

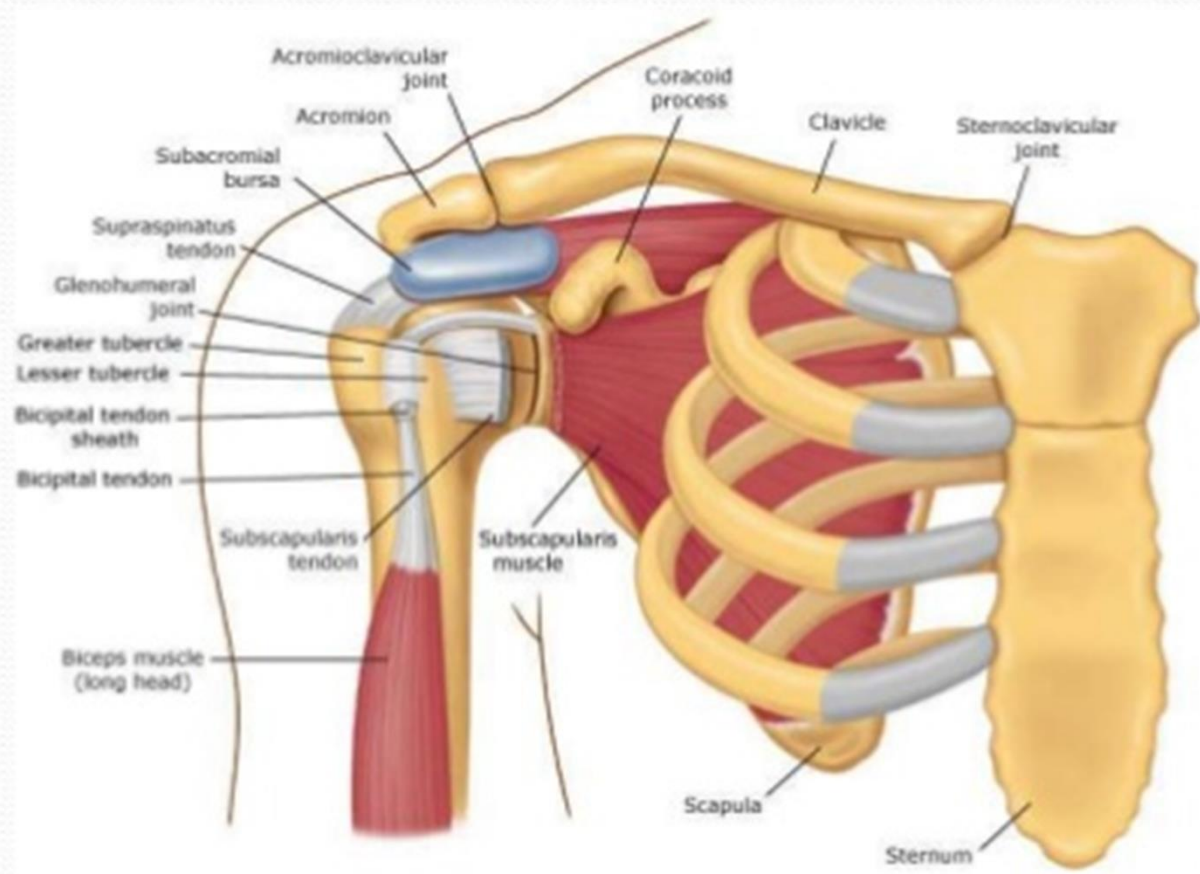
The Shoulder Complex

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Introduction

- The shoulder complex is composed of Three segment namely.
- Scapula
- Clavicle
- Humerus

Components of shoulder complex





► These 3 segments are controlled by four interdependent linkages.

1. SCAPULOTHORACIC JOINT

2. STERNOCLAVICULAR JOINT

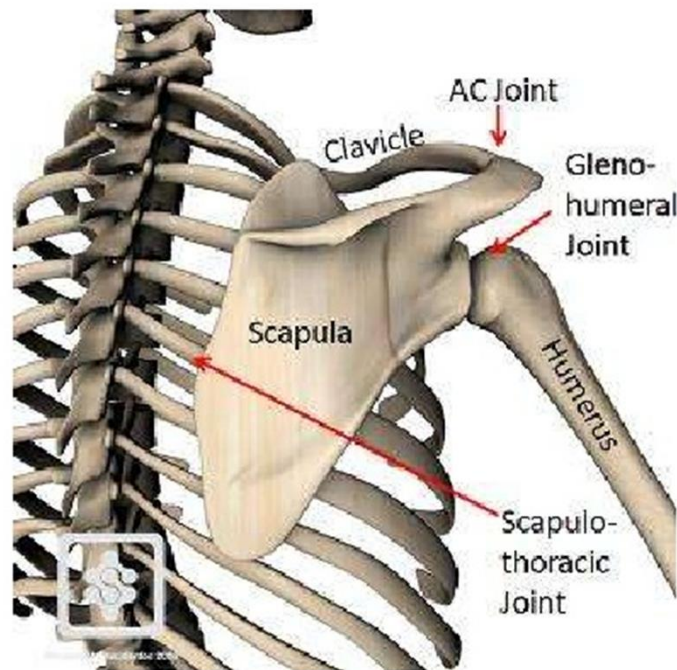
3. ACROMIOCLAVICULAR JOINT

4. GLENOHUMERAL JOINT

There is a **FIFTH** functional articulation called **CORACOACROMIAL ARCH OR SUPRAHUMERAL JOINT** , is formed by the coracoacromial arch and head of humerus .

SCAPULOTHORACIC JOINT

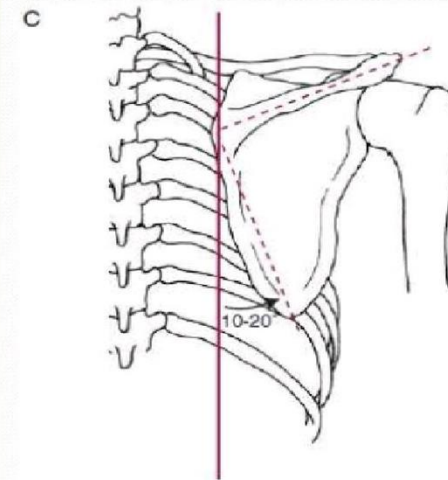
SCAPULOTHORACIC JOINT



Scapulothoracic joint

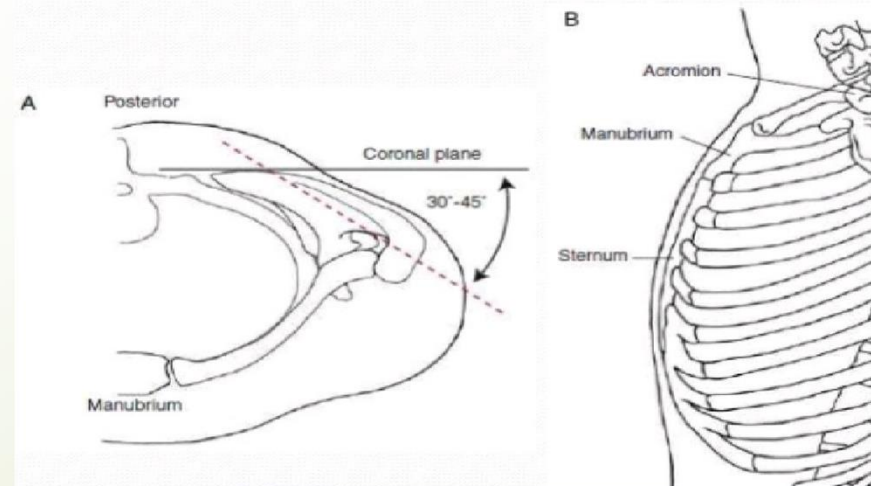
- ST Joint is formed by the articulation of **SCAPULA** and **THORAX** on which it sits.
- **POSITION AND MOTION-**
- Normally the SCAPULA rest at a position on the posterior thorax approximately 2 inches from the midline between **2nd-7th ribs**.
- SCAPULA also lies **30°-40° forward** of the frontal plane and it is tipped anteriorly approx. 10°-20° from vertical.

Resting position of scapula



- 2 inches from midline **2nd and 7th** rib.
- **Internally rot** -30 degrees from coronal plane.
- **Ant tipped** -10-20 degrees from frontal plane
- **Upward rotated** - degrees from sagittal plane

RESTING POSITION OF SCAPULA



MOTIONS AVAILABLE-

ELEVATION / DEPRESSION

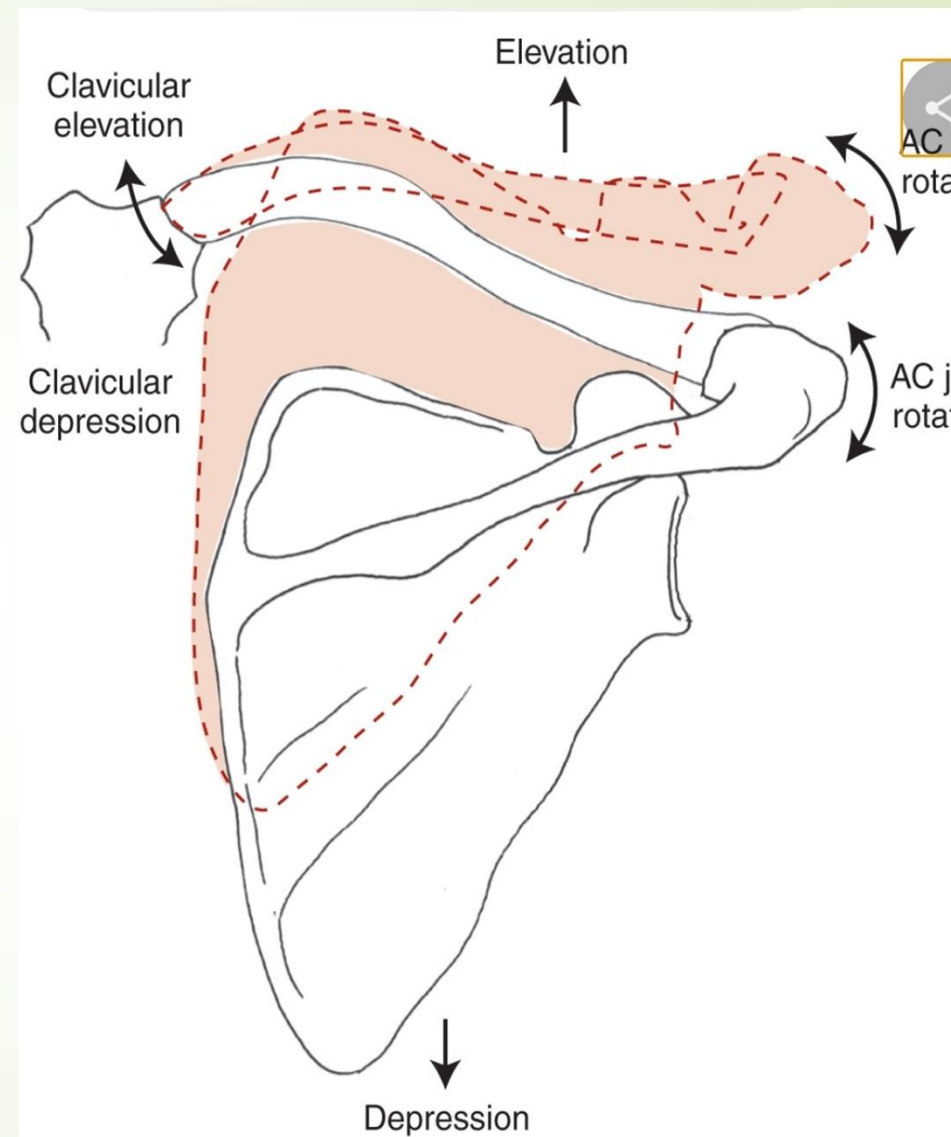
PROTRACTION / RETRACTION (ABDUCTION / ADDUCTION)

UPWARD / DOWNWARD ROTATION (LATERAL/MEDIAL ROTATION)

ANTERIOR/POSTERIOR TIPPING

ELEVATION /DEPRESSION

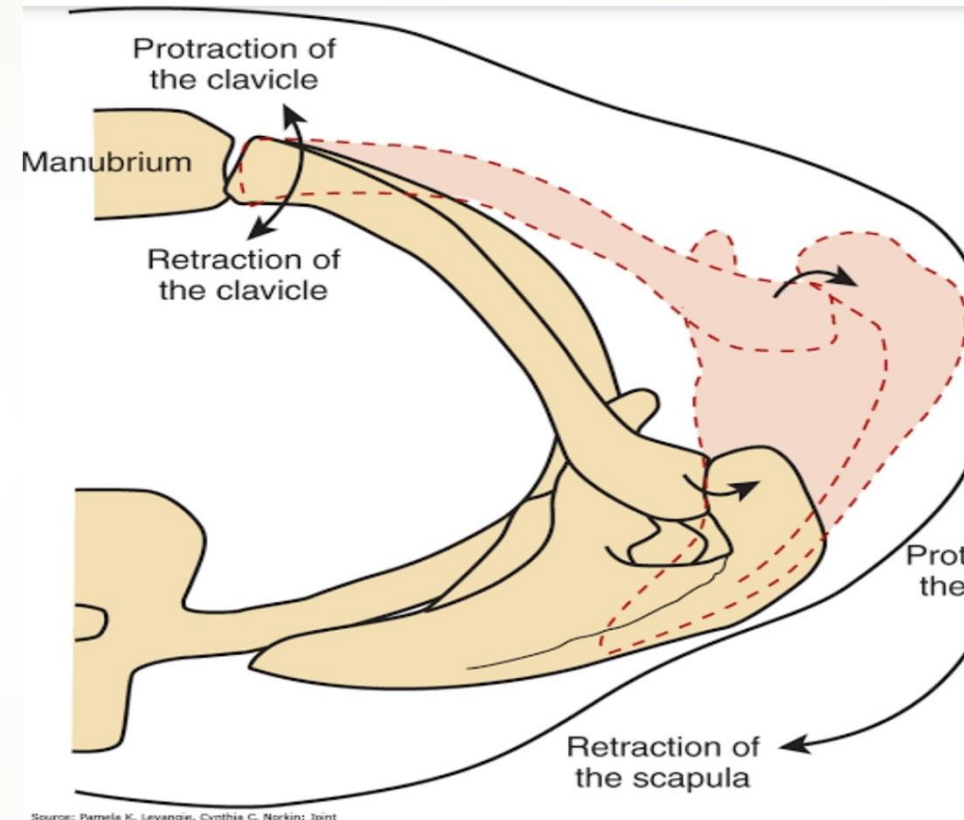
- Elevation and depression of scapula are translatory motion in which scapula moves upward or downward along rib cage from its resting position.



Source: Ranala M, Lussana G, Cortis C, Madigan J, et al.

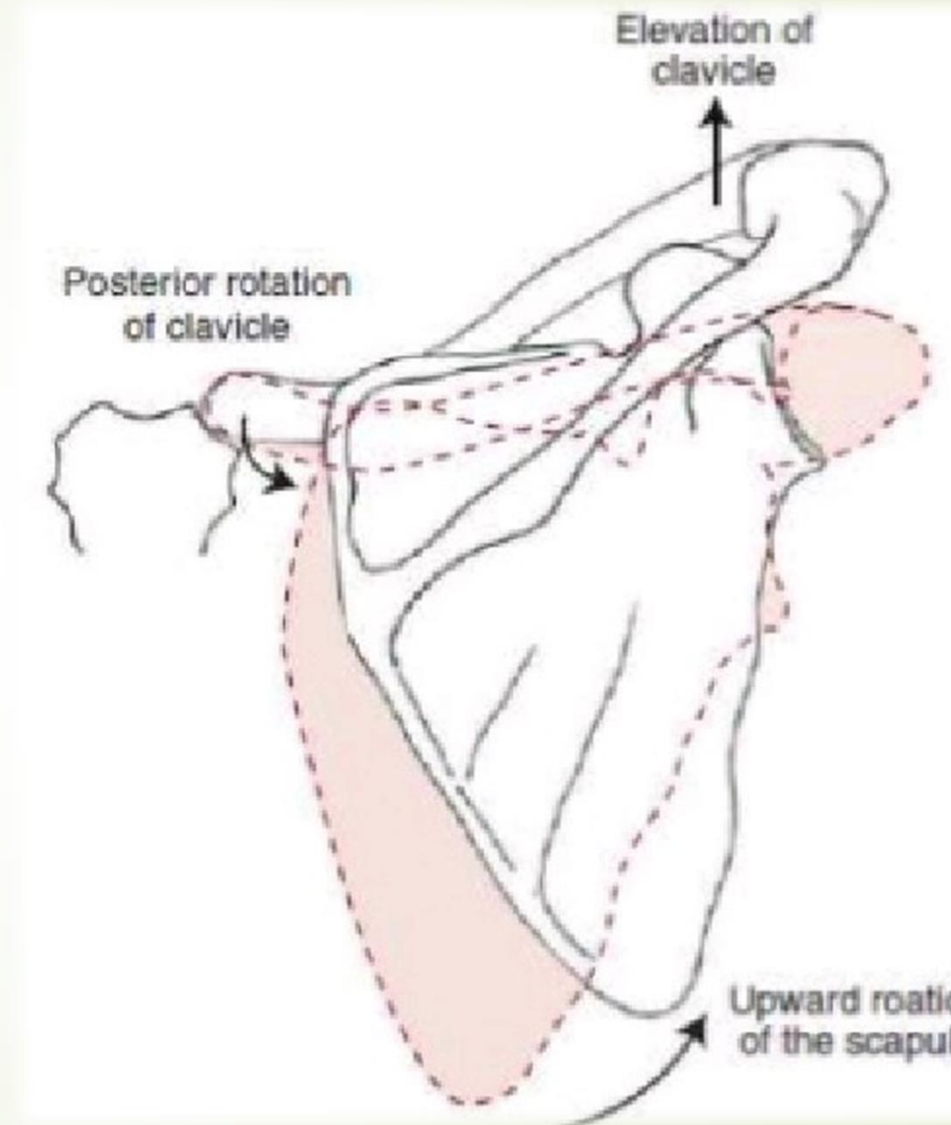
PROTRACTION / RETRACTION

- Protraction and retraction of scapula is described as translatory motion of scapula away from or towards the vertebral column.



UPWARD / DOWNWARD ROTATION

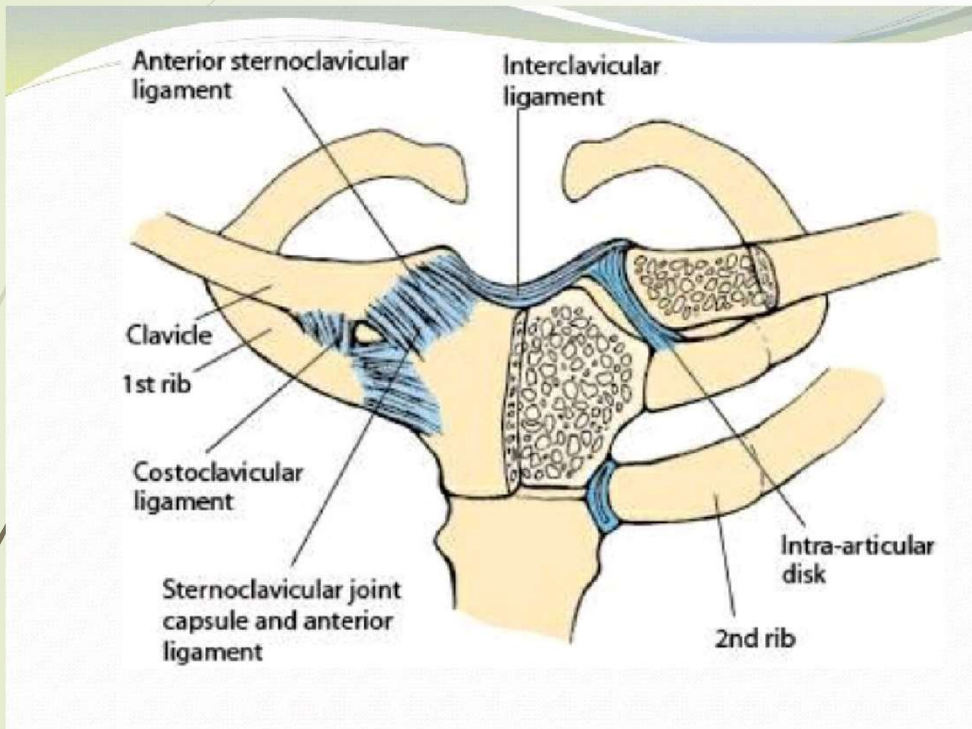
- Upward and downward rotations are rotatory motion that tilt the glenoid fossa upward or downward respectively.
- It can also be described by referencing movement of inferior angle away from the vertebral column or movement of inferior angle towards the vertebral column.



STRENOCLAVICULAR JOINT

- Since it is only structural attachment of the **scapula** to the **rest of the body**.
- The SC JOINT might be considered as “ Base of operation ” for the scapula.
- The SC JOINT is a plane synovial joint with 3 degree of freedom of motion.

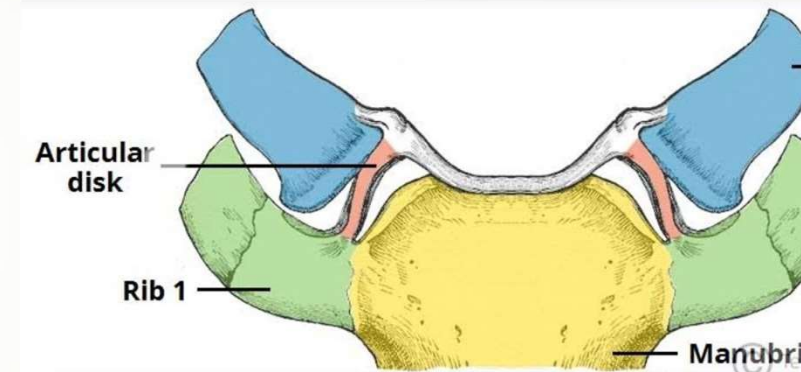
STERNOCLAVICULAR JOINT-



- It has **Joint Capsule** and **3 major ligaments**:
 - Sternoclavicular**
 - Costoclavicular**
 - Interclavicular.**

STERNOCLAVICULAR DISC-

- It is **fibrocartilaginous** joint disc found between the joint.
- Disc acts like a “hinge” or “pivot” during **SC motion**.
- It also serves as important stability function by increasing Joint congruence and absorbing forces that may be transmitted along the clavicle from its lateral end.



Sternoclavicular joint ligament and capsule-

SC joint is surrounded by strong capsules which is supported by three main ligament-

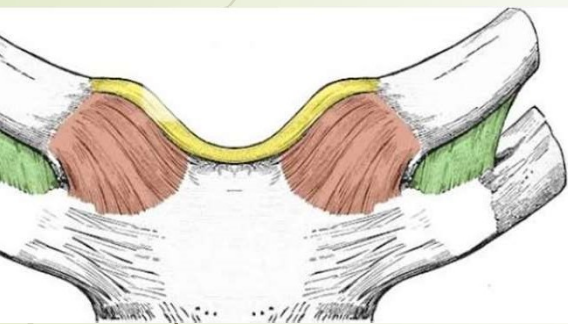
1.STERNOCLAVICULAR LIGAMENTS-

The anterior and posterior SC ligament reinforce the capsule and primarily checks the anterior and posterior movement of clavicle.

2.COSTOCLAVICULAR LIGAMENT-

Provides stability and acts as fulcrum for

- i. Elevation/Depression
- ii. Protraction/Retraction
- iii. Anterior and Posterior Rotation of clavicle



- Interclavicular lig.
- Anterior sternoclavicular lig
- Costoclavicular lig.

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3.INTERCLAVICULAR LIGAMENT-

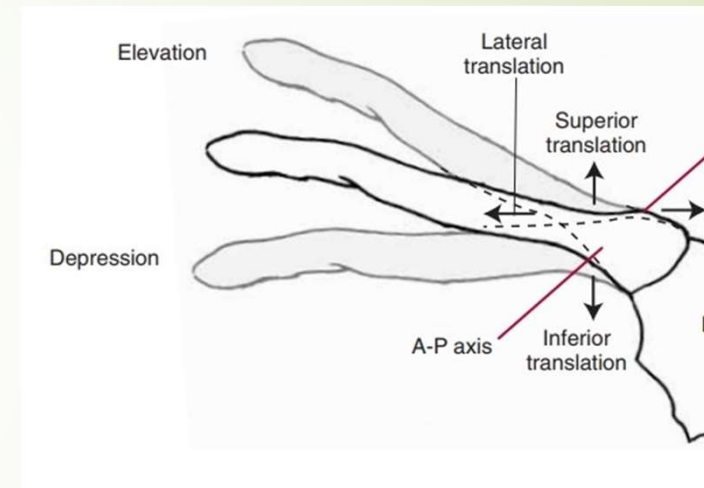
It checks excessive depression or downward glide of the clavicle. The limitation to clavicular depression is critical to protecting structures like the brachial plexus and subclavian artery which passes between clavicle and first ribs.

MOTIONS-

- ▶ The motion that occurs at SC joint are-
 - i. Elevation/depression
 - ii. Protraction/retraction
 - iii. Anterior and posterior rotation.

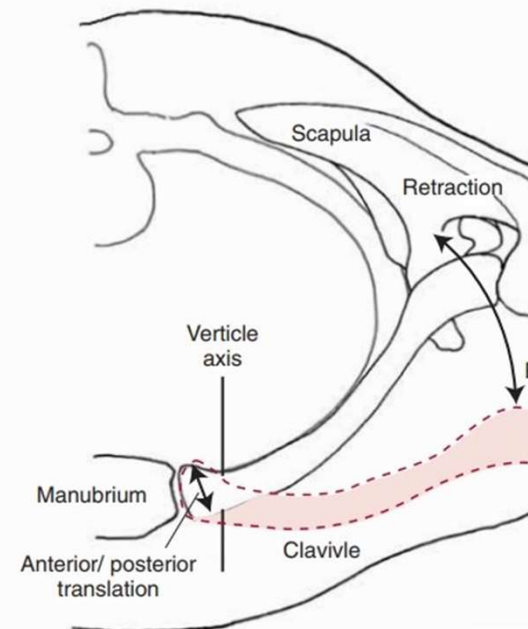
Elevation/Depression-

- ▶ The motions of elevation and depression occur around an approximately anteroposterior (A-P) axis between a convex clavicular surface and a concave surface formed by the manubrium and the first costal cartilage.
- ▶ Elevation and depression of the clavicle is invariably associated with elevation and depression of scapula because acromion of scapula is attached to the lateral end of clavicle.
- ▶ Elevation of scapula along with clavicle is not a pure motion but associated with concomitant upward rotation of scapula which play a significant role in increasing the range of elevation of arm.
- ▶ ROM clavicular elevation-45°
- ▶ ROM clavicular depression-15°



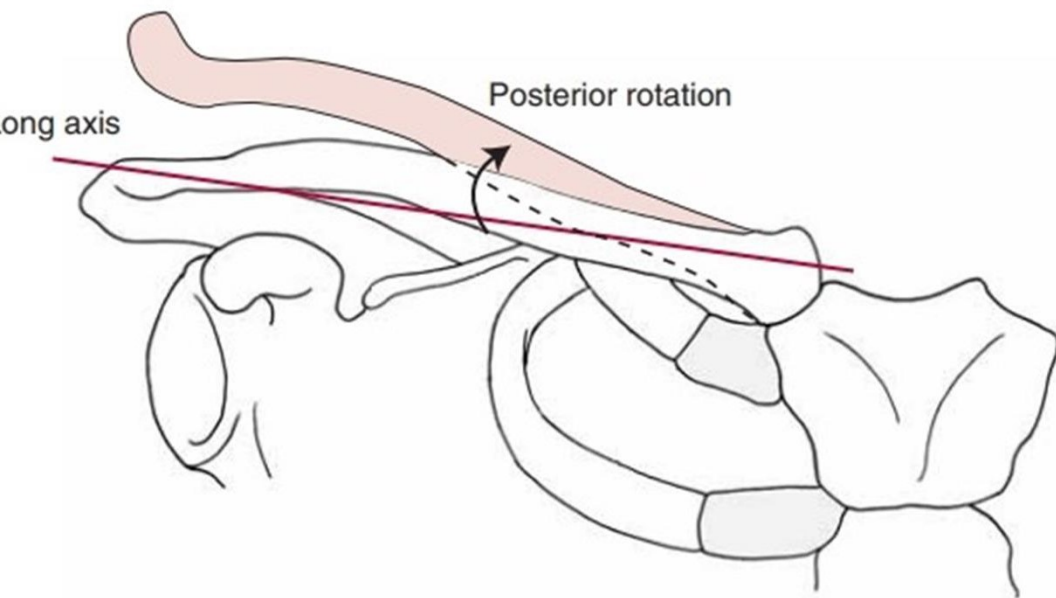
Protraction/Retraction

- It occurs around vertical axis that appears to lie at costoclavicular ligament here the medial end of the clavicle is concave and the manubrial side of the joint is convex .
- Arthrokinematically , the clavicular surface will now slide on the manubrium and first costal cartilage in the same direction as the lateral end of the clavicle.
- Protraction of the clavicle is expected to be accompanied by anterior sliding of the medial clavicle on the manubrium and first costal cartilage and posterior sliding in case of Retraction.
- Both protraction and Retraction are invariably associated with protraction and retraction of the scapula.
- Protraction = 15°
- Retraction = 15°



▲ **Figure 7-6** ■ Shown in a superior view, clavicle protraction/retraction at the SC joint occurs as movement of the clavicle (and attached scapula) around a vertical axis. The manubrium also has a small magnitude of anterior/posterior translation at the joint.

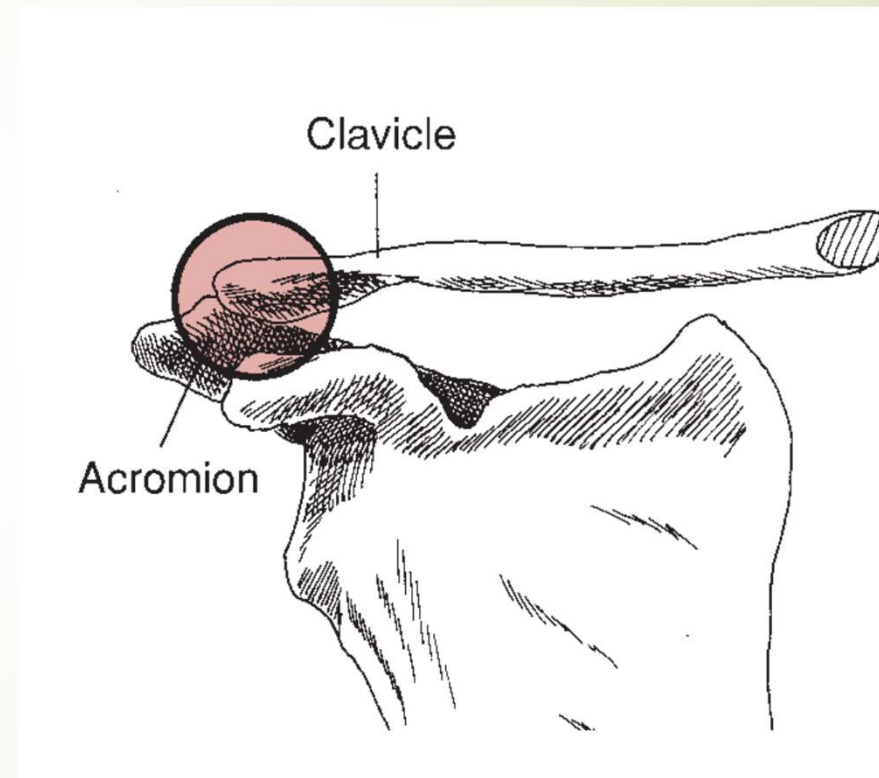
Anterior/Posterior Rotation



- It occurs as a spin between saddle shaped surfaces of the clavicle and manubriocoastal facet.
- Unlike other joint clavicle rotates in only one direction from its resting position.
- The clavicle rotates posteriorly, from neutral bringing the inferior surface face anteriorly from its fully rotated position the clavicle can rotate anteriorly again to return neutral.
- The axis for rotation is longitudinal which runs through clavicle intersecting the SC joint.
- Posterior rotation of the clavicle produces final 30° upward rotation of the scapula that occurs with elevation of Arms.
- ROM of rotation 30-45°

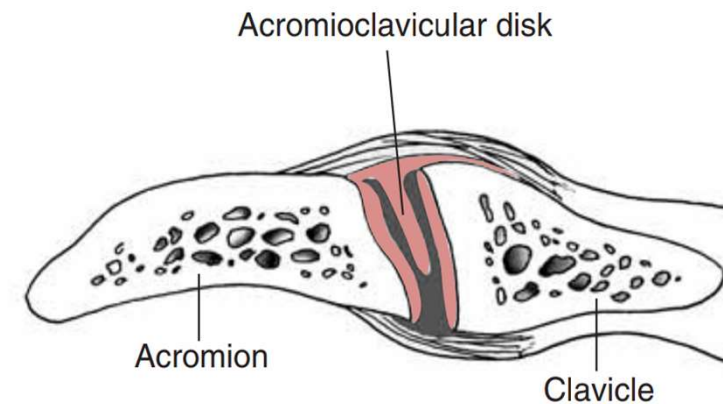
ACROMIOCLAVICULAR JOINT

- The AC joint attaches the scapula to the clavicle.
- It is a plane synovial joint with three degree of freedom.
- It has a joint capsule, 2 major ligament and a joint disc.



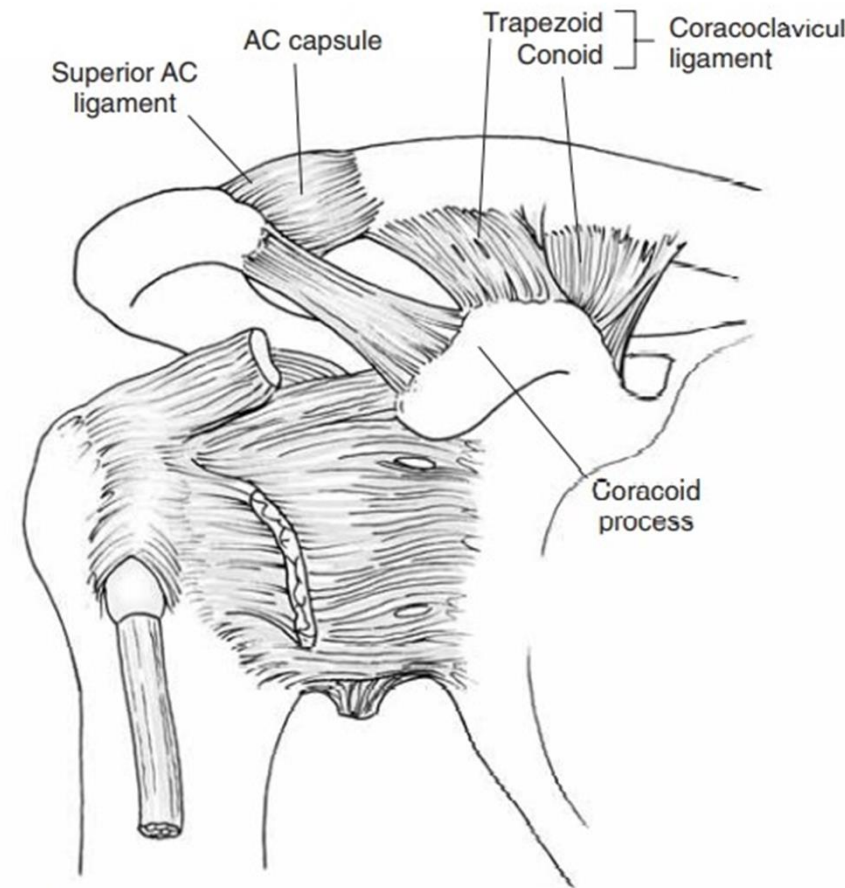
AC ARTICULATING SURFACES AND AC JOINT DISC.

- ▶ This consist of articulation between the lateral end of clavicle and the small facet on the acromion of scapula.
- ▶ The articular facets, considered to be incongruent, vary in configuration. They may be flat, reciprocally concave-convex, or reversed (reciprocally convex-concave).
- ▶ Arthrokinematics for this joint is not predictable.
- ▶ The joint disc is variable in size and it is a fibrocartilaginous structure.



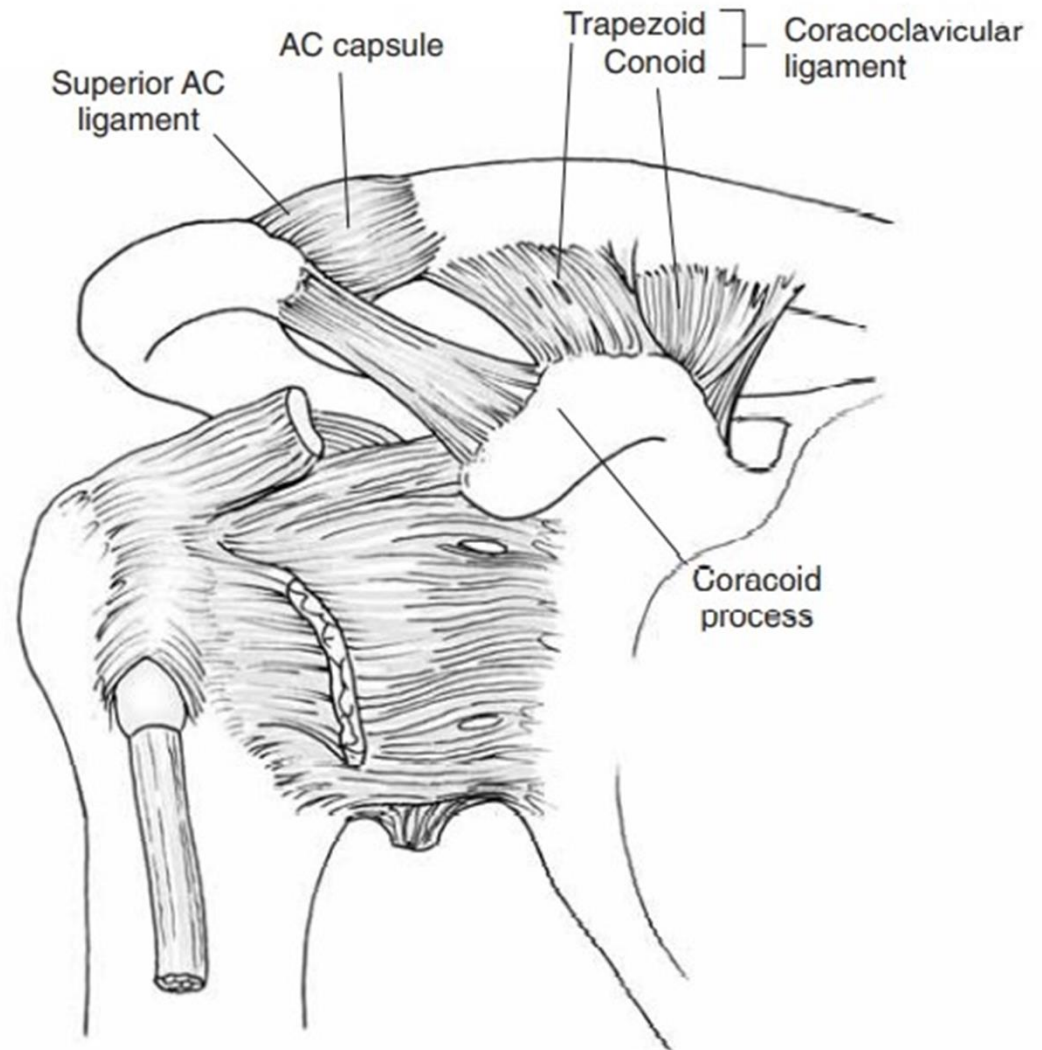
JOINT CAPSULE AND LIGAMENT.

- ▶ The capsule is weak and is reinforced by the **superior** and **inferior acromioclavicular** and the **coracoclavicular ligaments**.
- ▶ The superior acromioclavicular ligament controls **horizontal joint stability** which is reinforced by aponeurotic fibres of TRAPEZIUS and DELTOID.
- ▶ The **coracoclavicular ligament** is divided into-
 - i. Trapezoid Ligament (lateral portion, quadrilateral in shape)
 - ii. Conoid ligament (Medial portion, triangular in shape and vertically oriented)



▲ **Figure 7-9** ■ The AC joint capsule and ligaments, including the coracoclavicular ligament with its conoid and trapezoid portions.

- Both portion prevent the upward rotation of the scapula at AC joint and also assist in transferring the clavicle medially directed forces applied to the scapula.
- It also plays a major role in producing the longitudinal rotation of clavicle necessary for a full ROM in elevation of upper extremity.



▲ **Figure 7-9** ■ The AC joint capsule and ligaments, including the coracoclavicular ligament with its conoid and trapezoid portions.

ACROMIOCLAVICULAR MOTIONS-

The motions available at AC joint are-

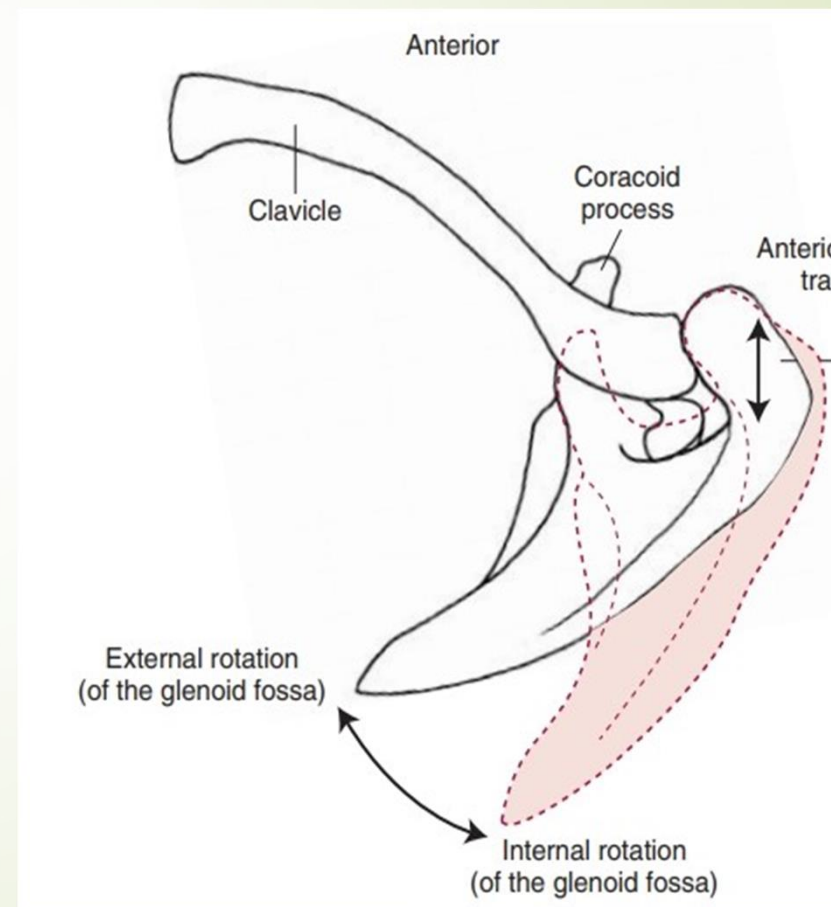
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graph TD; A[The motions available at AC joint are-] --> B[Medial and Lateral rotation of scapula]; A --> C[Anterior and Posterior Tipping of scapula];
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Medial and
Lateral rotation
of scapula

Anterior and
Posterior Tipping
of scapula

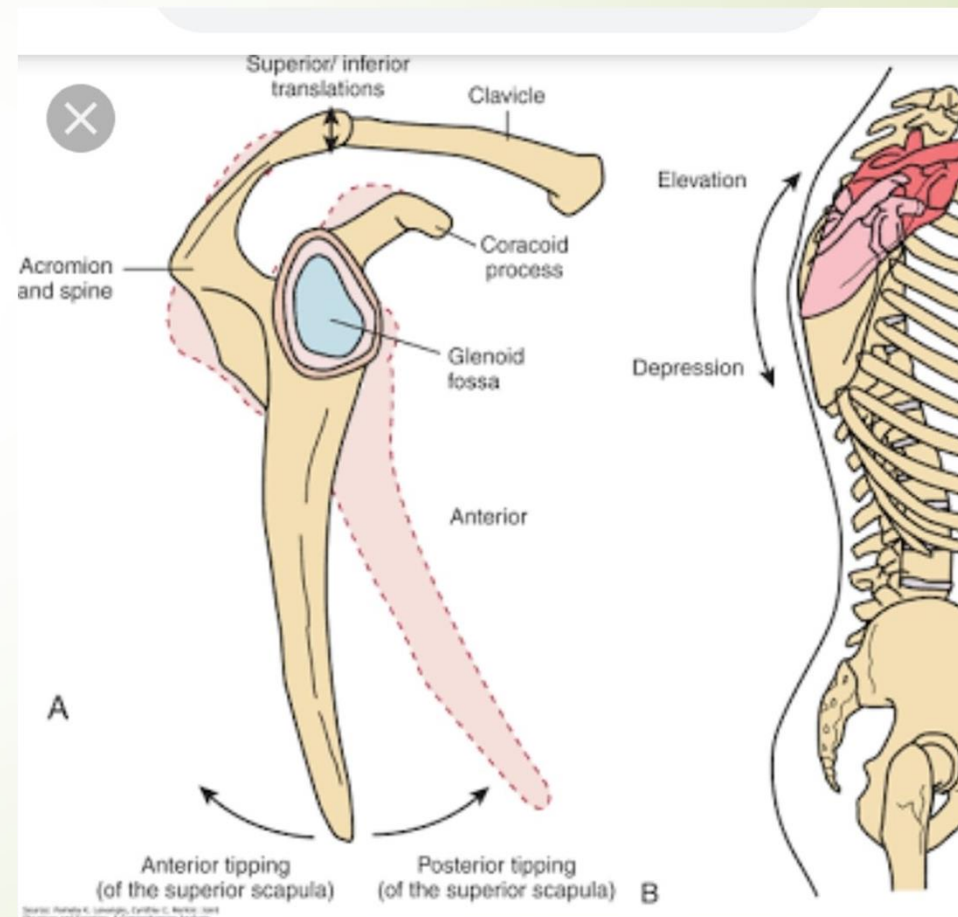
MEDIAL AND LATERAL ROTATION OF SCAPULA-

- It occurs around vertical axis.
- Medial rotation bring the glenoid fossa medially or anteriorly.
- Lateral rotation bring the glenoid fossa laterally or posteriorly.
- These motions occur to maintain the contact of scapula with thorax ion protraction and retraction.



ANTERIOR AND POSTERIOR TIPPING OF SCAPULA-

- It occurs around a coronal axis.
- Anterior Tipping moves the superior border of scapula anteriorly and inferior angle posteriorly.
- Posterior tipping moves the superior border of scapula posteriorly and inferior angle anteriorly.
- These motions helps the scapula to maintain the contact with contour of ribcage during elevation and depression of scapula.



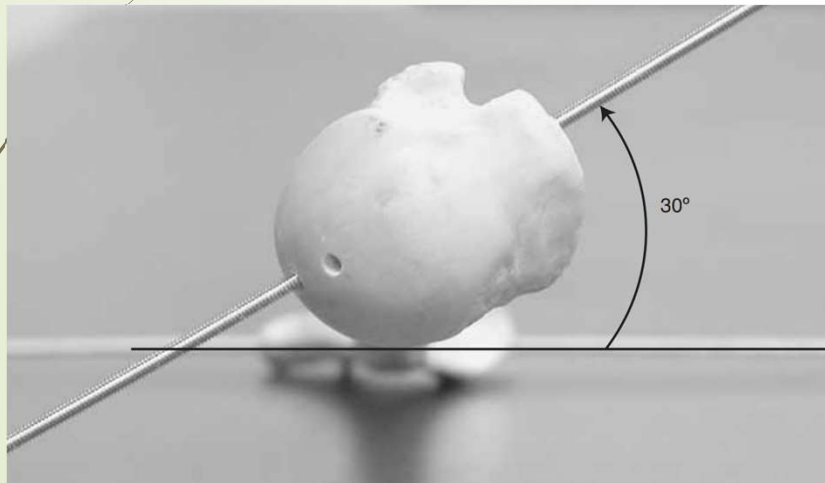
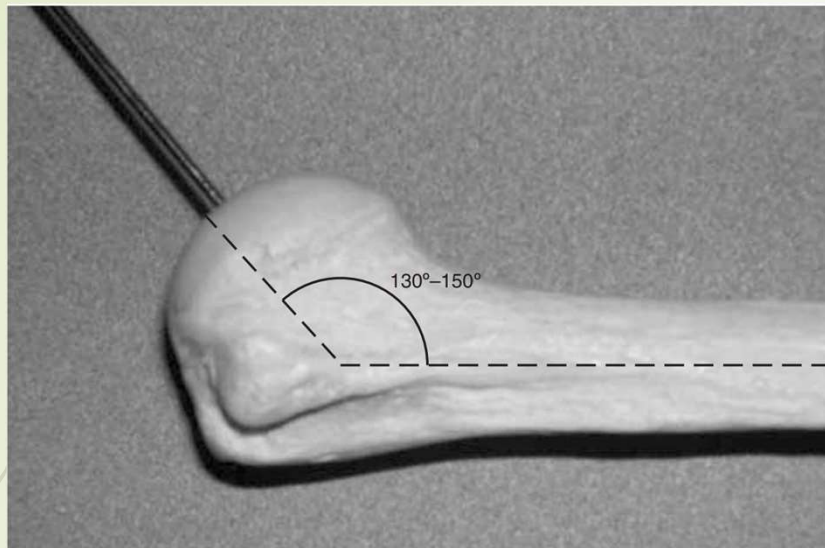
GLENOHUMERAL JOINT-



▲ **Figure 7-21** ■ The glenohumeral joint.

GLENOHUMERAL JOINT-

- ▶ This is a **ball and socket** type synovial joint with 3° of freedom.
- ▶ The GH Joint has sacrificed congruency to serve mobility needs of hands.
- ▶ The articulation is made up of the large head of the humerus and small glenoid fossa.
- ▶ The **glenoid fossa** at scapula serves as the proximal articular surface for this joint.
- ▶ The fossa may be tilted slightly upward or downward when the arm is at the side, although commonly show a slight upward tilt.
- ▶ The distal articular surface that is larger than that of proximal segment forming 1/3rd to one half of sphere.
- ▶ Generally, the head faces medially, superiorly and posteriorly with respect to the shaft of humerus.



▲ Figure A. The normal angle of inclination (the angle between the humeral head and the shaft) varies between 130 and 150. B. The humeral head is normally angled posteriorly approximately 30 (angle of torsion) with regard to an axis through the humeral condyles.

► ANGLE OF INCLINATION-

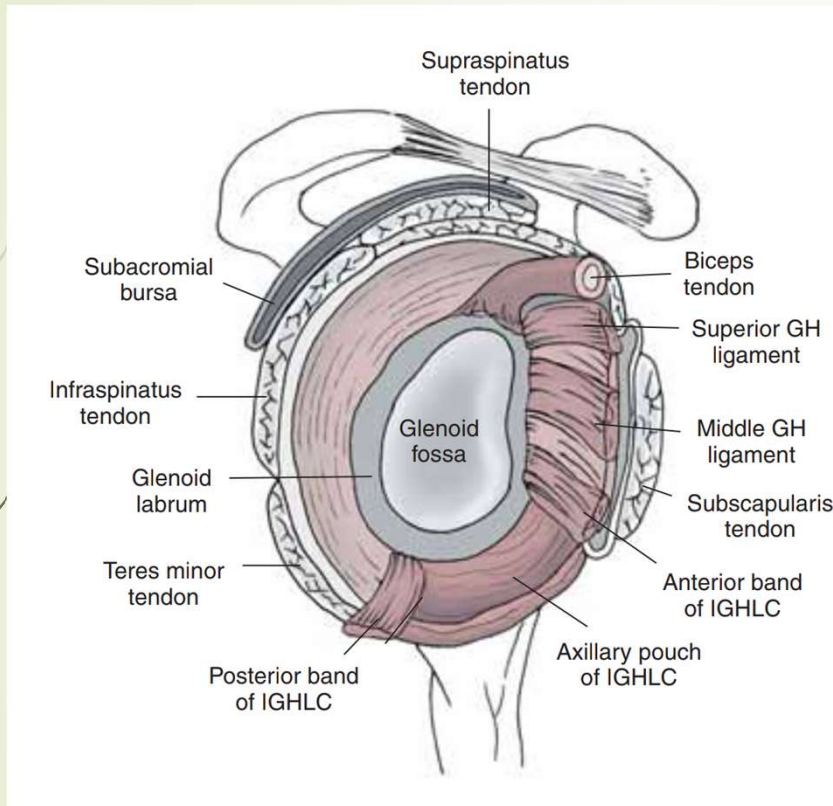
The axis through the humeral head of shaft and longitudinal axis of shaft of the humerus may form an angle of 130°-150° in the frontal plane. This is known as Angle Of Inclination.

► ANGLE OF TORSION-

This is an angle formed between the axis through the humeral head on the axis through the humeral condyles. This angle is about 30° posteriorly.

The normal posterior portion of the humeral head with respect to the humeral condyles may be termed posterior torsion or retrotorsion of humerus.

GLENOID LABRUM-

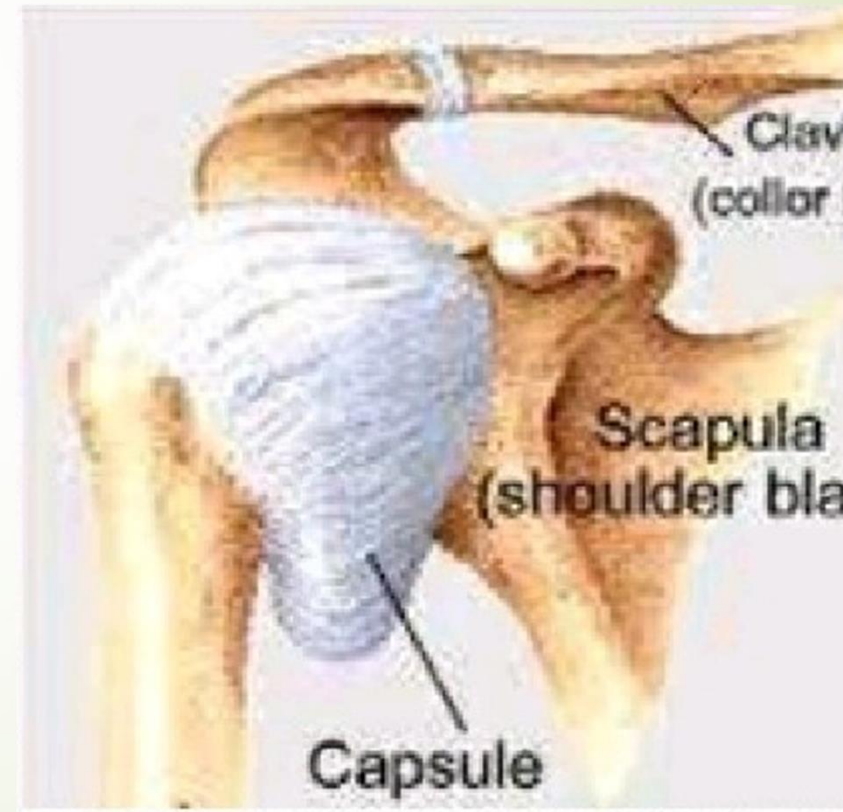


- The total available articular surface of the glenoid fossa is enhanced by an accessory structure known as glenoid labrum.
- This is attached to the periphery of the glenoid fossa enhancing the depth or curvature of fossa.
- Superiorly, the labrum is attached loosely.
- Inferior portion is firmly attached and immobile.

Figure ■ In a direct view into the glenoid fossa (humerus removed), it can be seen that the glenoid labrum increases the articular area of the glenoid fossa and serves as the attachment for the GH capsule and capsular ligaments

GLENOHUMERAL CAPSULE-

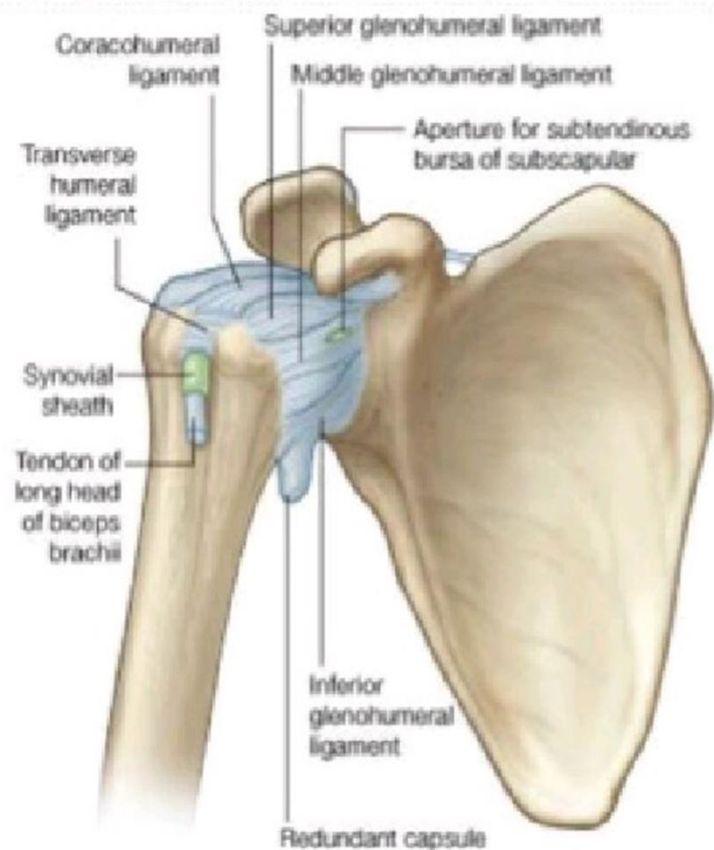
- ▶ The entire GH joint in resting position is surrounded by a large, loose capsule that is taut superiorly and slack anteriorly and inferiorly.
- ▶ The capsular surface area is twice that of the humeral head and when slack allows more than 1 inch of distraction of head from glenoid fossa in loose pack position.
- ▶ When humerus is abducted and laterally rotated on glenoid, the capsule twists on itself and tightens, making abduction and lateral rotation the closed pack position for the GH joint.



GLENOHUMERAL LIGAMENTS-

- ▶ The capsule is reinforced by three glenohumeral ligaments (**Superior, Middle, Inferior**) and a **coracohumeral ligament**.
- ▶ However, a thin area of capsule between the superior and middle GH ligament known as "Foramen of Weibrecht" is a point of weakness in the capsule in spite of anterior reinforcement by Subscapularis tendon.
- ▶ It is common site of extrusion of humeral head with anterior dislocation of the joint.
- ▶ The **Coracoacromial ligament** originates from the coracoid process as two bands.
- ▶ The first band inserts into the edge of the supraspinatus and onto the greater tuberosity where it joins the superior GH ligament.
- ▶ The other band inserts into the subscapularis of the lesser tubercle.
- ▶ The two bands form a tunnel through which the tendon of biceps passes.

GH ligament



- Superior
- Middle
- Inferior
- Coracohumeral lig
- **Foramen of weitbrecht**- area of weakness in the capsule.

BURSAE-

- ▶ Out of several bursae the most important are the **subacromial** or **subdeltoid** bursae.
- ▶ These bursae separates the supraspinatus tendon and head of humerus from the acromion, coracoid process, coracoacromial ligament and deltoid muscle.
- ▶ The bursae may be separate or continuous with each other. Collectively the two are known as sub acromial bursa the permits a smooth gliding of supraspinatus tendon and head of humerus under the deltoid muscle and acromion process.
- ▶ The inferior wall of bursa is continuous with the superior portion of the supraspinatus tendon sheath.
- ▶ sub acromial bursitis is most commonly secondary to the inflammation or degeneration of the supraspinatus tendon.

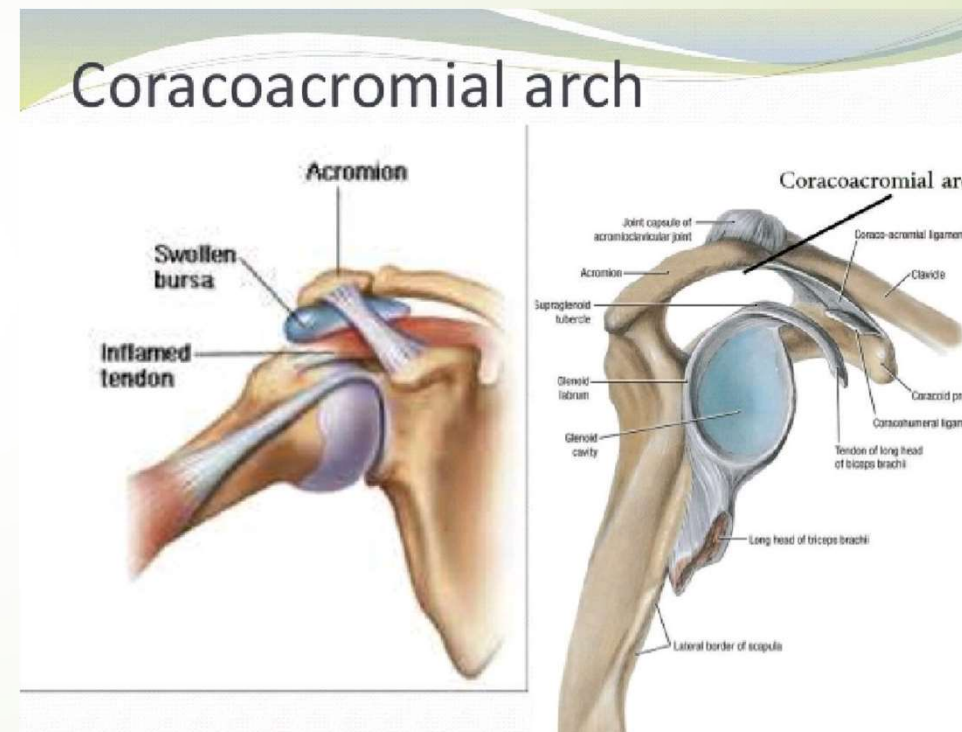


CORACOACROMIAL ARCH

- ▶ the coracoacromial or (suprahumeral arch) is formed by the coracoid process, the acromion process and the coracoacromial ligament that spans the 2 bone projections.
- ▶ the arch forms an osteoligamentous vault that covers the humeral head and forms the space within which the subacromial bursa, the supraspinatus tendon and a portion of the tendon of long head of the biceps lie.
- ▶ it also protects the structure we need from direct trauma from above.
- ▶ this also prevents the head of humerus from dislocating superiorly, when an upward translatory force applied on the humerus would cause the head of humerus to hit the coracoacromial arch.
- ▶ the impact of the humeral head into the arch simultaneously can cause pain and impingement when this space is narrowed and the likelihood of supraspinatus tendon and sub acromial bursa increases.

Coracoacromial Arch-

- The narrowing may occur due to several factors such as-
 - i. Change in the slope of acromion
 - ii. Acromial bone Spurs
 - iii. Acromioclavicular joint osteophytes
 - iv. A large coracoacromial ligament



INTREGATED FUNCTION OF THE SHOULDER COMPLEX-

The shoulder complex acts as in coordinated fashion to provide the smoothest and greatest range of motion possible of the upper limb.

Combined motion of GH and ST joint of shoulder complex helps in-

- Distribution of motion between other two joints.
- Maintenance of glenoid fossa in optimal position.
- Maintenance of good length tension

Scapulothoracic and Glenohumeral Contribution-

- ▶ For flexion and abduction (elevation) of the humerus the scapulothoracic joint contributes 60° of range of motion by rotating the glenoid fossa upward while GH joint contributes to 120° flexion and anywhere from 90° to 120° of abduction.
- ▶ The combination of scapula and humeral motion results in 180° degree of elevation with a ratio of two 2:1 for GH and ST motion.
- ▶ During initial 60° degree of flexion or 30° degrees of abduction of humerus, the scapula motion is inconsistent with increasing range a scapular contribution reaching to 1:1 with GH ratio.
- ▶ In later phase the GH joint again increases its contribution. This concomitant coordination of GH and ST motion is commonly referred to as scapulo-humeral rhythm.
- ▶ The rhythm also involves the SC and AC joint during 60° degrees of upward rotation of scapula because the ST joint is a part of close chain with SC and AC joint,
- ▶ The rotation of scapula is produced by the force couple of trapezius and serratus anterior muscle which are only muscles capable of upwardly rotating the scapula.

The scapula-humeral rhythm is divided into two phases

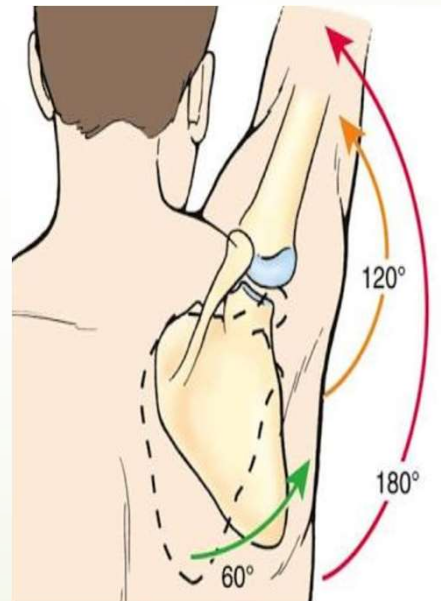
PHASE-1

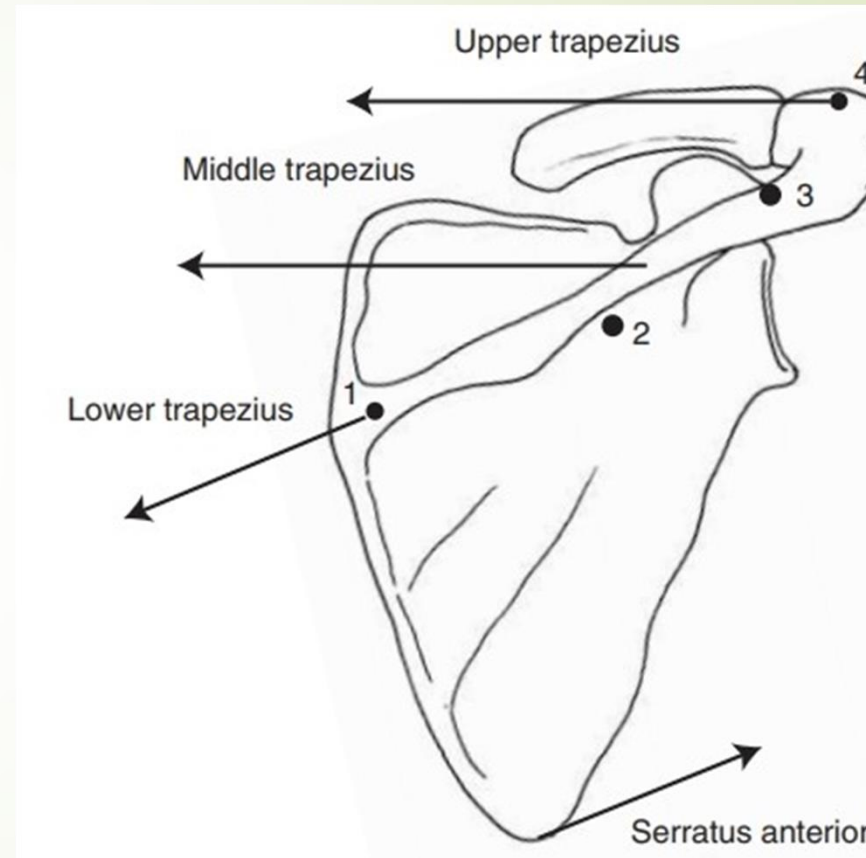
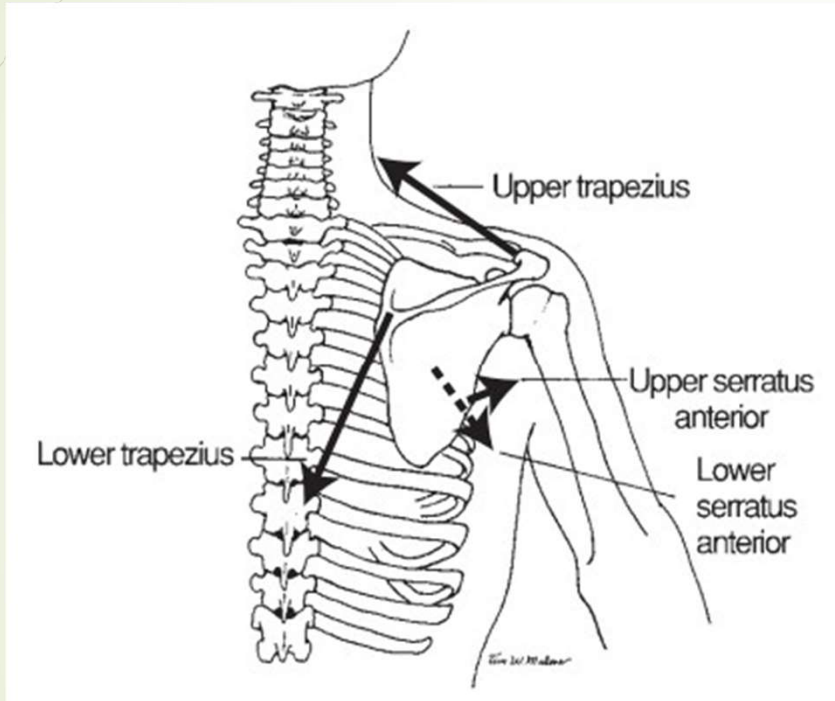
- ▶ The upper portion of the trapezius muscle elevates the clavicle and the lower portion of the trapezius muscle produce an upward rotatory force on the scapula (middle portion of trapezius may also involve) .
- ▶ It would appear that rotation of the scapula is occurring at AC joint but it is prevented by coracoclavicular ligament so the movement occurs at next possible SC joint.
- ▶ The clavicular elevation leads the scapula through 30° of upward rotation and the scapula rides on the lateral end of the rising clavicle while maintaining a relatively fixed scapula clavicular angle.
- ▶ Elevation of the clavicle is checked when costoclavicular ligament becomes taut because the ST upward rotation and clavicular elevation occur concurrently with GH motion.
- ▶ The GH joint can be expected under normal condition to simultaneously flex or abduct about 60 ° so that there will be total 90°-100 ° of the elevation of the arm.

PHASE-2

- ▶ As the two muscles that is the trapezius and serratus anterior are continue to generate rotatory force while the elevation at SC joint is checked by costoclavicular ligament and upward rotation at AC joint is still restrained by coracoclavicular ligament with no other available motion to dissipate the upward rotatory force treated by trapezius and serratus muscle.
- ▶ Tension in the coracoclavicular ligament builds as the coracoid process of the scapula gets pulled downwards and forward causes the clavicle to rotate posteriorly leads 30° of upward rotation of scapula because the scapula is attached to the lateral end of clavicle.
- ▶ As the scapula finds it final position on the rib cage the AC joint absorb into varying amount of anterior and posterior tipping of medial and lateral rotation.

- So if 180° is accepted as the maximum ROM of flexion and abduction of the humerus then raising the arm to the horizontal involves 60° of GH motion and 30° of ST motion and raising the arm from the horizontal to vertical in was addition 60° of GH and 30° of ST motion with the contribution of SC joint.









THANK-YOU