

## SHOULDER

The human shoulder is made up of three bones: the clavicle, the scapula, and the humerus. The joints are: Glenohumeral Joint [GHJ], Acromioclavicular Joint [ACJ], Sternoclavicular Joint [SCJ] and Scapulothoracic joint [STJ] .

The labrum is a fibrocartilage, which is found around the glenoid.

The shoulder must be mobile enough for the wide range actions of the arms and hands, but also stable enough to allow for actions such as lifting, pushing and pulling.

Glenohumeral joint [shoulder joint]

It is a ball and socket joint.

The shallowness of the fossa and relatively loose connections between the shoulder and the rest of the body allows the arm to have tremendous mobility, at the expense of being much easier to dislocate than most other joints in the body. There is disproportion between the large head of the humerus and the shallow glenoid cavity [1:4].

The capsule is a soft tissue envelope that encircles the glenohumeral joint and attaches to the scapula, humerus, and head of the biceps. This capsule is strengthened by the coracohumeral ligament which attaches the coracoid process of the scapula to the greater tubercle of the humerus. There are also three other ligaments attaching the lesser tubercle of the humerus to lateral scapula and are collectively called the glenohumeral ligaments.

This band is one of the most important strengthening ligaments of the joint capsule. The shoulder is a vital joint and critical for movement.

### Movements

1. Scapular retraction      rhomboideus major, minor, and trapezius
2. Scapular protraction      serratus anterior (prime mover), pectoralis
3. Scapular elevation      levator scapulae, upper trapezius
4. Scapular depression      Pectoralis minor, lower fibers of the trapezius, subclavius, latissimus dorsi
5. Shoulder Abduction      Supraspinatus, Deltoid, trapezius, Serratus
6. Shoulder adduction      Pectoralis major, latissimus dorsi
7. External rotation      Infraspinatus, teres minor, Post delotid
8. Internal rotation      Latismus dorsi, Pectoralis major, teres major, Subscapularis, anterior deltoid
9. Shoulder Flexion      Anterior fibres of deltoid, pectoralis major, coracobrachialis, biceps brachii
10. Shoulder extension      latissimus dorsi and teres major, long head of triceps, posterior deltoid

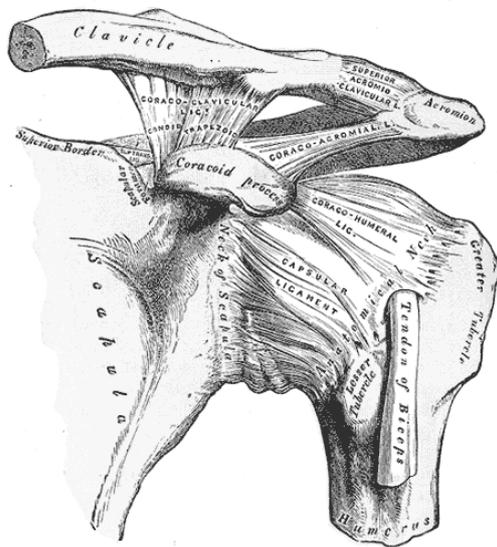
## Shoulder Girdle Muscles

Shoulder girdle muscles Name	Attachment	Function
<b>serratus anterior</b> [Long Tx N]	Originates: Upper eight <b>ribs</b> at the side of the chest Inserts: along the entire anterior length of the <b>medial border of the scapula</b> .	It fixes the scapula and aids in rotation and abduction.
<b>subclavius</b>	Originated: <b>first rib</b> Inserted: <b>subclavian groove</b> of the clavicle.	It depresses the lateral clavicle
<b>pectoralis minor</b>	Originated: third, fourth, and fifth ribs, near their cartilage Inserted: into the medial border and upper surface of the <b>coracoid process</b> of the scapula.	Medially rotates the scapula, protracts the scapula, and also draws the scapula inferiorly.
<b>sternocleidomastoid</b> [Cr XI]	Originated: <b>sternum</b> , the <b>clavicle</b> Inserted: the <b>mastoid process</b>	Flex and rotate the head.
<b>levator scapulae</b> [DSN]	Originated: the transverse processes of the I-IV Cervical Vertebrae Inserted: into the <b>medial border of the scapula</b> .	It is capable of rotating the scapula downward and elevating the scapula.
<b>rhomboid major</b> and [DSN] <b>rhomboid minor</b>	Oriniated: The <b>spinous processes</b> of the <b>thoracic vertebrae</b> T1 to T5 Inserted: on the medial border of the scapula	Downward rotation of the scapula with the levator scapulae, adduction of scapula.
<b>trapezius</b> [Cr XI]	Originated: The <b>occipital bone</b> , the <b>ligamentum nuchae</b> , the spinous process of the VII cervical and all the thoracic vertebrae, Inserted: on the lateral clavicle, the <b>acromion process</b> , and into the <b>spine of the scapula</b> .	depression, upward rotation, elevation, and adductions of scapula
<b>deltoid</b> , anterior fibers [Ax N]	Originated: The lateral third of the <b>clavicle</b> . Inserted: The deltoid tuberosity	abduction when the shoulder is externally rotated. Forward flexion
<b>deltoid</b> , middle fibers	Originated: the lateral margin and upper surface of the <b>acromion</b> . Inserted: The deltoid tuberosity	Shoulder abduction when the shoulder is internally Rotated.
<b>deltoid</b> , posterior fibers	Originated: Border of the <b>spine of the scapula</b> Inserted: The deltoid tuberosity	The posterior deltoid is the primary shoulder :hyperextensor. Also an external rotator

## Rotator cuff muscles

Muscle	Origin on scapula	Greater tuberosity
Supraspinatus muscle C5 [SSN]	supraspinous fossa	superior facet
Infraspinatus muscle C5 [SSN]	infraspinous fossa	posterior facet
Teres minor muscle C5 [Ax N]	middle half of lateral border	inferior facet
Subscapularis muscle C5,6 [Sub N]	subscapular fossa	lesser tuberosity

## The Articular Capsule of the Shoulder Joint



- The **fibrous capsule** enclosing the shoulder joint is thin and loose; thus it allows a wide range of movement.
- The capsule is attached medially to the glenoid fossa, beyond the glenoid labrum.
- Superiorly, it encroaches on the root of the coracoid process so that the fibrous capsule encloses the attachment of the long head of the biceps muscle within the joint.
- Laterally the fibrous capsule is attached to the anatomical neck of the humerus.
- The inferior part of the capsule is the weakest area. The capsule is lax and lies in folds when the arm is adducted, but it becomes taut when the arm is abducted.
- There are two apertures in the articular capsule. The opening between the tubercles of the humerus is for the passage for the tendon of the long head of the biceps.
- The other opening is situated anteriorly, inferior to the coracoid process. It allows communication between the subscapular bursa and the synovial cavity of the joint.
- The **synovial membrane** lines the fibrous capsule and is reflected from it onto the glenoid labrum and the neck of the humerus, as far as the articular margin of the head.
- The synovial capsule forms a tubular sheath for the tendon of the long head of the biceps brachii muscle, where it passes into the joint cavity and lines in the intertubercular groove, extending as far as the surgical neck of the humerus.

**Intrinsic Ligaments of the Capsule of the Shoulder Joint** :These ligaments are thickenings of the fibrous capsule, which strengthen the shoulder joint.

### The Glenohumeral Ligaments

These are thickenings of the anterior part of the fibrous capsule. The superior, middle, and inferior glenohumeral ligaments run from the supraglenoid tubercle of the scapula to the lesser tubercle and the anatomical neck of the humerus.

### **The Transverse Humeral Ligament**

This is a broad band of transverse fibres passing from the greater to the lesser tubercles of the humerus. It forms a bridge over the superior end of the intertubercular groove, converting it into a canal that holds the synovial sheath and the tendon of the long head of the biceps as they emerge from the capsule of the shoulder joint.

### **The Coracohumeral Ligament**

This is a strong, broad band that strengthens the superior part of the capsule of the shoulder joint. It passes from the lateral side of the base of the coracoid process of the scapula to the anatomical neck of the humerus, adjacent to the greater tubercle.

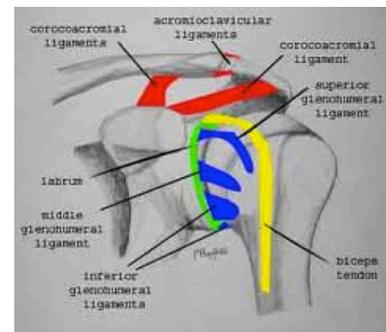
### **The Coraco-acromial Arch**

This is formed by the coracoid process, coracoacromial ligament, and acromion. When force is transmitted superiorly along the humerus (e.g., when standing at a desk and partly supporting the body with the outstretched limbs), the head of the humerus is

pressed against this protective arch. The coracoacromial arch prevents displacement of the humeral head superiorly from the glenoid cavity of the scapula.

The supraspinatus muscle passes under this arch and lies between the deltoid muscle and the capsule of the shoulder joint. The supraspinatus tendon,

passing to the greater tubercle of the humerus, is separated from the arch by the subacromial bursa.



### **The Coraco-acromial Ligament**

This is a strong triangular ligament, the base of which is attached to the lateral border of the coracoid process. Its apex is inserted into the edge of the acromion.

### **Bursae around the Shoulder Joint**

1. The Subscapular Bursa: This bursa is located between the tendon of the subscapularis muscle and the neck of the scapula. The bursa protects this tendon where it passes inferior to the root of the coracoid process and over the neck of the scapula. It usually communicates with the cavity of the shoulder joint through an opening in its fibrous capsule; thus it is really an extension of the cavity of the shoulder joint.

2. The Subacromial Bursa: This is a larger bursa that lies between the deltoid muscle, the supraspinatus tendon, and the fibrous capsule of the shoulder joint. Its size varies, but it does not normally communicate with the cavity of the shoulder joint. The subacromial bursa is located inferior to the acromion and the coracoacromial ligament, between them and the supraspinatus muscle.

## Bone morphology

**Glenoid:** 7° Retroverted to the plan of the scapula ie., 30° anteverted to the coronal plane

Glenoid: Faces superiorly by 5°

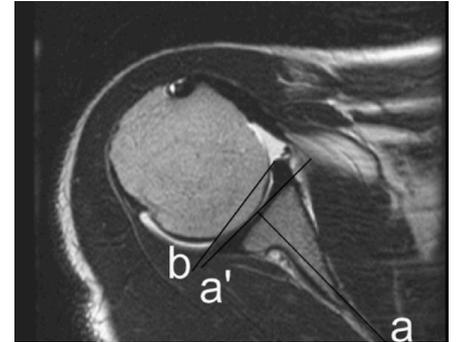
Area of Glenoid = 1/3 of Humeral head (RJ Last 4 times)

Depth of Glenoid: 9 mm in Sup-inf direction and 5 mm in AP

Depth: 50% by the bone & cartilage; 50% by Glenoid labrum.

Excision of the labrum : 50% reduction in force needed to dislocate head in compressive pressure

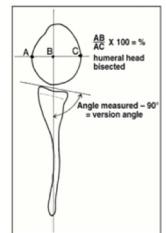
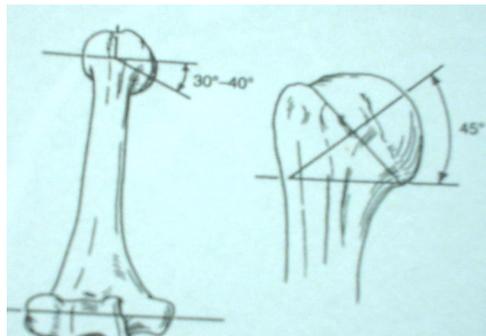
Articular cartilage is thicker in the periphery than central



**Head:** Retroversion 30-40° retroverted with respect to the intercondylar plan

Inclination 45° of inclination.

Articular surface is congruous with glenoid



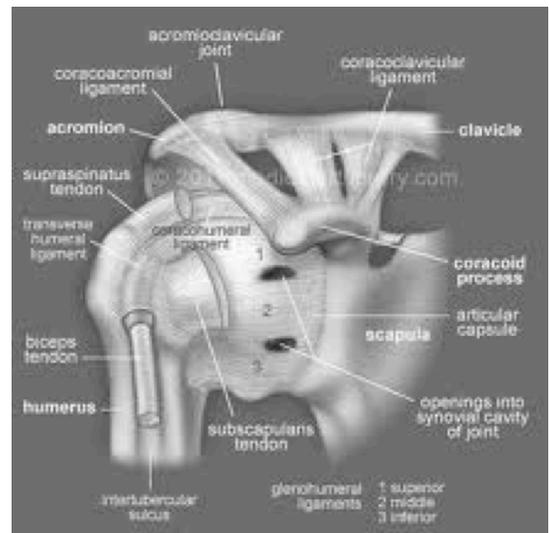
## Glenohumeral stability

- 1. conformity of the radii of curvature
- 2. Cohesion: from synovial fluid
- 3. Integrity of capsule is important in maintaining by the negative intra articular pressure.
- 4. Ligaments: Even after paralysing muscles around the shoulder, translation of the head does not occur
- 5. Dynamic muscles: Maintain concentric reduction throughout all movements

	Superior Glenohumeral	Middle glenohumeral	Inferior glenohumeral
Origin	12 '0' clock	1 or 11 '0' clock	3 or 9 '0' clock
Insertion	Lesser Tuberosity	Lesser Tuberosity	Medial anatomic neck
Present	90%	70%	100%
Function	Inferior stability in 0°	Inferior stability in 90°	AP translation at 90° (ER)
		Anterior stability at 45°	Ant band: ER Post band: IR
Relation	Biceps tendon	Subscapularis	Axillary pouch

### Acromio-Clavicular Joint

- Conoid ligament: Is medial and resists superior displacement
- Trapezoid ligament is lateral (Larger) and resist axial displacement
- Conoid although smaller can resist 4 times as much force (70%) Vs 20% by trapezoid
- Greater motion occurs at Sternoclavicular than Acromioclavicular joint.
- Clavicle rotates 40 to 50° at SCl joint but only 5-8° at acromioclavicular joint on elevation
- Fusion of the ACL joint, there is little loss of overall function of shoulder
- Fusion of SCl joint restricts shoulder motion or implant failure



For every 10° of abduction there is 4° of elevation of the clavicle and the majority of the movement occurs in sternoclavicular joint

### ROM of Shoulder

Abduction and Flexion	180°
External rotation	70°
Internal rotation	90°
Extension	30°

## Elevation of the shoulder

1. Supraspinatus and Deltoid work synergistic whereas rest of the cuff muscle acts as depressor of the humeral head.

2. At 30° deltoid fibers are more vertical and at 90° both deltoid and supraspinatus are horizontal.

3. Selective blocking Suprascapular nerve and Axillary Nerve:

AN block: Full abduction possible 50% weak on the Isometric abduction

SSN block: “ 50% weak at 30° Abduction

35% at 90° abduction

25% at 125°

18% at 150°

4. EMG shows all muscles are active during elevation. Both Supraspinatus and deltoid are necessary for elevation and are active through the entire range, Deltoid becomes more effective with increasing abduction. Supraspinatus is more effective in initiating abduction. Supraspinatus not only elevate but also compresses the head (cf deltoid)

## Shoulder Ossification Centers

### Clavicle

Medial: forms during 5th week of gestation

Lateral: forms during 5th week of gestation

### Coracoid Process

Center: forms at 1 year

Base: forms at 10 years

Tip: forms during puberty

Acromion: form during puberty

### Glenoid

Inferior: forms 1 years; Superior: forms during puberty

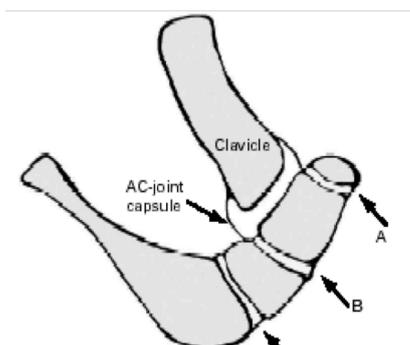
### Proximal humerus

Humeral head: forms at 1 year

Greater tuberosity: forms at 3 years

Lesser tuberosity: forms at 5 years

## Os Acromialae



A Pre-acromiale

B Meso acromiale

C Metaacromiale

Approximately 8%:

Bilateral in 60%;

Ages 15 and 18 years, they coalesce

The incidence of cuff tear may be as high 50%

Mudge : 6% of cases of tears of rotator cuff. Higher than normal population

With os acromiale, the axillary lateral view is essential.

Excision causes poor results due to deltoid dysfunction. ORIF with cannulated screws and a tension band construct for large fragment are recommended

### **Brachial Plexus Anatomy**

Brachial plexus is formed from C5, C6, C7, C8, and T1 nerve roots.

There may be contributions from C4, and T2. A plexus with contributions from C4 is called "prefixed." (28% to 62%). "Postfixed" = contributions from T2 (16% to 73%).

Roots and trunks are more commonly affected than the divisions, cords, or terminal branches.

If serratus anterior function is preserved in post-ganglionic lesion [Bell's nerve]

Avulsion of the T1 root (a pre-ganglionic injury) interrupts the T1 sympathetic ganglion, causing Horner's syndrome (miosis (small pupil), enophthalmos (sinking of the orbit), ptosis (lid droop), and anhidrosis (dry eyes).

Injury to C5,C6,C7 may result in loss of shoulder flexion, elbow flexion and extension and occasionally wrist and finger extension.

Injury to C8 and T1 may limit hand function.

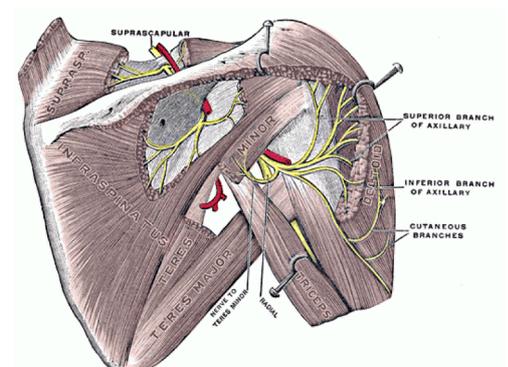
### **Axillary Nerve [C5,6]**

5 mm below Musculotendinous junction of subscapularis.

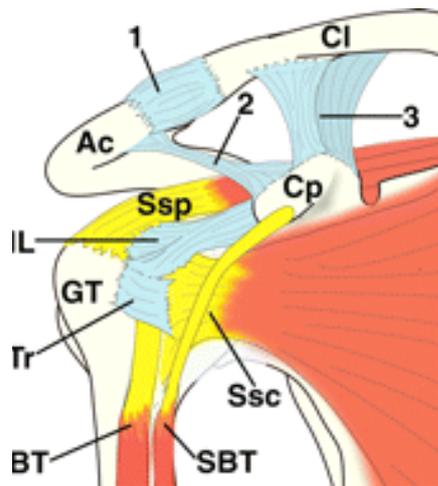
Runs in the Quadrilateral space and divides into anterior and posterior division.

Posterior division: supplies motor to post deltoid, teres minor and then it becomes lateral cutaneous nerve

Anterior division: Relation of anterior part of axillary nerve is 5 cm distal to the acromion [deltoid splitting approach avoid splitting distally more than 5 cm from the acromion].



## Ligaments



- IL coracohumeral ligament,
- Tr transverse humeral ligament,
- 1 acromioclavicular ligament
- 2 coracoacromial ligament.
- 3 coracoclavicular ligament,

## Rotator Interval

The triangular space between the superior border of the subscapularis tendon and the anterior border of the supraspinatus tendon is termed the rotator interval. Changes in the rotator interval has been implicated in adhesive capsulitis and instability of the shoulder.

Content: Long head of biceps tendon, Coracohumeral ligament, Superior glenohumeral ligament

The apex: Formed by the transverse ligament bridging the bicipital groove

Base: Coracoid process with the origin of the CHL medially

The coracohumeral ligament originates from the lateral aspect of the base of the coracoid process. It courses through the rotator interval and forms two discrete bands distally. The coracohumeral ligament is the most superficial capsular structure of the rotator interval. It blends with the fibers of the subscapularis and supraspinatus tendons at their insertions.

The larger (lateral) band blends into the greater tuberosity and the fibers of the supraspinatus tendon.

The smaller (medial) band crosses over the biceps tendon to insert at the proximal aspect of the lesser tuberosity, forming an anterior covering around the biceps tendon, where it blends with the fibers of the subscapularis tendon..

The superior GHL originates from the superior glenoid tubercle just anterior to the biceps tendon. Laterally, it forms a U-shaped “sling” that crosses underneath the biceps tendon and inserts into the lesser tuberosity, where it blends with the CHL.

The insertion fibers of the superior glenohumeral ligament extend inferiorly to the superior margin of the subscapularis tendon and blend with the fibers of the subscapularis tendon at the lesser tuberosity.

The Long head of biceps may arise from the postero-superior labrum, the superior glenoid tubercle, or both. As the tendon passes laterally through the rotator interval, it is surrounded by the coracohumeral ligament superiorly and the superior glenohumeral ligament anteriorly, forming a sling like band.

When the biceps tendon approaches the distal end of the capsule, the bicipital groove, the conjoined fibers of the superior glenohumeral and joint capsule form the floor of the tendon.

**The biceps pulley** or “sling” is a capsuloligamentous complex that acts to stabilize the long head of the biceps tendon in the bicipital groove. The pulley complex is composed of the superior glenohumeral ligament, the coracohumeral ligament, and the distal attachment of the subscapularis tendon, and is located within the rotator interval between the anterior edge of the supraspinatus tendon and the superior edge of the subscapularis tendon