JOINTS OF UPPER LIMB

ASSIGNMENT NO # 1

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JOINTS OF THE UPPER LIMB

THE UPPER LIMB:

The upper limb has a wide range of precise movements associated with it to allow us to effectively interact with our environment, the 6 main joints covered here (from proximal to distal) are the sternoclavicular, acromioclavicular, shoulder, elbow, radioulnar, and wrist joints.

The sternoclavicular joint is located between the clavicle and the manubrium of the sternum. It is a very mobile yet very stable joint and is the main point of attachment between the upper limb and the axial skeleton.

Further down the clavicle, the acromioclavicular joint allows articulation between the clavicle, and the acromion process of the scapula.

The shoulder joint is highly mobile ball-and-socket type joint between the scapula and the head of the humerus. It allows for a vast array of movements from the shoulder and is reinforced by its many ligaments and the rotator cuff muscles. Due to it's mobility, it is not surprising that the shoulder is the most commonly dislocated joint in the body.

Another joint of the upper limb is the elbow joint**;** Formed between the humerus of the upper arm and the radius and ulnar of the forearm, it is a hinge-type joint which allows us to flex and extend our arms. The joint is reinforced by the medial and lateral collateral ligament, as well as its tough joint capsule.

The radioulnar joints are located at the proximal and distal ends of the radius and ulnar. The proximal joint is just past the elbow joint and is an articulation between the head of the radius and the radial notch of the ulnar. The distal joint is formed between the head of the ulnar and the ulnar notch of the radius.

The wrist joint is formed between the radius of the forearm and the scaphoid, lunate and triquetrum of the carpal bones. In addition to this, a fibrocartilaginous disk which, with the radius, forms a concave surface in which the convex carpal bones can articulate.

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- **THE ACROMIOCLAVICULAR JOINT:**

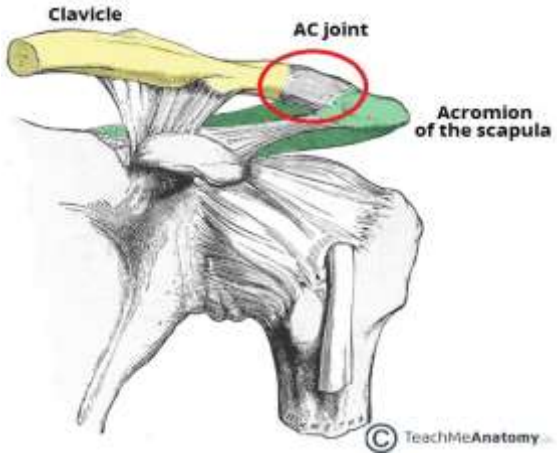
The acromioclavicular joint is a plane type synovial joint. It is located where the lateral end of the clavicle articulates with the acromion of the scapula. The joint can be palpated during a shoulder examination; 2-3cm medially from the 'tip' of the shoulder (formed by the end of the acromion).

In this article, we shall look at the anatomy of the acromioclavicular joint – its articulation, ligaments, neurovascular supply, and any clinical correlations.

➢ STRUCTURES OF THE ACROMIOCLAVICULAR JOINT:

○ ARTICULATING SURFACES:

- The acromioclavicular joint consists of an articulation between the lateral end of the clavicle and the acromion of the scapula. It has two atypical features:
- The articular surfaces of the joint are lined with fibrocartilage (as opposed to hyaline cartilage).
- The joint cavity is partially divided by an articular disc – a wedge of fibrocartilage suspended from the upper part of the capsule.



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- **JOINT CAPSULE:**

The joint capsule consists of a loose fibrous layer which encloses the two articular surfaces. It also gives rise to the articular disc. The posterior aspect of the joint capsule is reinforced by fibres from the trapezius muscle.

As would be expected of a synovial joint, joint capsule is lined internally by a synovial membrane. This secretes synovial fluid into the cavity of the joint.

- **LIGAMENTS:**

There are three main ligaments that strengthen the acromioclavicular joint. They can be divided into intrinsic and extrinsic ligaments:

- **Intrinsic**:

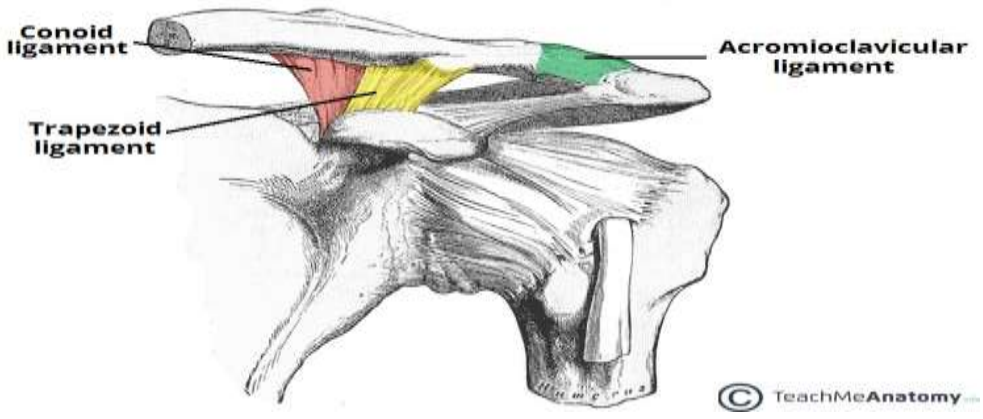
Acromioclavicular ligament – runs horizontally from the acromion to the lateral clavicle. It covers the joint capsule, reinforcing its superior aspect.

- **Extrinsic:**

Conoid ligament – runs vertically from the coracoid process of the scapula to the conoid tubercle of the clavicle.

Trapezoid ligament – runs from the coracoid process of the scapula to the trapezoid line of the clavicle.

Collectively, the conoid and trapezoid ligaments are known as the coracoclavicular ligament. It is a very strong structure, effectively suspending the weight of the upper limb from the clavicle.



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- **NEUROVASCULAR SUPPLY:**

  - **Vessels:**

The arterial supply to the joint is via two vessels:

- Suprascapular artery – arises from the subclavian artery at the thyrocervical trunk.
- Thoraco-acromial artery – arises from the axillary artery.

The veins of the joint follow the major arteries.

  - **Nerves:**

The acromioclavicular joint is innervated by articular branches of the suprascapular and lateral pectoral nerves**.** They both arise directly from the brachial plexus.

- **Movements:**

The acromioclavicular joint allows a degree of axial rotation and anteroposterior movement.

As no muscles act directly on the joint, all movement is passive, and is initiated by movement at other joints (such as the scapulothoracic joint).

- **THE STERNOCLAVICULAR JOINT:**

The sternoclavicular joint is a synovial joint between the clavicle and the manubrium of the sternum.

It is the only attachment of the upper limb to the axial skeleton. Despite its strength, it is a very mobile joint and can function more like a ball-and-socket type joint.

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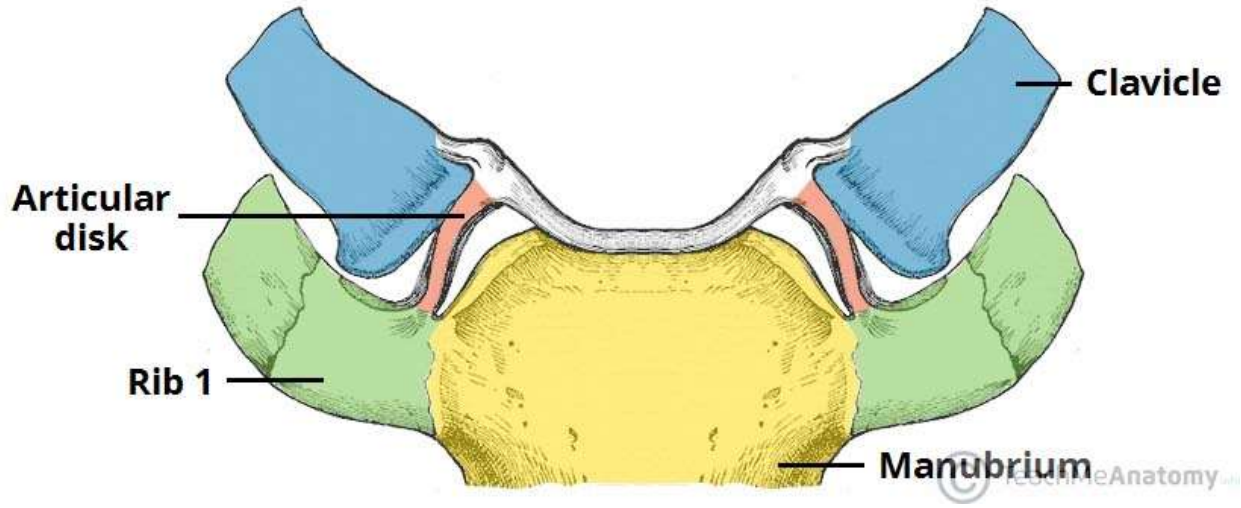
- **Joint Structure:**

  - **ARTICULATING SURFACES:**

The sternoclavicular joint consists of the sternal end of the clavicle, the manubrium of the sternum, and part of the 1st costal cartilage. The articular surfaces are covered with fibrocartilage (as opposed to hyaline cartilage, present in the majority of synovial joints). The joint is separated into two compartments by a fibrocartilaginous articular disc**.**



  - **JOINT CAPSULE:**

The joint capsule consists of a fibrous outer layer, and inner synovial membrane. The fibrous layer extends from the epiphysis of the sternal end of the clavicle, to the borders of the articular surfaces and the articular disc. A synovial membrane lines the inner surface and produces synovial fluid to reduce friction between the articulating structures.

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➢ LIGAMENTS:

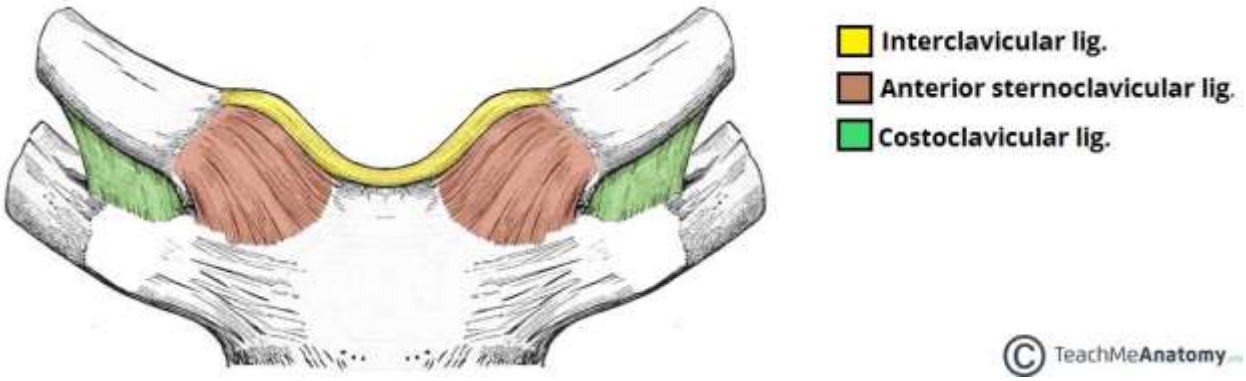
The ligaments of the sternoclavicular joint provide much of its stability. There are four major ligaments:

Sternoclavicular ligaments (anterior and posterior) – these strengthen the joint capsule anteriorly and posteriorly**.**

Interclavicular ligament – this spans the gap between the sternal ends of each clavicle and reinforces the joint capsule superiorly**.**

Costoclavicular ligament – the two parts of this ligament (often separated by a bursa) bind at the 1st rib and cartilage inferiorly and to the anterior and posterior borders of the clavicle superiorly. It is a very strong ligament and is the main stabilising force for the joint, resisting elevation of the pectoral girdle.

The sternoclavicular and interclavicular ligaments can be considered to be thickenings of the joint capsule.



➢ NEUROVASCULAR SUPPLY:

Arterial supply to the sternoclavicular joint is from the internal thoracic artery and the suprascapular artery**.**

The joint is supplied by the medial supraclavicular nerve (C3 and C4) and the nerve to subclavius (C5 and C6).

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- **MOVEMENTS:**

The sternoclavicular joint has a large degree of mobility. There are several movements that require joint involvement:

Elevation of the shoulders – shrugging the shoulders or abducting the arm over 90º

Depression of the shoulders – drooping shoulders or extending the arm at the shoulder behind the body

Protraction of the shoulders – moving the shoulder girdle anteriorly

Retraction of the shoulders – moving the shoulder girdle posteriorly

Rotation – when the arm is raised over the head by flexion the clavicle rotates passively as the scapula rotates. This is transmitted to the clavicle by the coracoclavicular ligaments

The costoclavicular ligament acts as a pivot for movements of the clavicle.

- **MOBILITY AND STABILITY:**

The sternoclavicular joint is required to accommodate the movements of the upper limb, and thus has a high degree of mobility. However, it also requires much stability, as it is the only connection between the upper limb and the axial skeleton.

Here we will consider the factors which contribute to both its mobility and its stability.

Mobility

Type of joint – being a saddle joint it can move in two axes.

Articular disc – this allows the clavicle and the manubrium to slide over each other more freely, allowing for the rotation and movement in a third axis.

Stability

Strong joint capsule.

Strong ligaments – particularly the costoclavicular ligament, which transfers stress from the clavicle to the manubrium (via the costal cartilage).

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- **The Shoulder Joint:**

The shoulder joint (glenohumeral joint) is a ball and socket joint between the scapula and the humerus. It is the major joint connecting the upper limb to the trunk.

It is one of the most mobile joints in the human body, at the cost of joint stability. In this article, we shall look at the anatomy of the shoulder joint and its important clinical correlations.
Structures of the Shoulder Joint

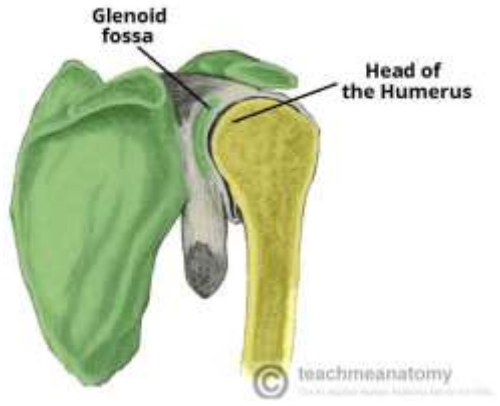
- ARTICULATING SURFACES:

The shoulder joint is formed by the articulation of the head of the humerus with the glenoid cavity (or fossa) of the scapula. This gives rise to the alternate name for the shoulder joint – the glenohumeral joint.

Like most synovial joints, the articulating surfaces are covered with hyaline cartilage. The head of the humerus is much larger than the glenoid fossa, giving the joint a wide range of movement at the cost of inherent instability. To reduce the disproportion in surfaces, the glenoid fossa is deepened by a fibrocartilage rim, called the glenoid labrum**.**

- JOINT CAPSULE AND BURSAE;

The joint capsule is a fibrous sheath which encloses the structures of the joint.



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It extends from the anatomical neck of the humerus to the border or ‘rim’ of the glenoid fossa. The joint capsule is lax, permitting greater mobility (particularly abduction).

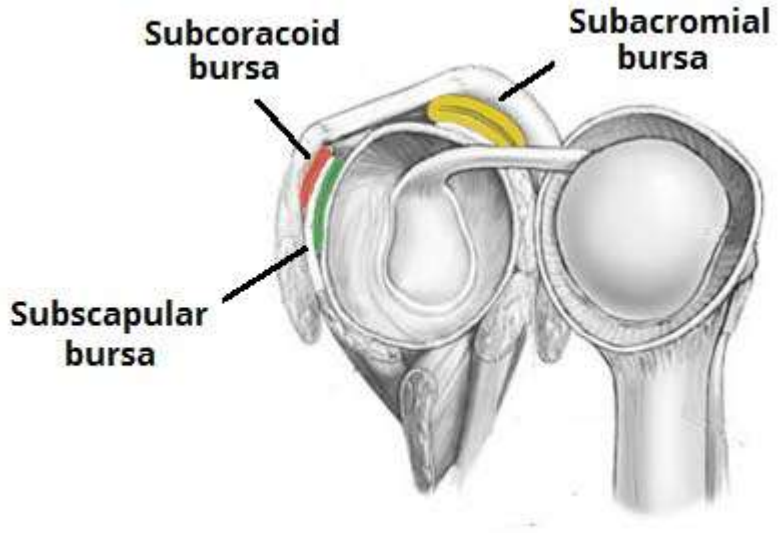
The synovial membrane lines the inner surface of the joint capsule, and produces synovial fluid to reduce friction between the articular surfaces.

To reduce friction in the shoulder joint, several synovial bursae are present. A bursa is a synovial fluid filled sac, which acts as a cushion between tendons and other joint structures.

The bursae that are important clinically are:

Subacromial – located deep to the deltoid and acromion, and superficial to the supraspinatus tendon and joint capsule. The subacromial bursa reduces friction beneath the deltoid, promoting free motion of the rotator cuff tendons. Subacromial bursitis (i.e. inflammation of the bursa) can be a cause of shoulder pain.

Subscapular – located between the subscapularis tendon and the scapula. It reduces wear and tear on the tendon during movement at the shoulder joint.



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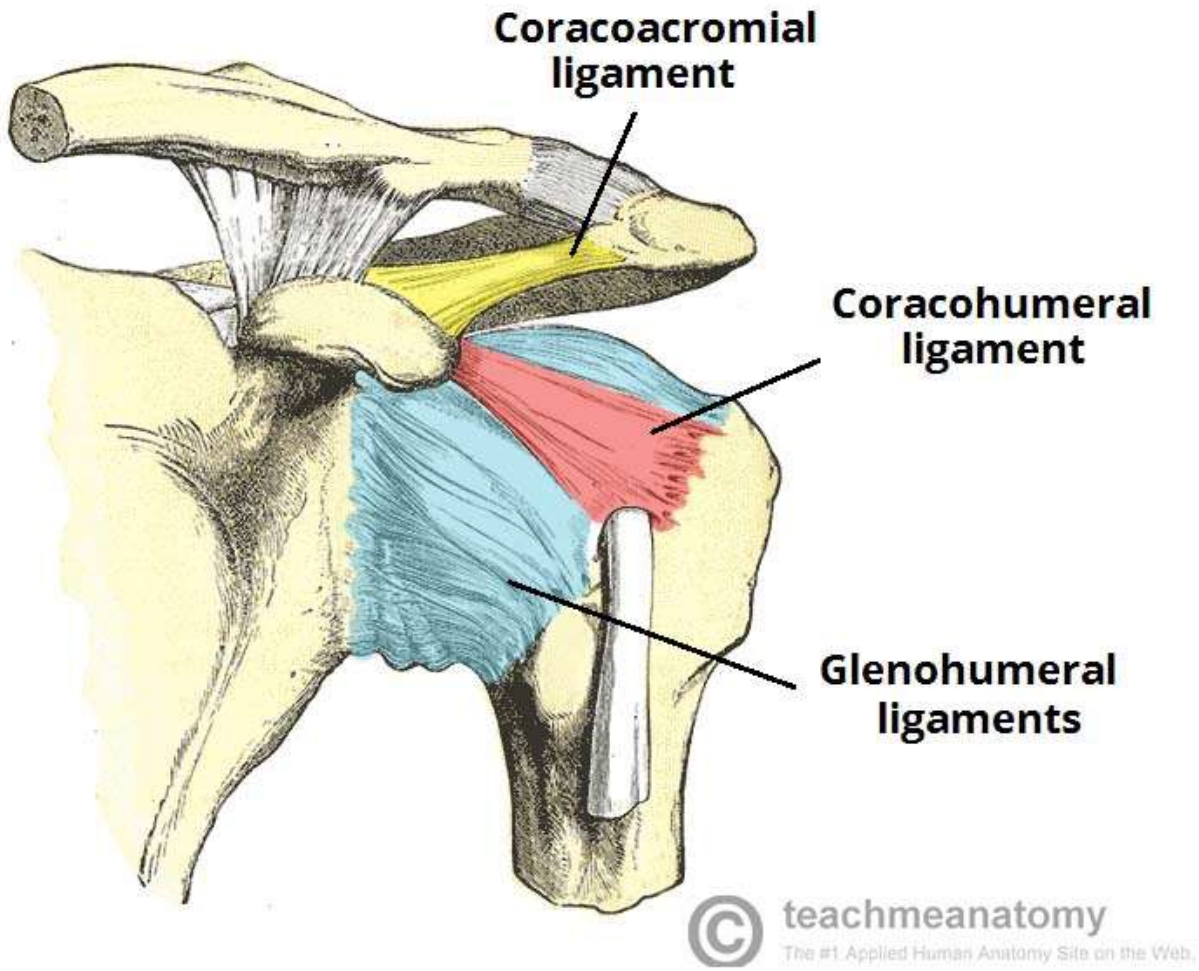
- **Ligaments:**

In the shoulder joint, the ligaments play a key role in stabilising the bony structures.

Glenohumeral ligaments (superior, middle and inferior) – the joint capsule is formed by this group of ligaments connecting the humerus to the glenoid fossa. They are the main source of stability for the shoulder, holding it in place and preventing it from dislocating anteriorly. They act to stabilise the anterior aspect of the joint.



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Coracohumeral ligament – attaches the base of the coracoid process to the greater tubercle of the humerus. It supports the superior part of the joint capsule.

Transverse humeral ligament – spans the distance between the two tubercles of the humerus. It holds the tendon of the long head of the biceps in the intertubercular groove.]

Coraco–clavicular ligament – composed of the trapezoid and conoid ligaments and runs from the clavicle to the coracoid process of the scapula. They work alongside the acromioclavicular ligament to maintain the alignment of the clavicle in relation to the scapula. They have significant strength but large forces (e.g. after a high energy fall) can rupture these ligaments as part of an acromio-clavicular joint (ACJ) injury. In severe ACJ injury, the coraco-clavicular ligaments may require surgical repair.

The other major ligament is the coracoacromial ligament. Running between the acromion and coracoid process of the scapula it forms the coraco-acromial arch**.** This structure overlies the shoulder joint, preventing superior displacement of the humeral head.

- Movements:

As a ball and socket synovial joint, there is a wide range of movement permitted:

Extension (upper limb backwards in sagittal plane) – posterior deltoid, latissimus dorsi and teres major.

Flexion (upper limb forwards in sagittal plane) – pectoralis major, anterior deltoid and coracobrachialis. Biceps brachii weakly assists in forward flexion.

Abduction (upper limb away from midline in coronal plane):

The first 0-15 degrees of abduction is produced by the supraspinatus.

The middle fibres of the deltoid are responsible for the next 15-90 degrees.

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Past 90 degrees, the scapula needs to be rotated to achieve abduction – that is carried out by the trapezius and serratus anterior.

Adduction (upper limb towards midline in coronal plane) – pectoralis major, latissimus dorsi and teres major.

Internal rotation (rotation towards the midline, so that the thumb is pointing medially) – subscapularis, pectoralis major, latissimus dorsi, teres major and anterior deltoid.

External rotation (rotation away from the midline, so that the thumb is pointing laterally) – infraspinatus and teres minor.

- **Mobility and Stability:**

The shoulder joint is one of the most mobile in the body, at the expense of stability. Here, we shall consider the factors the permit movement, and those that contribute towards joint structure.

Factors that contribute to mobility:

Type of joint – ball and socket joint.

Bony surfaces – shallow glenoid cavity and large humeral head – there is a 1:4 disproportion in surfaces. A commonly used analogy is the golf ball and tee.

Inherent laxity of the joint capsule.

Factors that contribute to stability:

Rotator cuff muscles – surround the shoulder joint, attaching to the tuberosities of the humerus, whilst also fusing with the joint capsule. The resting tone of these muscles act to compress the humeral head into the glenoid cavity.

Glenoid labrum – a fibrocartilaginous ridge surrounding the glenoid cavity. It deepens the cavity and creates a seal with the head of humerus, reducing the risk of dislocation.

Ligaments – act to reinforce the joint capsule, and form the coraco-acromial arch.

Biceps tendon – it acts as a minor humeral head depressor, thereby contributing to stability.

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- The Elbow Joint:

The **elbow** is the joint connecting the upper arm to the forearm. It is classed as a hinge-type synovial joint.

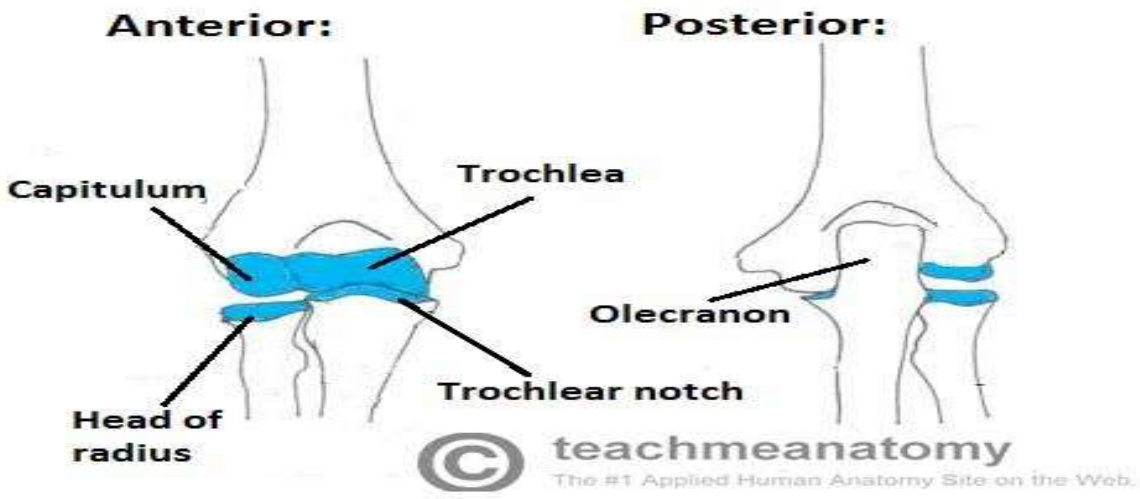
➢ Structures of the Elbow Joint:

○ Articulating Surfaces:

It consists of two separate articulations:

Trochlear notch of the ulna and the trochlea of the humerus

Head of the radius and the capitulum of the humerus



○ Joint Capsule and Bursae:

Like all synovial joints, the elbow joint has a capsule enclosing the joint. This in itself is strong and fibrous, strengthening the joint. The joint capsule is thickened

medially and laterally to form collateral ligaments, which stabilise the flexing and extending motion of the arm.

A bursa is a membranous sac filled with synovial fluid. It acts as a cushion to reduce friction between the moving parts of a joint, limiting degenerative damage. There are many bursae in the elbow, but only a few have clinical importance:

Intratendinous – located within the tendon of the triceps brachii.

Subtendinous – between the olecranon and the tendon of the triceps brachii, reducing friction between the two structures during extension and flexion of the arm.

Subcutaneous (olecranon) bursa – between the olecranon and the overlying connective tissue (implicated in olecranon bursitis).

- Ligaments:

The joint capsule of the elbow is strengthened by ligaments medially and laterally.

The radial collateral ligament is found on the lateral side of the joint, extending from the lateral epicondyle, and blending with the annular ligament of the radius (a ligament from the proximal radioulnar joint).

The ulnar collateral ligament originates from the medial epicondyle, and attaches to the coronoid process and olecranon of the ulna.

- Neurovasculature:

The arterial supply to the elbow joint is from the cubital anastomosis, which includes recurrent and collateral branches from the brachial and deep brachial arteries.

Its nerve supply is provided by the median**,** musculocutaneous and radial nerves anteriorly, and the ulnar nerve posteriorly.

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- Movements of the Joint:

The orientation of the bones forming the elbow joint produces a hinge type synovial joint, which allows for extension and flexion of the forearm:

Extension – triceps brachii and anconeus

Flexion – brachialis, biceps brachii, brachioradialis

- The Radioulnar Joints:

The radioulnar joints are two locations in which the **radius** and **ulna** articulate in the forearm:

- **Proximal radioulnar joint** – located near the elbow. It is articulation between the head of the radius and the radial notch of the ulna.
- **Distal radioulnar joint** – located near the wrist. It is an articulation between the ulnar notch of the radius and the ulnar head.

Both of these joints are classified as pivot joints, responsible for **pronation** and **supination** of the forearm.

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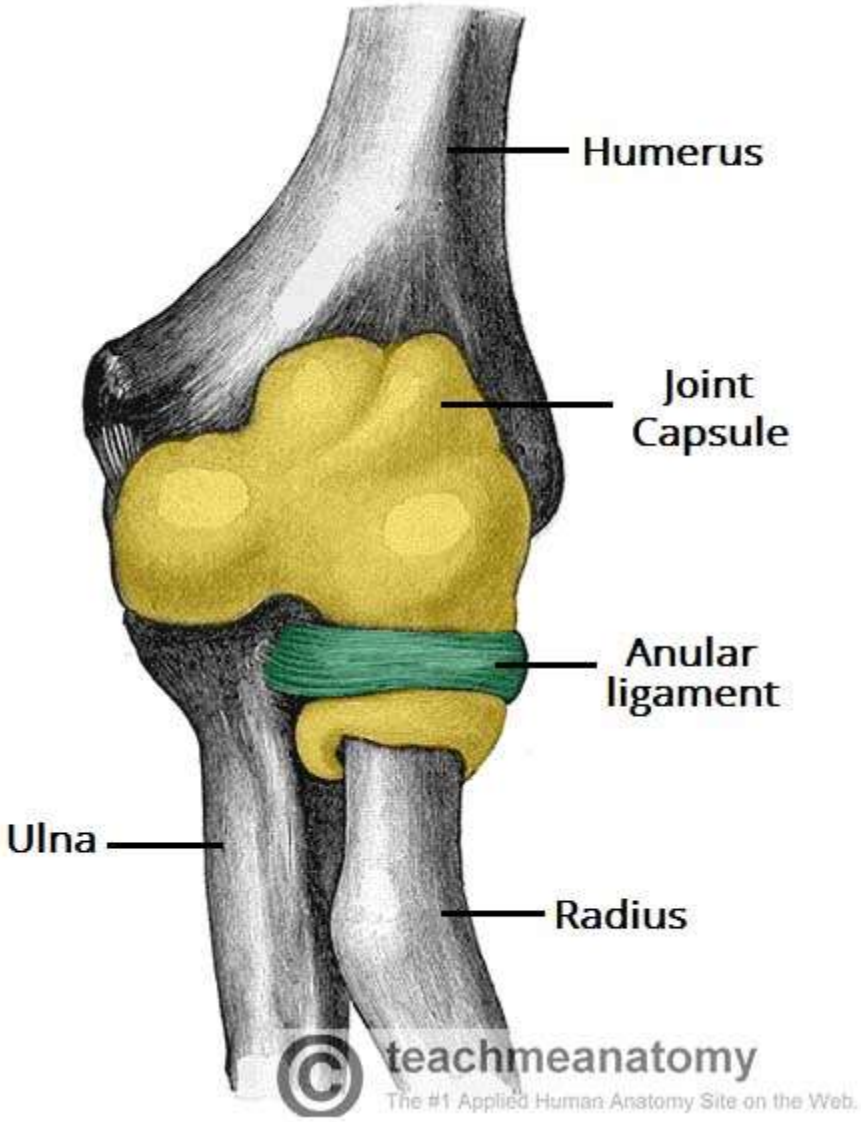

- **Proximal Radioulnar Joint:**

The proximal radioulnar joint is located immediately distal to the **elbow joint**, and is enclosed with in the same **articular capsule**. It is formed by an articulation between the head of the radius and the radial notch of the ulna.

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The radial head is held in place by the **annular radial ligament**, which forms a 'collar' around the joint. The annular radial ligament is lined with a synovial membrane, reducing friction during movement.

Movement is produced by the head of the radius rotating within the annular ligament. There are two movements possible at this joint; pronation and supination.

Pronation: Produced by the pronator quadratus and pronator teres.

Supination*:* Produced by the supinator and biceps brachii.

- **The Wrist Joint:**

The wrist joint (also known as the radiocarpal joint) is a synovial joint in the upper limb, marking the area of transition between the forearm and the hand.

In this article, we shall look at the structures of the wrist joint, the movements of the joint, and the relevant clinical syndromes.

- **Structures of the Wrist Joint**
  - **Articulating Surfaces:**

The wrist joint is formed by:

Distally – The proximal row of the carpal bones (except the pisiform).

Proximally – The distal end of the radius, and the articular disk (see below).

The ulna is not part of the wrist joint – it articulates with the radius, just proximal to the wrist joint, at the distal radioulnar joint. It is prevented from articulating with the carpal bones by a fibrocartilaginous ligament, called the articular disk, which lies over the superior surface of the ulna.

Together, the carpal bones form a **convex** surface, which articulates with the **concave**surface of the radius and articular disk.

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- Joint Capsule:

Like any synovial joint, the capsule is dual layered. The fibrous outer layer attaches to the radius, ulna and the proximal row of the carpal bones. The internal layer is comprised of a synovial membrane, secreting synovial fluid which lubricates the joint.

Ligaments

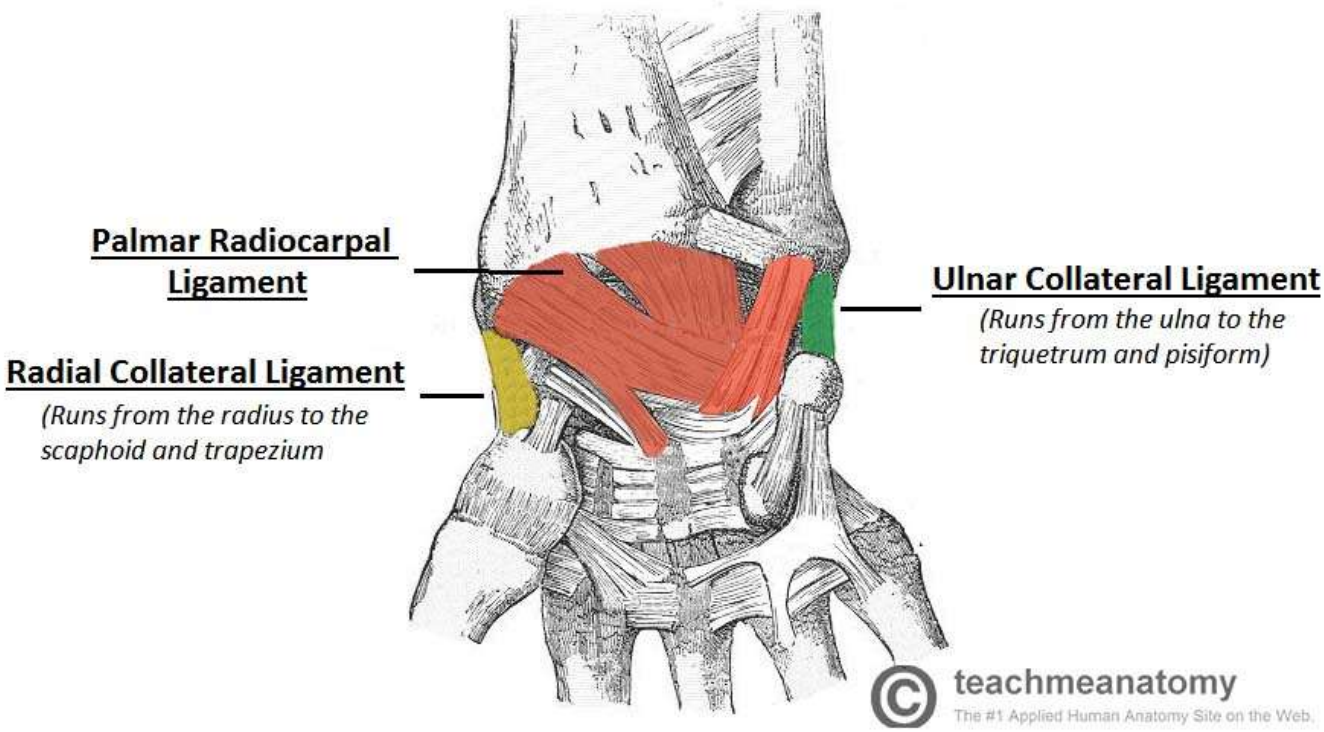
There are four ligaments of note in the wrist joint, one for each side of the joint

Palmar radiocarpal – It is found on the palmar (anterior) side of the hand. It passes from the radius to both rows of carpal bones. Its function, apart from increasing stability, is to ensure that the hand follows the forearm during supination.

Dorsal radiocarpal – It is found on the dorsum (posterior) side of the hand. It passes from the radius to both rows of carpal bones. It contributes to the stability of the wrist, but also ensures that the hand follows the forearm during pronation.

Ulnar collateral – Runs from the ulnar styloid process to the triquetrum and pisiform. Works in union with the other collateral ligament to prevent excessive lateral joint displacement.

Radial collateral – Runs from the radial styloid process to the scaphoid and trapezium. Works in union with the other collateral ligament to prevent excessive lateral joint displacement.



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Neurovascular Supply

The wrist joint receives blood from branches of the dorsal and palmar carpal arches, which are derived from the **ulnar** and **radial** arteries (for more information, see Blood Supply to the Upper Limb)

Innervation to the wrist is delivered by branches of three nerves:

Median nerve – Anterior interosseous branch.

Radial nerve – Posterior interosseous branch.

Ulnar nerve – deep and dorsal branches.

Movements of the Wrist Joint

The wrist is an **ellipsoidal** (condyloid) type synovial joint, allowing for movement along two axes. This means that flexion, extension, adduction and abduction can all occur at the wrist joint.

All the movements of the wrist are performed by the muscles of the forearm.

Flexion – Produced mainly by the flexor carpi ulnaris, flexor carpi radialis, with assistance from the flexor digitorum superficialis.

Extension – Produced mainly by the extensor carpi radialis longus and brevis, and extensor carpi ulnaris, with assistance from the extensor digitorum.

Adduction – Produced by the extensor carpi ulnaris and flexor carpi ulnaris

Abduction – Produced by the abductor pollicis longus, flexor carpi radialis, extensor carpi radialis longus and brevis.