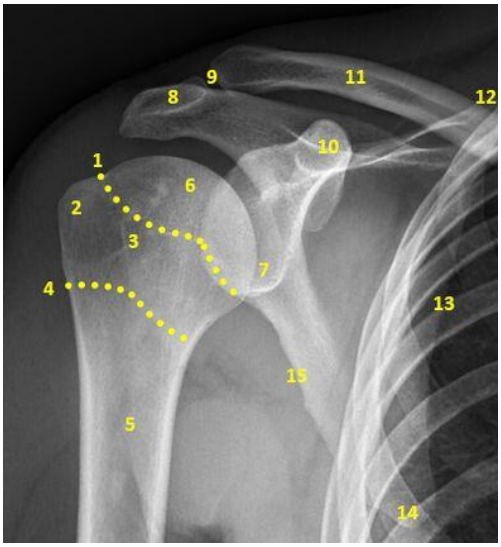
KARNATAKA RADIOLOGY EDUCATION PROGRAM

Shoulder Joint Anatomy and Applied Radiology

The shoulder complex is the connection of the upper arm and the thorax. Comprising numerous ligamentous and muscular structures, composed of the clavicle, scapula, humerus and sternum, and an intricately designed combination of four joints, the Glenohumeral (GH) Joint, the Acromioclavicular (AC) Joint and the Sternoclavicular (SC) Joint, and a "floating joint", known as the Scapulothoracic (ST) joint. The shoulder allows for a large range of motion due to the spheroid shape of the glenohumeral joint but this (i.e. a large ball in a small socket) renders it prone to dislocation and other injuries.

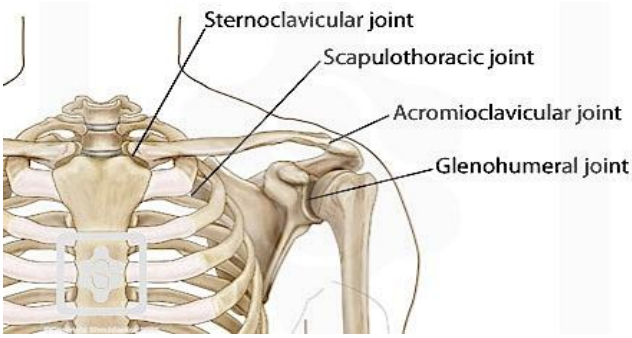


1. anatomical neck of humerus 2. greater tuberosity 3. lesser tuberosity 4. surgical neck of humerus 5. humeral shaft 6. humeral head 7. glenoid fossa 8. acromion 9. acromioclavicular joint 10. coracoid process 11. clavicle 12. superior angle of scapula 13. medial border of scapula 14. inferior angle of scapula 15. lateral border of scapula 16. scapula

The osseous segments of the shoulder complex comprise of the clavicle, scapula (shoulder blade), the humerus and the sternum (the link to the thoracic cage).

In all, there are four major articulations associated with the Shoulder Complex involving the sternum, clavicle, ribs, scapula, and humerus, which work together to provide large ranges of motion to the upper extremity in all three planes of motion. Movement at the Shoulder Complex occurs as a result of movement at each of these four joints, listed below.

Glenohumeral Joint, Acromioclavicular Joint, Sternoclavicular Joint,Scapulothoracic Joint



Ultrasound of Shoulder Joint

Scan shoulders with the patient erect, seated on a high swivel chair for ease and ergonomics.

Long Head Biceps (LHB)

Technique

To identify the biceps tendon:

Patient with their hand resting on their lap. Palm upwards (external rotation) is best.

Palpate the anterior humeral head (bicipital groove if you can) and place the probe transversely.

Slide the probe superiorly and inferiorly to assess the entire tendon from the musculo-tendinous junction.

TIP: When you slide down, look for the pectoralis major tendon crossing over the biceps. This is the level of the bicipital musculotendinous junction. You must extend beyond this point to check for retraction if a tear is suspected

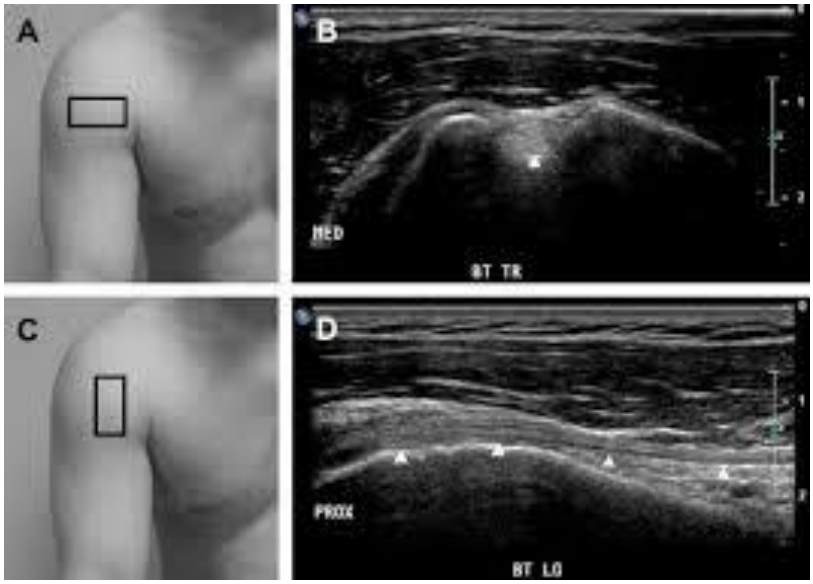
What to look for? Once you identify the biceps tendon:

- **Is it in the bicipital groove? (enlocated)**
- **Is it intact?**

- **Assess it from the superior humeral head (at the rotator cuff interval) to the musculo-tendinous junction inferiorly.**
- **Is there fluid or synovial thickening of the sheath.**

Normal appearance:

TRANSVERSE: Echogenic and ovoid (proximally, it is usually against the medial edge of the bicipital groove)
LONGITUDINAL: Echogenic and fibrillar.
SHEATH: a trace of simple fluid is physiologically normal.



A dynamic evaluation of the long head of the biceps brachii tendon stability can be performed by returning the US transducer to its original transverse position over the tendon at the level of the intertubercular groove. The patient should be instructed to externally and internally rotate the shoulder while the examiner monitors for subluxation or dislocation of the long head of the biceps brachii tendon out of the intertubercular groove.

Subscapularis

To identify the subscapularis tendon:

From your transverse bicipital groove, keep the probe still and externally rotate the patient's arm to stretch subscapularis into view.

Slide the probe superiorly and inferiorly to assess the entire tendon width.

TIP: When you slide up/down and 'fall off ' the lesser tuberosity, you have covered the entire subscapularis tendon.

What to look for? Once you identify the Subscapularis tendon:

- **Is it fibrillar**
- **Is there fluid/calcification?**
- **Is the contour flattened?**

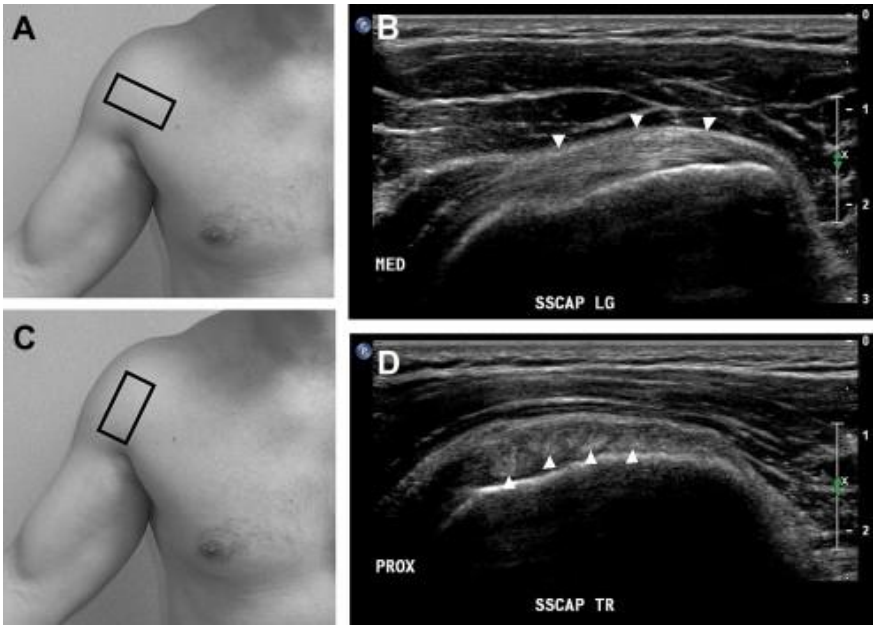
Dynamics:

- **Internally and externally rotate the arm to:**
- **Better view the entire length of the tendon.**
- **Assess the overlying bursa for impingement against the Coracoid process.**

Normal appearance:

- **LONGITUDINAL: Echogenic and fibrillar. Convex contour.**
- **TRANSVERSE: The tendon will have a slightly heterogeneous appearance due to the multi- pennate nature of the tendon.**

The overlying sub-deltoid bursa (SDB) should be uniform and very thin (essentially no visible gap between the subscapularis tendon and the overlying deltoid muscle).



Coraco-Acromial Ligament

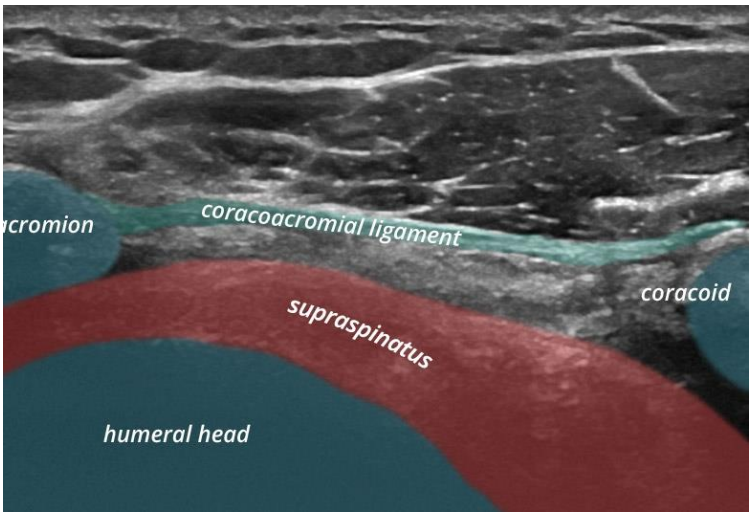
Technique : To identify the coraco-acromial ligament:

From your transverse subscapularis view, slide medially and adjust antil you have the coracoid process on the edge of your image.

Rotate the other end of the probe towards the acromion (keep the coracoid end fixed so the coracoid is always visible)

What to look for? This ligament rarely suffers damage. Instead, look deep to it for fluid (may be joint or bursal overlying subscapularis in this area).

Normal appearance: LONGITUDINAL: Echogenic and fibrillar. Flared ends at the insertions.



Supraspinatus

Patient position

To stretch the Supraspinatus tendon: Firstly you need to stretch the tendon out from beneath the acromion. To do this we must externally rotate and push the humeral head forwards.

Position 1. Ask the patient to turn their palm up and pull their elbow back (modified Crass)
Position 2. Ask the patient to place the back of their hand against their lower back (Crass position)

TIP: If you only use position 2, you may have difficulty clearly visualising the anterior aspect of supraspinatus tendon because of the degree of internal rotation. This position is also more difficult for the patient

Technique : To identify the Supraspinatus:

TRANSVERSE

- **Begin with a transverse biceps tendon on the medial edge of your image.**
- **Slide the probe up and over the humeral head.**
- **The Supraspinatus will come into view (if it is present).**
- **The probe will be directed down towards the floor.**
- **Examine anteriorly-posteriorly by sliding the probe.**

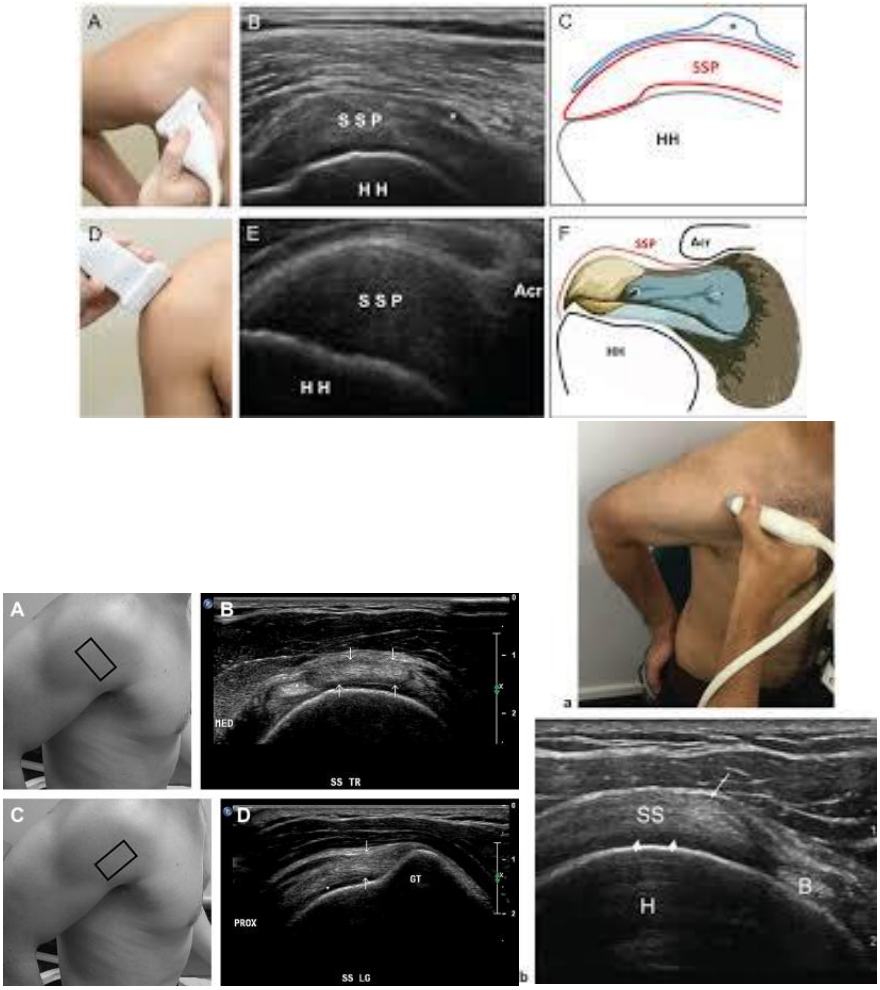
LONGITUDINAL

- **From the transverse view, rotate the probe 90degrees so the marker end is pointed towards the acromion.**
- **Sweep the probe around the humeral head. Anteriorly until you see the biceps tendon and posteriorly until you see the hypoechoic change of infraspinatus anisotrphy.**
- **Ensure you rock (heel/toe) the transducer to view from insertion to musculo-tendinous junction.**

TIP:Always keep the humeral head echo crisp. If it is blurry, you will not be perpendicular to the tendon)

What to look for? Once you identify the Supraspinatus tendon:
Is it fibrillar
Is there fluid/calcification?
Is the contour flattened?

Normal appearance:
LONGITUDINAL: Echogenic and fibrillar. Convex contour.
The supraspinatus tendon will become hypoechoic posteriorly related to the merging Infraspinatus fibres
The overlying sub-acromial bursa (SAB) should be uniform and very thin (less than 2mm).
TIP: A thin bursa may still be adherent and symptomatically impinge so should be observed dynamically.



Acromio Clavicular Joint (ACJ)

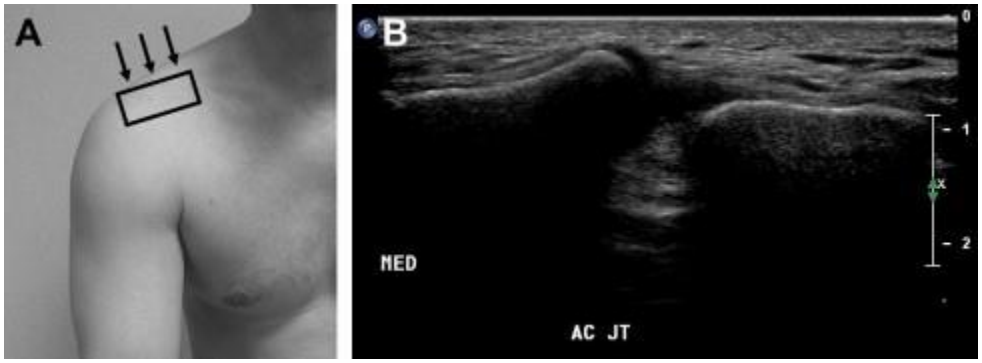
Patient position: Patient begins with arm relaxed by their side.
Technique Scan plane:
Place the probe in a coronal plane, bridging the AC joint.
Slide anteriorly and posteriorly to interrogate the entire joint.

Dynamic assessment: Ask the patient to grip the side of the chair and pull downwards. Look for widening of the ACJ.
Ask the patient to forward flex their shoulder and internally rotate (tipping a drink out).

What to look for? Statically:
Narrowing of the joint.
Bony irregularity

Fluid, cysts or synovial bulging
Joint stability
Dynamically: Look for bony contact in the joint.
TIPS: Clinically correlate...is it painful?
Scan through from anterior to posterior as pathology will not always be central.

Normal appearance:
Smooth bone contours.
Bones separated by hypoechoic central synovium.
Gently convex contour of the AC ligament.



Infraspinatus (ISP) and Teres Minor (TM)

Patient position: Patient's arm by their side, internally rotated. Ensure their entire arm is internally rotated, not just their forearm.
TIP: Common practice is to place the affected hand across to the opposite shoulder. Whilst this tightens the infraspinatus and Teres, it also creates an oblique angle on the tendons. We find simply internally rotating to be far simpler for the operator and patient.

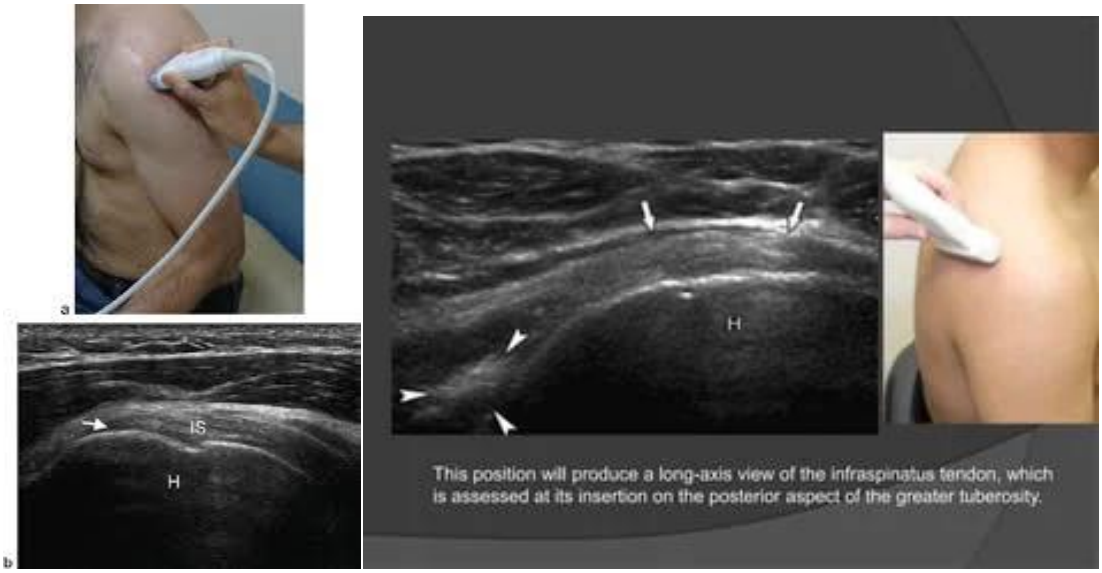
To identify the infraspinatus tendon:
Place your probe across the lateral edge of the acromion.
Slide the probe inferiorly.
As you drop off the acromion, you should see the humeral head and the infraspinatus tendon, longitudinal plane.

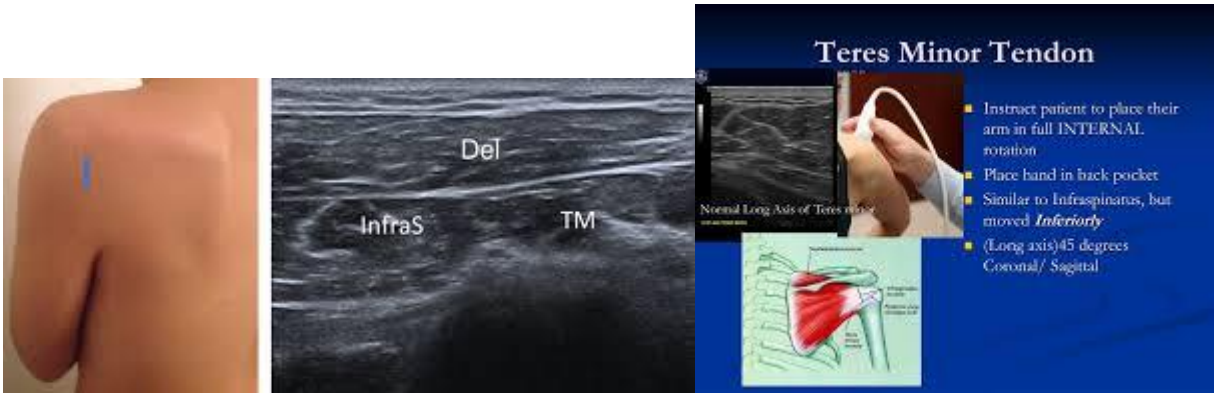
To identify the Teres Minor tendon:
From the infraspinatus tendon, slide your probe inferiorly slightly.
Teres will be immediately inferior to the Infraspinatus tendon.

TIP: The ISP insertion is more anterior than most people expect.
You may need to 'rock' the probe anteriorly to see the insertion fully.

What to look for? Assess for: Homogeneous fibrillar tendons.

Normal appearance:
Infraspinatus: Echogenic and fibrillar. Convex contour.
Teres: Thinner than ISP with a small bony defect (nutrient foramen).
Infraspinatus scan plane: Patient's arm internally rotated.
Teres Minor scan plane: Imediately inferior to infraspinatus





Posterior Gleno-Humeral Joint (GHJ)

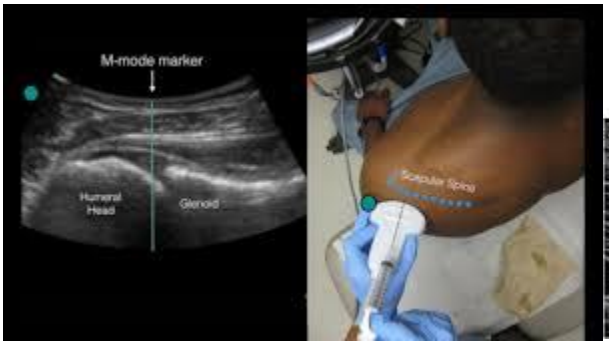
Patient position: Patient's arm relaxed hanging by their side.
Technique : To identify the posterior glenohumeral joint:

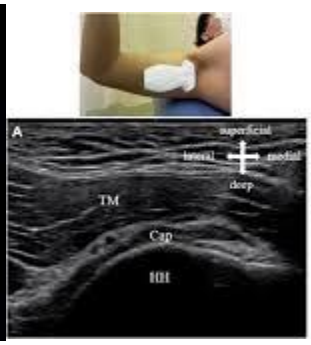
From your Infraspinatus view, simply slide and roll your transducer around the humeral head.
Slide the probe superiorly and inferiorly to assess the entire joint.
Ask the patient to internally/externally rotate their arm to assess for joint effusions.
TIP: A joint effusion will become visible during external rotation when the posterior capsule is not under tension.

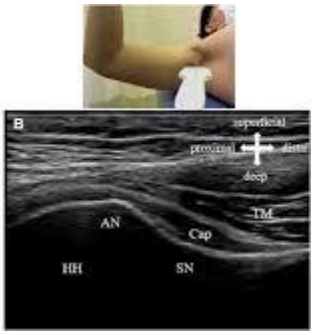
What to look for? /Assess for: Bony irregularity,Fluid,Synovial cysts

TIPS:
This is the best scan plane for ultrasound guided joint injections
A curvi-linear probe will provide better views in larger patients (muscular or otherwise).
A curvilinear probe is also useful for needle visualisation (when the image is optimised appropriately)

Normal appearance:
BONY CONTOUR: Smooth humeral head.
LABRUM: Smooth, homogeneous echogenic triangular structure arising from the glenoid.







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