartilaginous septum, make up the non-bony portion.

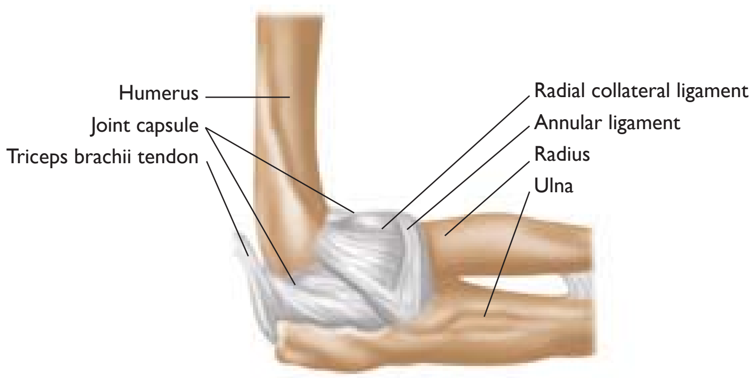


8 Sports Injuries of the Elbow

ANATOMY AND PHYSIOLOGY

The elbow is a hinge joint comprised of three bones: the humerus of the upper arm and the two bones of the forearm – the ulna and the radius. The elbow encompasses three articulations – the humeroulnar, humeroradial and proximal radioulnar joints. Of the forearm bones the ulna is the most medial, being on the little finger side, and is also the largest. At the distal end of the humerus are the trochlea and the capitulum, bony features that articulate with the radius and ulna.

The elbow is reinforced by several important ligaments, the two most important being the ulnar (medial) collateral ligament and the radial (lateral) collateral ligament. The medial collateral ligament is composed of three strong bands that reinforce the medial side of the joint capsule. The lateral collateral ligament is a strong triangular ligament that reinforces the lateral side of the capsule. These ligaments connect the humerus to the ulna and act together to stabilize the elbow. Additionally, the annular ligament envelopes the head of the radius and holds it firmly against the ulna to form the proximal radioulnar joint.



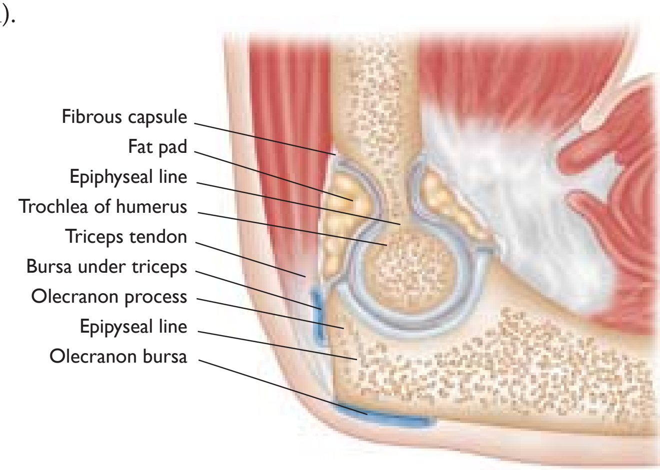
The elbow joint, right arm, lateral view.

The elbow allows flexion and extension capacity as well as the ability to pronate and supinate, affording a great range of motion. Considerable force is required to dislocate the elbow joint.

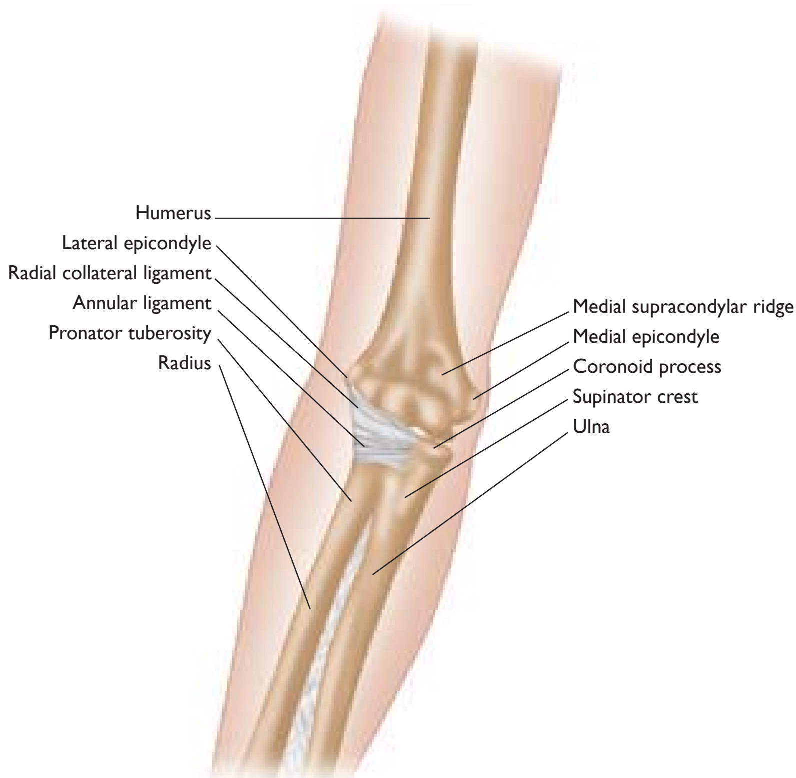
The bony prominence at the tip of the elbow is known as the olecranon process of the ulna. The fluid-filled sac located at the olecranon process is the olecranon bursa. It is the largest bursa in the elbow region and provides cushioning protection to the underlying bone.

The lateral epicondyle of the humerus is an important bony feature located just proximal to the outside of the elbow joint. Many muscles attach to the lateral epicondyle, including the common tendon of the forearm extensor muscles, anconeus and the supinator muscle, which is involved in supination (rotating the forearm to the palm up position).

The medial epicondyle is a bony prominence on the inside of the elbow. It is the insertion point for the muscles used to flex the wrist and fingers and for pronation (rotating the forearm to the palm down position).

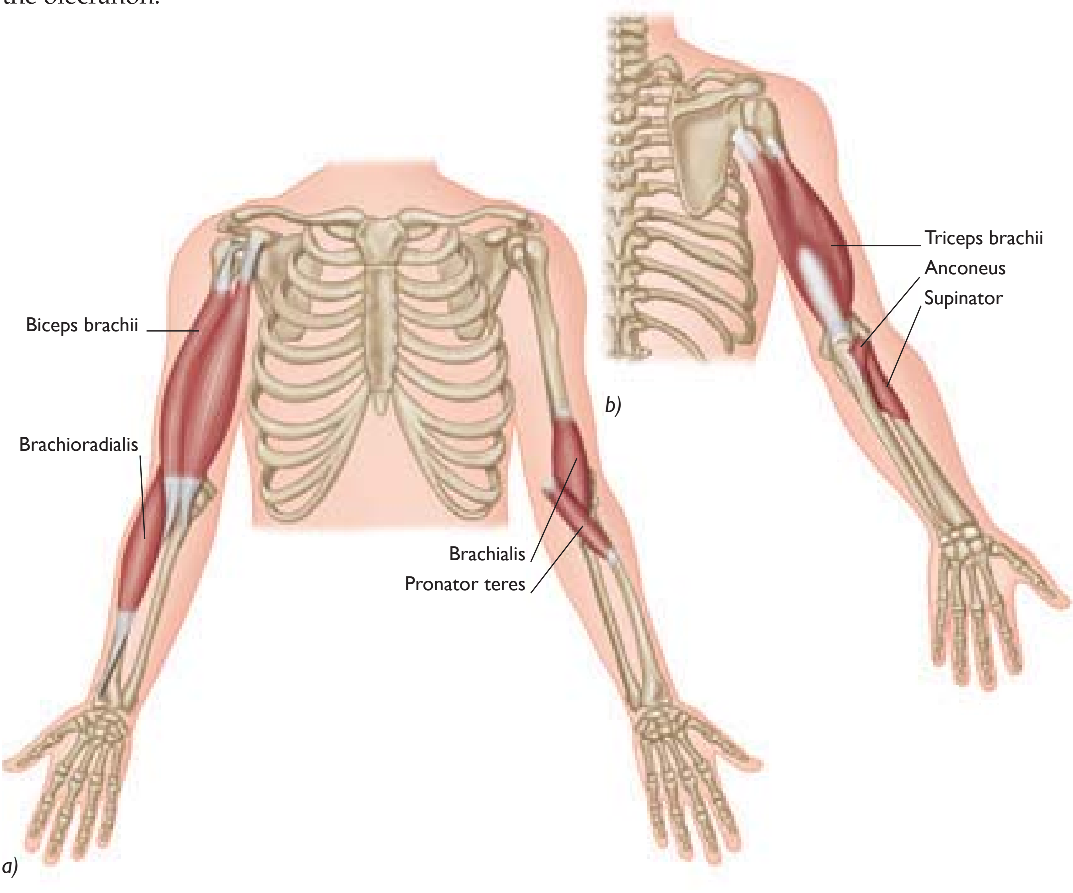


The elbow joint, right arm, mid-sagittal view.



The elbow joint, anterior view.

The muscles of the arm originate from the scapula and / or the humerus and insert onto the radius and / or ulna to act upon the elbow joint. They are: biceps brachii; brachialis; triceps brachii and anconeus. (Coracobrachialis, although acting upon the shoulder joint, is also included because of its proximity to the other muscles of this group.) Biceps brachii is the main supinator of the forearm and has two tendinous heads at its origin and two tendinous insertions. The short head of biceps forms part of the lateral wall of the axilla along with coracobrachialis and the humerus. Brachialis lies posterior to biceps brachii and is the main flexor of the elbow joint. Triceps brachii originates from three heads and is the only muscle on the back of the arm. The triceps brachii tendon permits the elbow to straighten with force during certain activities, e.g. push-ups. The tendon of triceps begins around the middle of the muscle and consists of two segments, one covering the back of the lower half of the muscle, the other more deeply situated within the muscle. The two segments or lamellæ join each other above the elbow and insert onto the olecranon.



Elbow joint muscles; a) anterior view, b) posterior view.

ELBOW FRACTURE

An elbow fracture is a break involving any of the three arm bones that work together to form the elbow joint. Such fractures may occur as the result of a blunt force striking the elbow during athletics or from a fall onto the elbow. The injury is common to many sports, particularly contact sports such as football. Fractures may be classified as distal humeral fractures, radial fractures and ulnar fractures. Fractures of the radial head are the most common.

Cause of injury
Falling directly onto the elbow. Direct trauma to the elbow. Severe torsion of the elbow beyond its normal range of motion.

Signs and symptoms
Swelling and pain in the region of the elbow. Deformity of the elbow due to bone fracture. Loss of arm mobility.

Complications if left unattended
Without treatment, fractured bones of the elbow can fail to heal properly, and at times fuse in misalignment. This can lead to long-term deficit in range of motion and strength, increased vulnerability to re-injury and deformity of the joint.

Immediate treatment
Apply ice immediately to the swollen area. Immobilize the arm in a splint or sling before seeking emergency help.

Rehabilitation and prevention
Elbow fractures occur from sudden, accidental trauma and are often difficult to prevent. Avoiding athletics at periods of extreme fatigue and protection of the elbow with padding during athletics are both prudent. Additionally, consuming calcium and performing bone strengthening exercises may help avoid fractures.

Long-term prognosis
Long-term prospects for elbow fractures vary depending on the nature and severity of the fracture as well as the age and medical history of the injured athlete. Infections, stiffening of the elbow joint, arthritis, non-union or malunion of bone are possible. In the case of less severe elbow fractures, full recovery may be expected, though the healing process often requires several months.

ELBOW SPRAIN

Ligaments are strong bands of tissue connecting bones and act to stabilize the elbow. A sprain involves the stretching or tearing of elbow ligaments. Many sports are prone to elbow sprains, particularly sports involving throwing, and often involve the medial collateral ligament. Elbow sprains are also common in gymnastics.

Cause of injury
Sudden, abnormal twisting of the arm. Falling onto an outstretched arm. Deficient strength in arm ligaments and muscles.

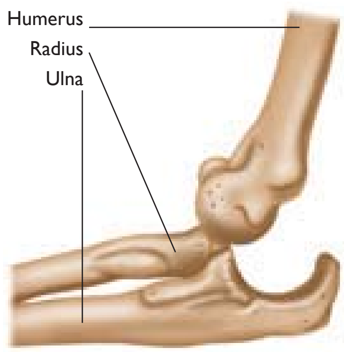
Signs and symptoms
Pain, tenderness and swelling in the area of the elbow joint. Bruising around the elbow. Limited range of motion in the arm.

Complications if left unattended
Sprains, particularly when they are severe, can lead to future painful or disabling symptoms, including instability and weakness in the elbow, limited range of motion and osteoarthritis.

Immediate treatment
RICER regimen to reduce inflammation and treat pain. Immobilization of injured elbow with a sling or splint.

Rehabilitation and prevention
Proper athletic technique, avoiding exercise during periods of fatigue and protective sportswear including padding can all reduce the risk of elbow sprains. Following initial healing, range of motion exercises and gradual return to athletic activity will help restore flexibility. For a time a supportive brace may be used to prevent sudden re-injury.

Long-term prognosis
Depending on the severity of the sprain and general health of the patient, minor sprains heal thoroughly without future complication. Older athletes or those who have suffered severe sprain (including sprains occurring in conjunction with fractures or dislocations) may suffer some impairment of movement and pain associated with arthritis.



(a) Elbow dislocation.

(b) Elbow subluxation.

ELBOW DISLOCATION

Dislocation of the elbow occurs when the humerus is separated by force from where it articulates with the ulna and/or radius. The injury typically produces considerable pain, swellings and loss of movement in the injured arm. Contact sports are more prone to such injuries. Fractures as well as injuries to arteries and nerves sometimes accompany dislocation. A partial dislocation is known as a subluxation.

Cause of injury

Blow or other trauma to the elbow. Fall onto an outstretched arm. Violent contact between the elbow and another athlete or object.

Signs and symptoms

Severe pain in the elbow, swelling and bruising. Loss of range of motion. Loss of feeling in the hand following sharp injury to the elbow.

Complications if left unattended

Improper healing can follow if a dislocation is left untreated, causing nerve and arterial damage, osteoarthritis, ongoing pain in the injured arm, loss of full movement and distortion of the elbow joint. Infection of the dislocated region is also possible, particularly if a fracture is involved.

Immediate treatment

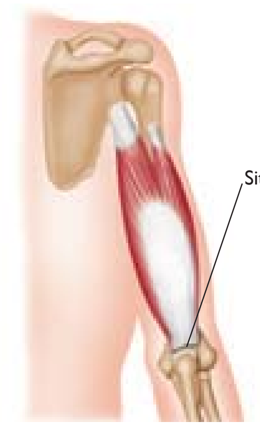
Check for possible damage to an artery by taking the pulse. Treat the injury with ice and immobilize the elbow in a splint or sling.

Rehabilitation and prevention

Ice should be used to reduce initial pain and swelling, while proper medical attention is sought. The elbow should be moved as little as possible and elevated frequently. Proper attention to athletic technique and padding of the elbow region, especially in the case of contact sports such as football, may help prevent such injuries.

Long-term prognosis

Generally, dislocations without further complications of nerve or arterial damage heal thoroughly given proper initial care and some rehabilitative exercises.



TRICEPS BRACHII TENDON RUPTURE

The triceps brachii tendon is located at the back of the upper arm, inserting onto the back of the elbow. A direct fall onto an outstretched hand can rupture this tendon (tendon avulsion) though the injury is fairly uncommon. Weightlifters and football linemen are among the athletes who run a risk of triceps brachii tendon rupture due to excessive weight on the tendon.

Cause of injury

Fall onto an outstretched hand, with the elbow in mid-flexion. Excessive weightlifting. Underlying health issues such as diabetes mellitus. It is believed the use of anabolic steroids increases the risk of tendon rupture.

Signs and symptoms

Pain and swelling at the back of the elbow. Inability to straighten the elbow. Muscle spasm.

Complications if left unattended

The injury generally requires surgery to repair. Failure to repair a ruptured triceps brachii tendon can cause permanent tendon deficiency, leading to muscle weakness, continued pain loss of elbow mobility and weightbearing capacity.

Immediate treatment

RICER regimen to reduce inflammation and treat pain. Prevent movement by immobilizing the injury with a splint or sling.

Rehabilitation and prevention

Following surgery to repair a ruptured triceps brachii tendon, exercises may be used to gradually increase the range of motion, flexibility and strength of the injured arm. Proper technique, particularly if weightlifting or bodybuilding is critical to prevent such injuries.

Long-term prognosis

With surgery soon after the time of injury and proper rehabilitation, ruptures of the triceps brachii tendon generally heal completely, though complications such as accompanying fractures will affect long-term prognosis.

REHABILITATION EXERCISES

Dumbbell curls

Stand with your feet shoulder width apart and a dumbbell in each hand. Begin by letting the dumbbells rest naturally at your sides. Turn the dumbbells so your palms are facing the ceiling as you bend your elbows and lift the dumbbells up to your chest.

Close grip bench press

Lie on a weight bench and let the bar relax against your chest with your elbows at your side. Move your hands as close together as possible and lift the bar directly upwards.

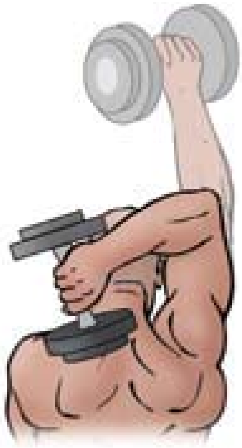
Rope press down

With your feet firmly on the ground, grip a rope with your elbows bent at a 90-degree angle. Pull the rope down by straightening your elbows and bringing your hands toward the floor.

Dumbbell kickbacks

Rest one hand and the same knee on a weight bench. Begin by holding a dumbbell with your elbow at a 90-degree angle in the other hand. Straighten your elbow and push the dumbbell as far behind you as you can. Return to the starting position slowly without letting the dumbbell fall.

Dumbbell overhead extension



Hold a dumbbell in one hand and put it behind your head letting it fall toward the floor. With your elbow pointing toward the ceiling, raise the dumbbell as high as you can until your elbow is straight. Slowly bring the dumbbell back to the starting position and repeat.

Broomstick rotator stretch

Stand with your arm out and your forearm pointing upwards at 90 degrees. Place a broomstick in your hand and behind your elbow. With your other hand pull the bottom of the broomstick forward.

Overhead triceps stretch

Stand with your hand behind your neck and your elbow pointing upwards. Then use your other hand to pull your elbow down.