

Intro to Ultrasound

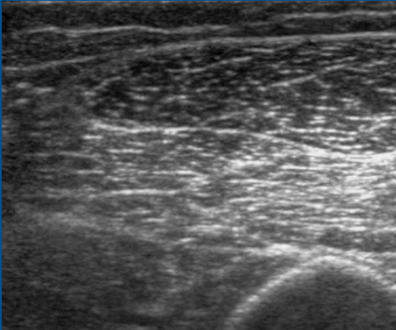
Hector Rivera-Melo, DC, DACBR, RMSK
Director, Center for Diagnostic Imaging
Southern California University of Health Sciences

1

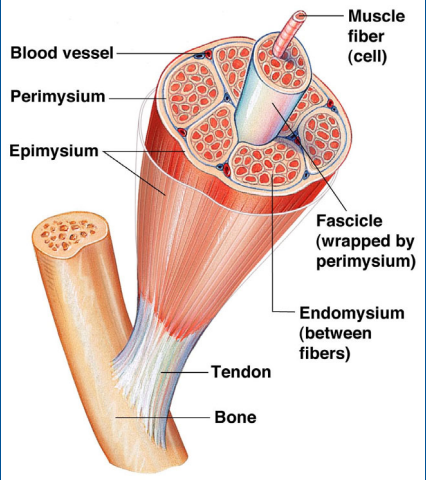
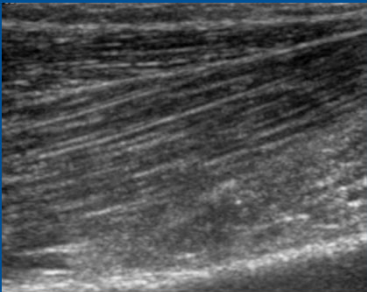
Tissue Identification

- Muscle:

Hypoechoic, “Starry night” appearance in short axis



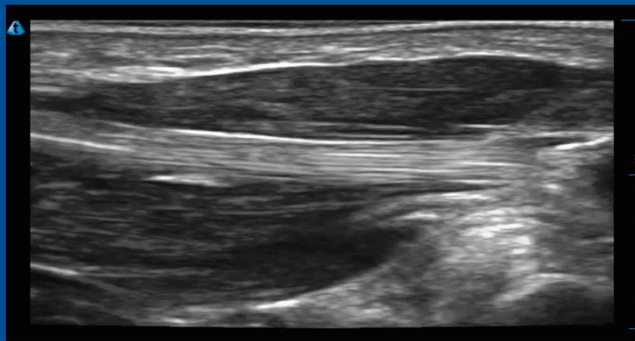
Pennate appearance in long axis



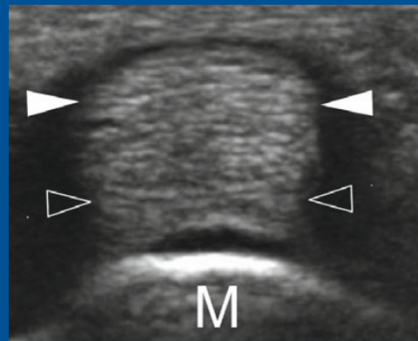
2

Tissue Identification

- **Tendon:**
 - Hyperechoic, fibrillar appearance.



Long axis



Short axis

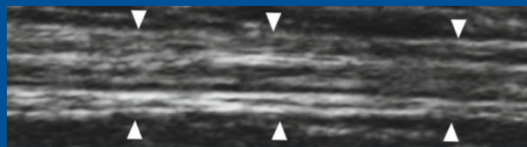
3

Tissue Identification

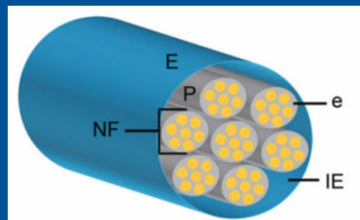
- **Nerve:**
 - Honeycomb appearance in short axis.
 - Striated appearance in long axis.



Short axis

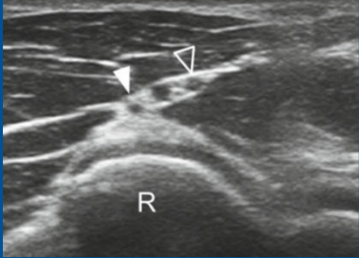
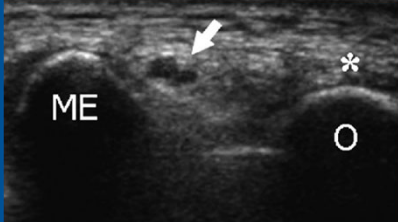
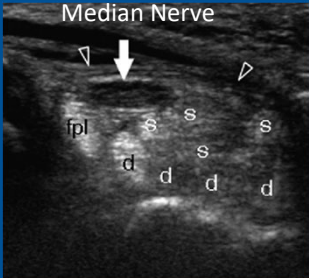
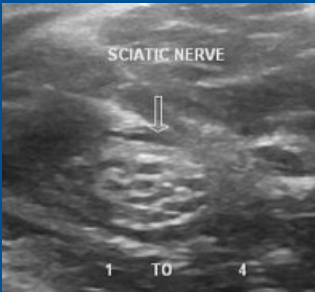
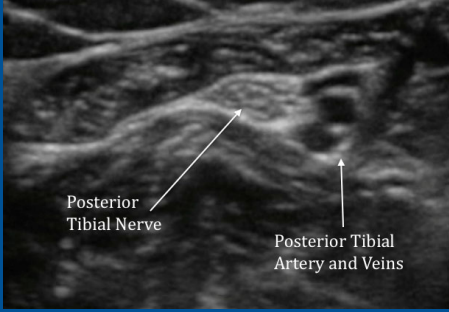


Long axis



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Tissue Identification

- Nerves:**
 - Radial Nerve:** 
 - Ulnar Nerve:** 
 - Median Nerve:** 
 - SCIATIC NERVE:** 
 - Posterior Tibial Nerve:** 

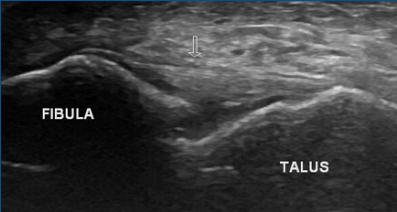
5

Tissue Identification

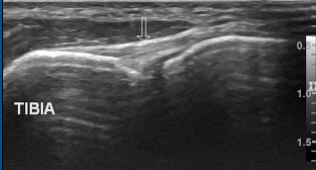
- Ligament:**
 - Hyperechoic like tendons
 - But appearance may vary



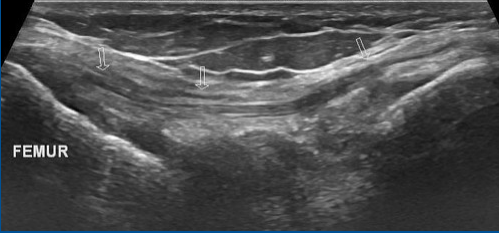
UCL (Elbow)



ATFL



AI TFL



LCL (Knee)

FEMUR

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Tissue Identification

- **Blood Vessels:**
 - Anechoic
 - Arteries are pulsatile
 - Veins are compressible



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Tissue Identification

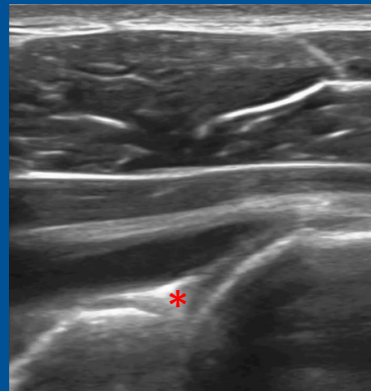
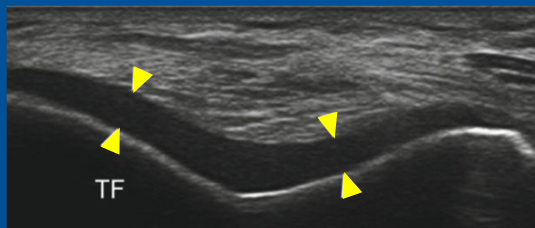
- **Bone:**
 - Brightest structure (Hyperechoic) on most any image.
 - Acoustic shadowing deep to bone



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Tissue Identification

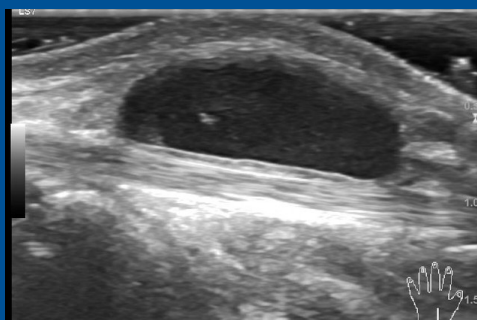
- **Cartilage:**
 - **Hyaline cartilage** (covering a joint surface) will be hypo/anechoic
 - **Fibrocartilage** (e.g. meniscus, **labrum**, TFCC) will be hyperechoic



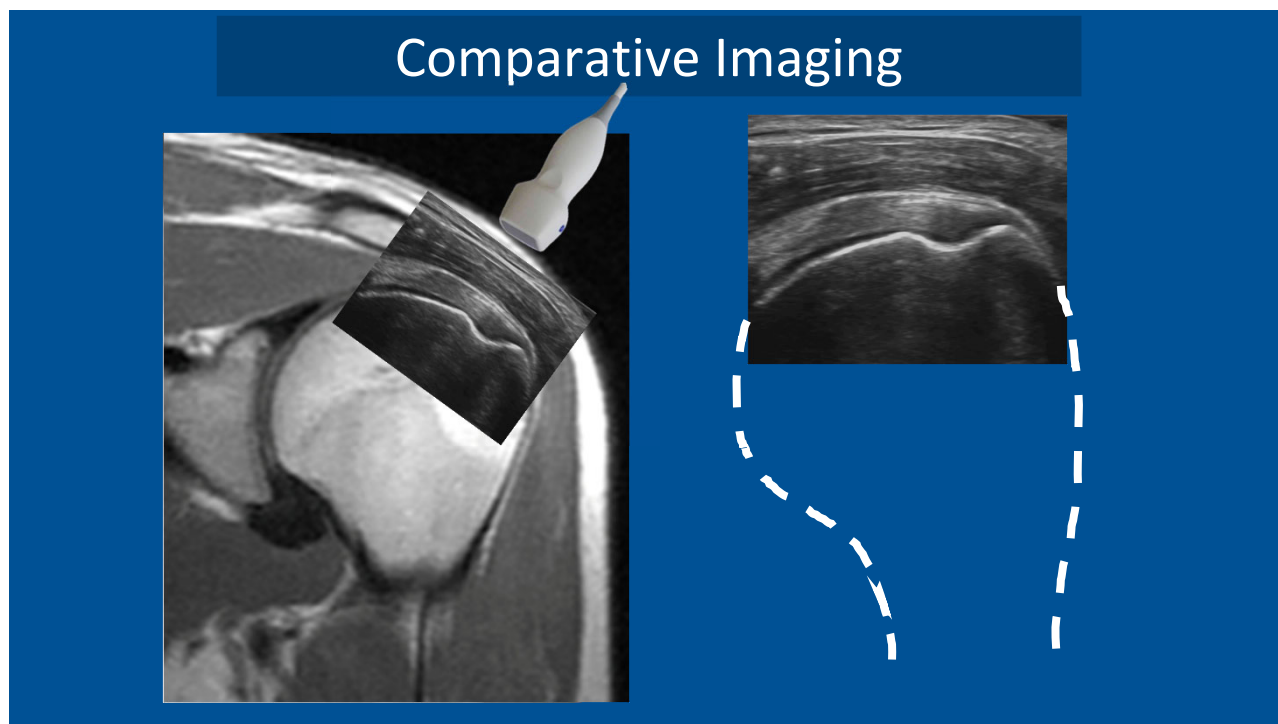
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Tissue Identification

- **Fluid:**
 - Anechoic (sometimes hypoechoic) collections, may be:
 - Rounded (e.g. bursa or cyst) or have sharp corners (free fluid)



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Ergonomic Tips



- Keep the patient close to you
- Keep your hand below your shoulder
- Try to make contact between your scanning hand and the patient
- Try not to grip the transducer too tightly
- Demonstrate any dynamic maneuvers to the patient first

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CPT Codes

CPT Code	Description
76881	Extremity Ultrasound (non-vascular) with image documentation – Complete Consists of real time scans of a specific joint that includes examination of the muscles, tendons, joint, other soft tissue structures, and any identifiable abnormality.
76882	Extremity Ultrasound (non-vascular) with image documentation – Limited This is a limited examination of the extremity where a specific anatomic structure such as a tendon or muscle is assessed.

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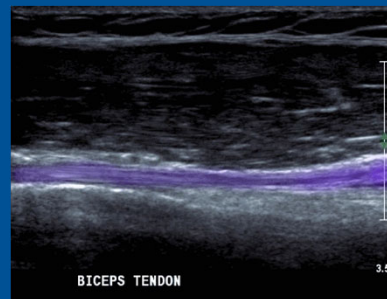
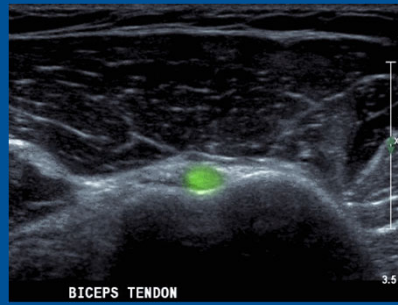


Shoulder Ultrasound Technique and Assessment

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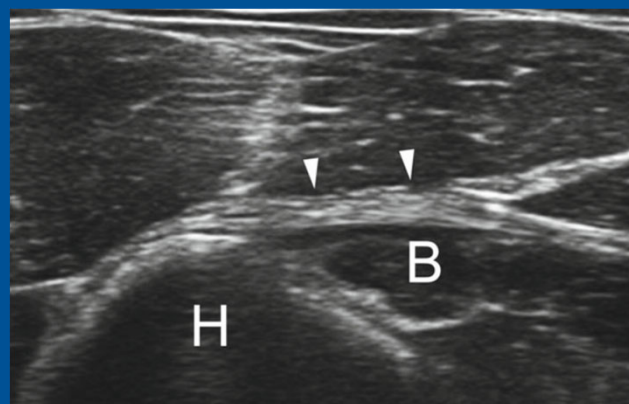
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Long Head of the Biceps Tendon



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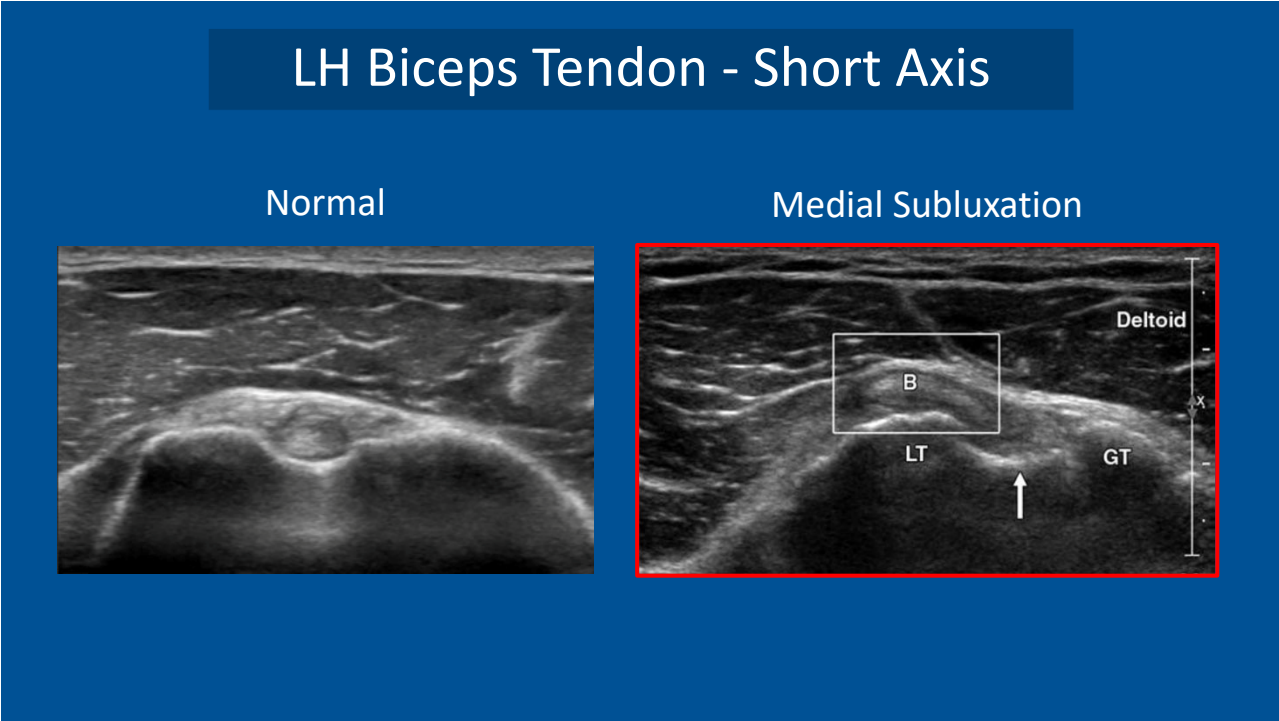
Long Head of the Biceps Tendon



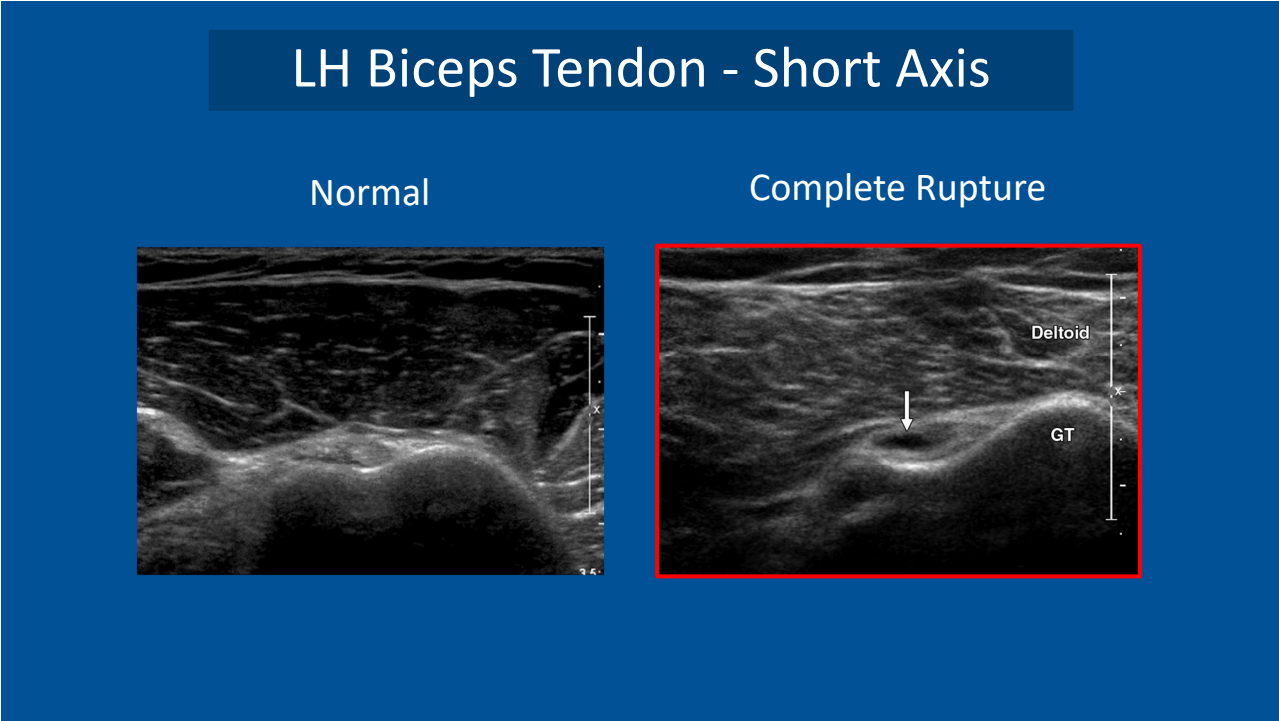
Gliding the transducer distally brings the pec major in to view as the bicep tendon transitions into a muscle belly

▼ = Pectoralis Major Tendon
H = Humerus
B = Biceps Brachii Muscle

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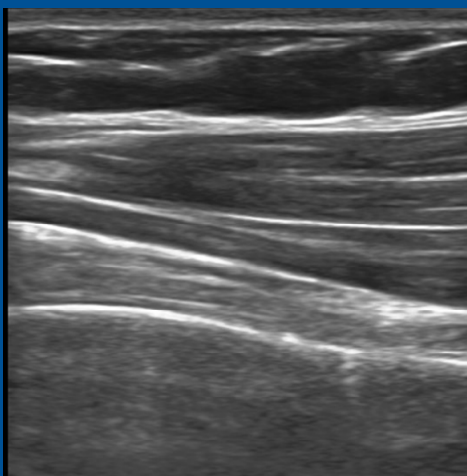
17



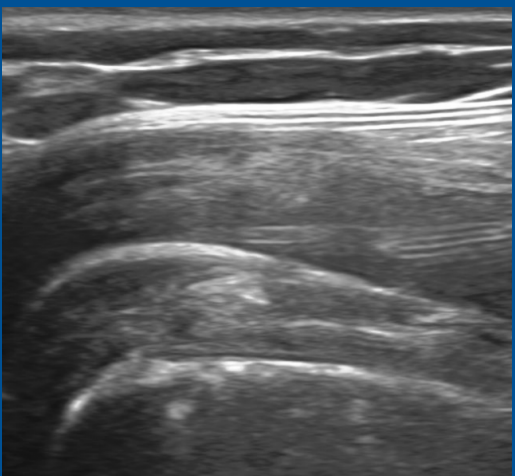
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LH Biceps Tendon - Long Axis

Normal



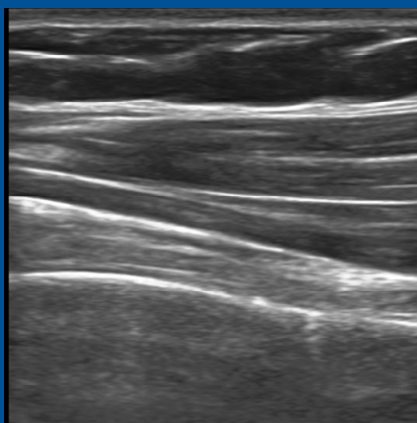
Moderate tendinosis



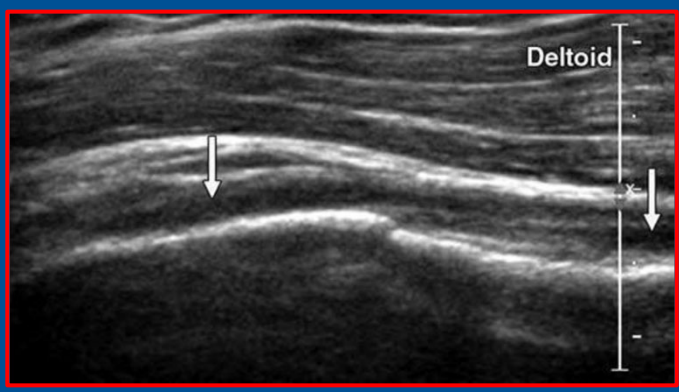
19

LH Biceps Tendon - Long Axis

- Normal

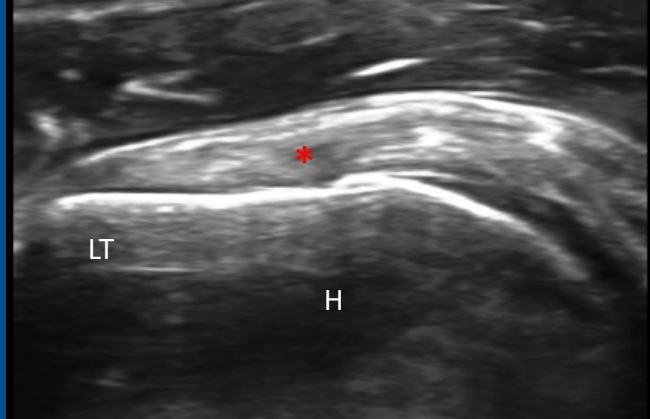
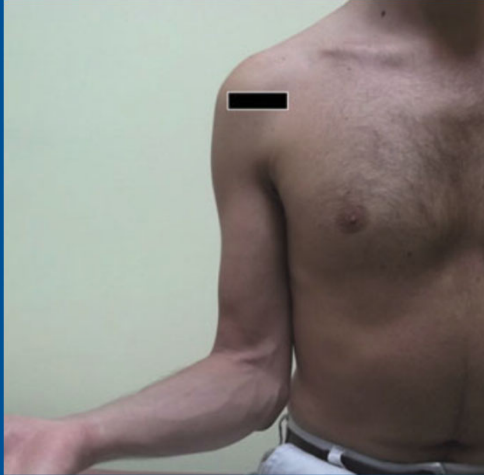


- Complete Rupture



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Normal Subscapularis Tendon



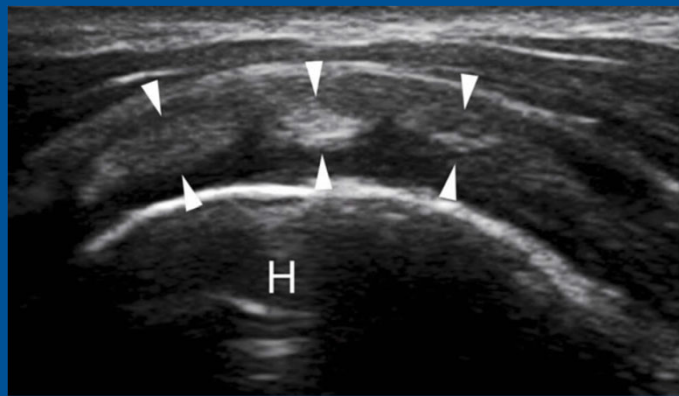
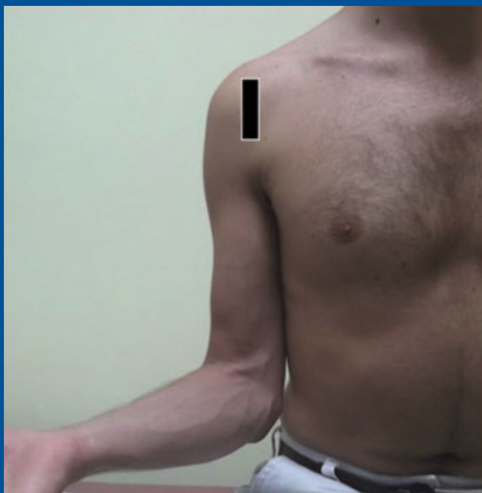
Long axis view:

- * = Subscapularis tendon
- H = Humerus
- LT = Lesser Tuberosity

Have patient externally rotate arm to bring subscapularis tendon into view

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Normal Subscapularis Tendon



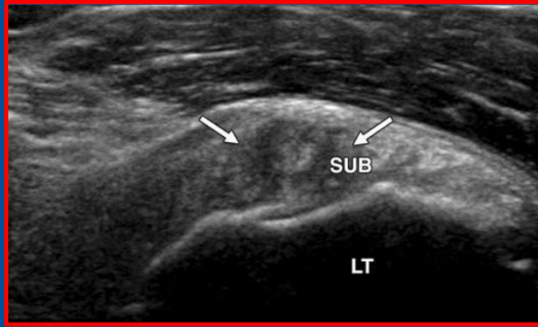
Short axis view:

- ▲ = Multiple tendons of the subscapularis
- H = Humerus

Rotate transducer 90 degrees from long axis view

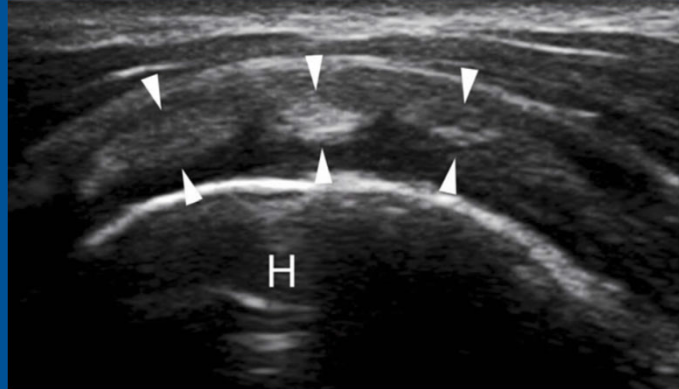
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Subscapularis Tendon – Short Axis



Heterogeneity and
hypoechoic thickening

Moderate Tendinosis



Short axis view:

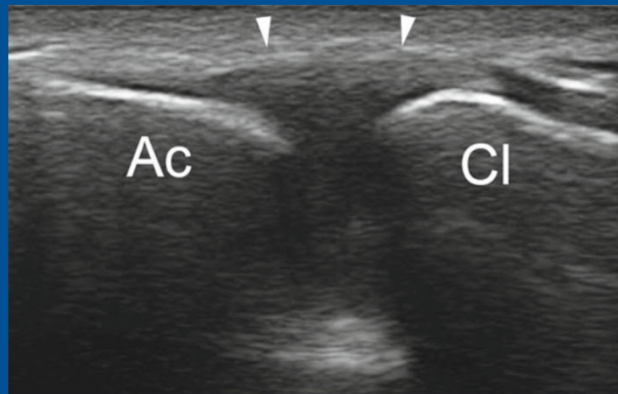
▲ = Multiple tendons of the subscapularis
H = Humerus

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Normal Acromioclavicular Joint



Be sure to decrease
your depth for this
superficial structure

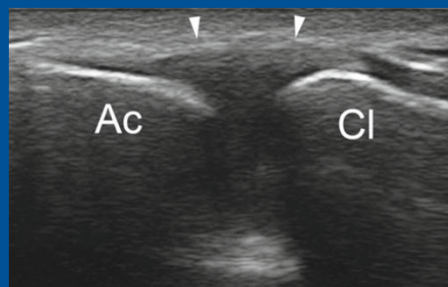
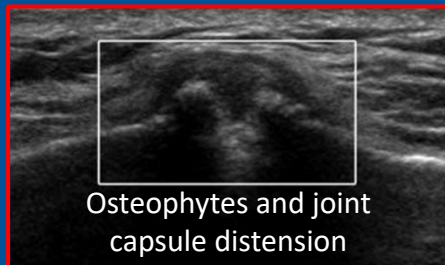


Coronal View:

▲ = Joint Capsule
Ac = Acromion
Cl = Clavicle

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Acromioclavicular Joint



Coronal View:
▲ = Joint Capsule
Ac = Acromion
Cl = Clavicle



Prominent Joint Effusion

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Subacromial Impingement Assessment

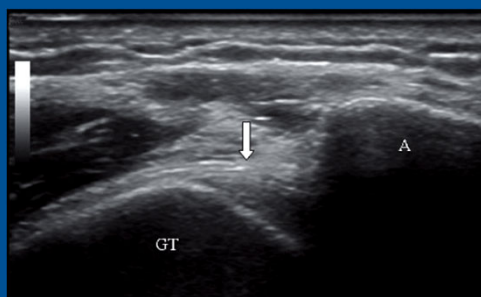


Have patient abduct to 90 degrees with about 10-20 degrees of flexion

GT = Greater Tuberosity

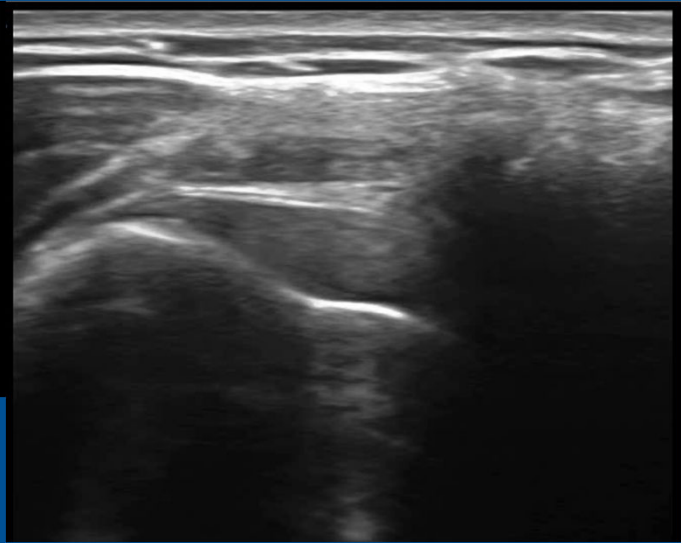
A = Acromion

↓ = Supraspinatus



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Subacromial Impingement Assessment

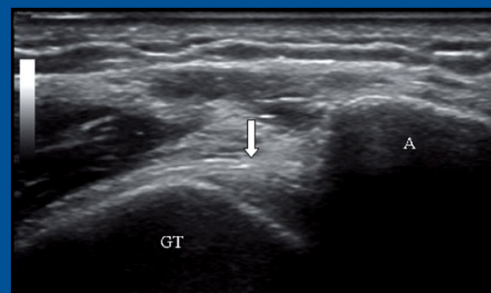
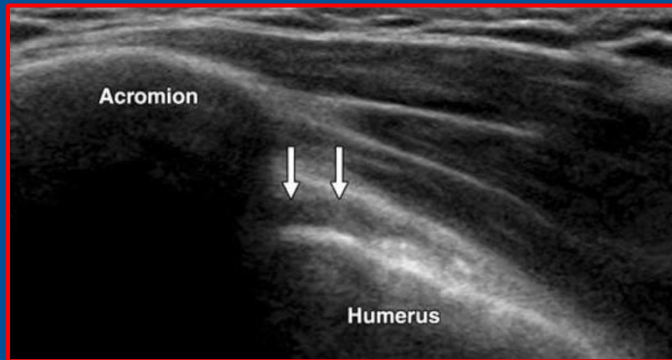


- Looking for evidence of:
 - Subacromial/subdeltoid bursal distension
 - Ratcheting motion
 - Buckling of supraspinatus tendon

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Subacromial Impingement Assessment

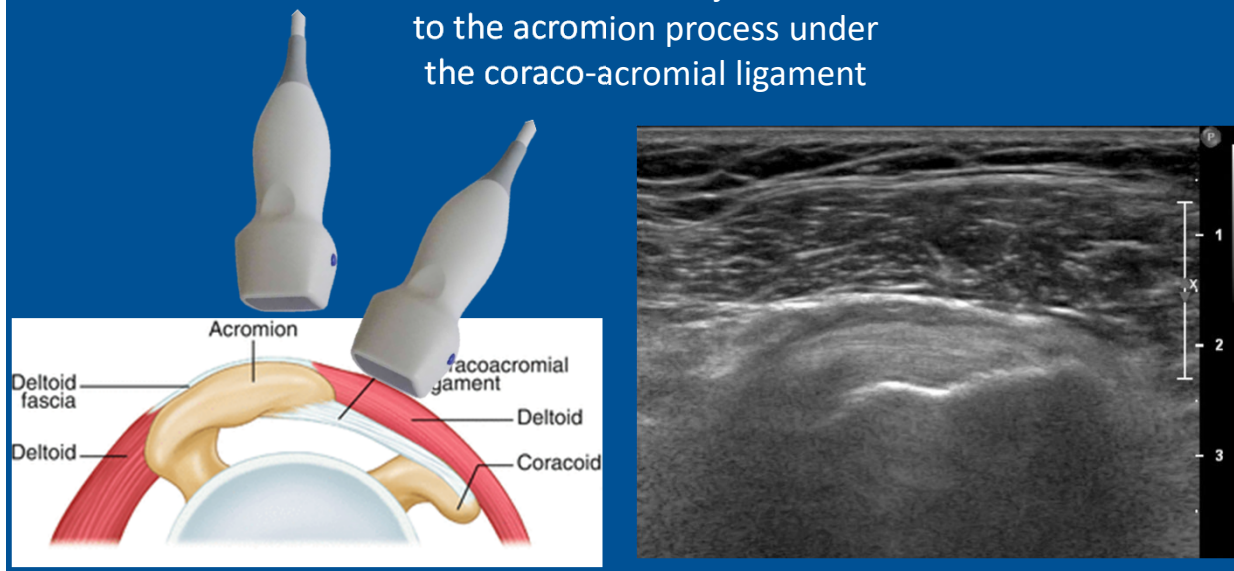
Pooling of subacromial-subdeltoid bursal fluid



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Subacromial Impingement Assessment

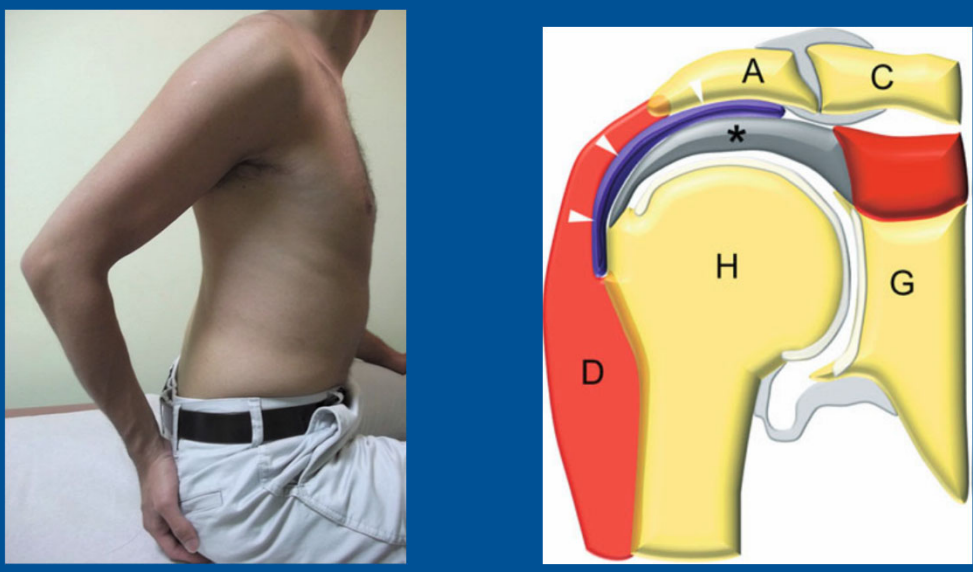
Can also be assessed just anterior to the acromion process under the coraco-acromial ligament



The image contains three main visual elements: 1) Two 3D anatomical models of the shoulder joint, one showing the acromion and coracoid process. 2) A cross-sectional anatomical diagram of the shoulder joint with labels: 'Acromion', 'Deltoid fascia', 'Deltoid', 'Coracoacromial ligament', and 'Coracoid'. 3) A grayscale ultrasound image showing a cross-section of the shoulder joint with a vertical scale on the right side marked 1, 2, and 3.

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Supraspinatus Position

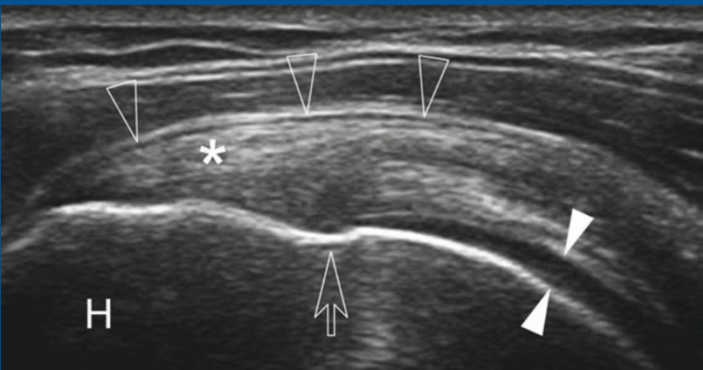



The image contains two main visual elements: 1) A clinical photograph of a person's back and shoulder from a side view, with their hand on their hip. 2) A cross-sectional anatomical diagram of the shoulder joint with labels: 'A', 'C', 'H', 'G', 'D', and an asterisk '*'. The diagram shows the supraspinatus tendon (D) and its position relative to the acromion (A) and coracoid (C).

*Alternatively, can have the hand on their hip

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Normal Supraspinatus Tendon



Long axis view:
* = Supraspinatus Tendon
▲ = Humeral cartilage
△ = Subacromial-subdeltoid bursa
H = Humerus

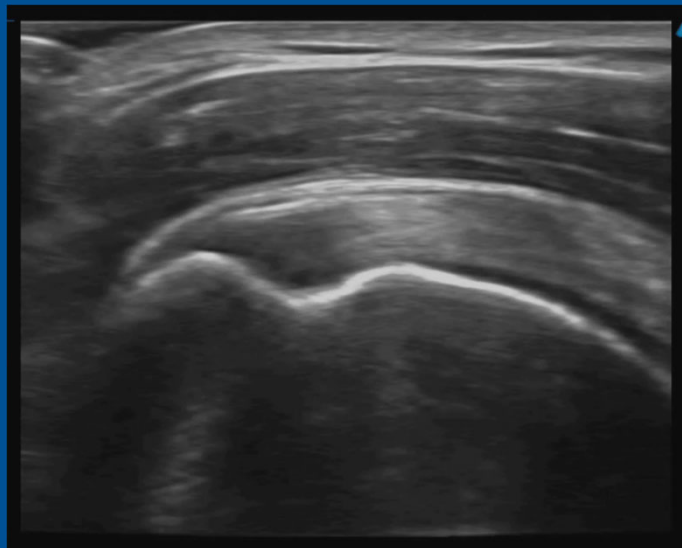
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Normal Supraspinatus Tendon



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Normal Supraspinatus Tendon

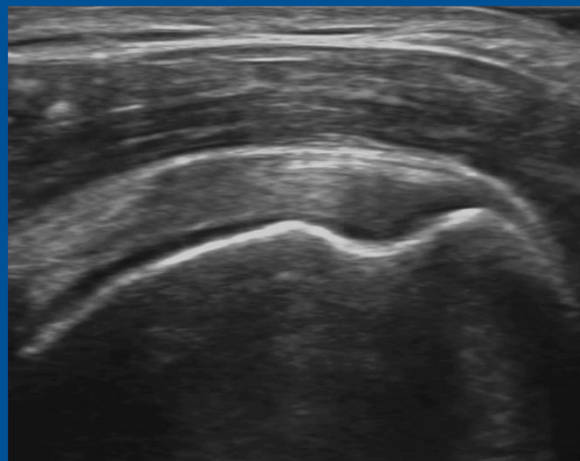


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Supraspinatus Tendon – Long Axis



Thickening of the
Subacromial-Subdeltoid Bursa



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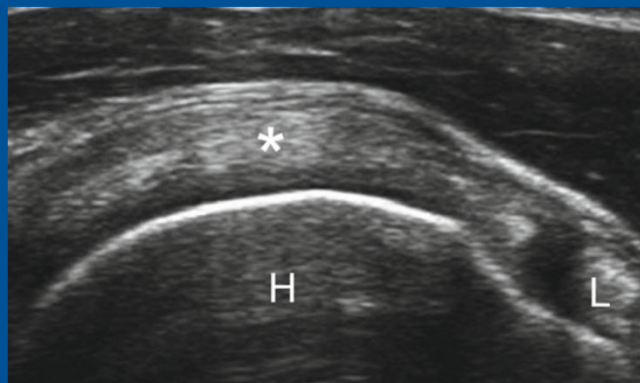
Supraspinatus Tendon – Long Axis



Chondrocalcinosis within the
hyaline cartilage of the humerus

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Normal Supraspinatus Tendon



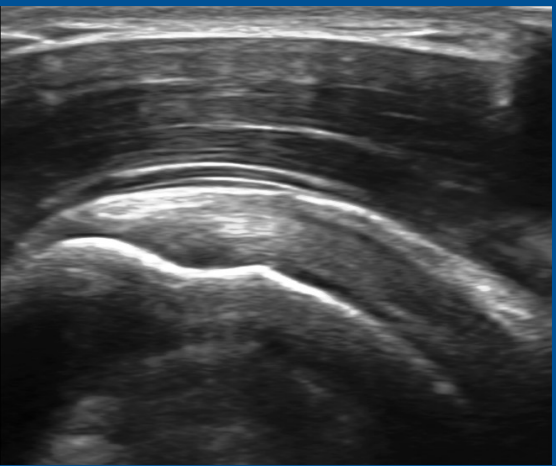
Short axis view:

- * = Supraspinatus Tendon
- L = Long head of the Biceps Tendon
- H = Humerus

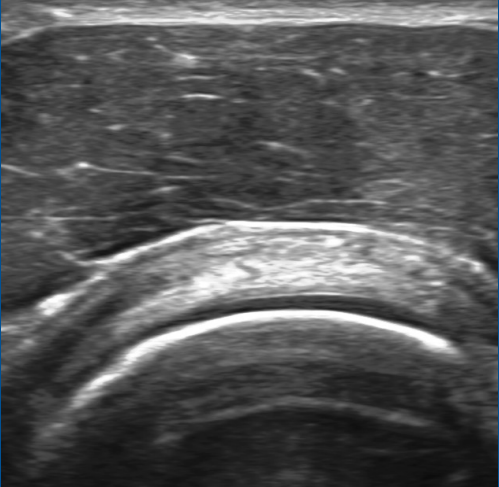
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Normal Supraspinatus Tendon

Long Axis



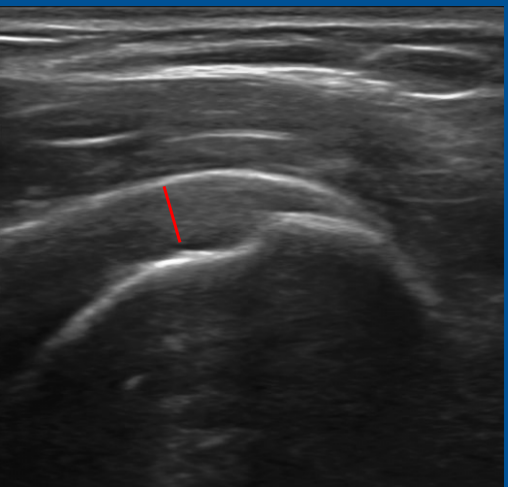
Short Axis



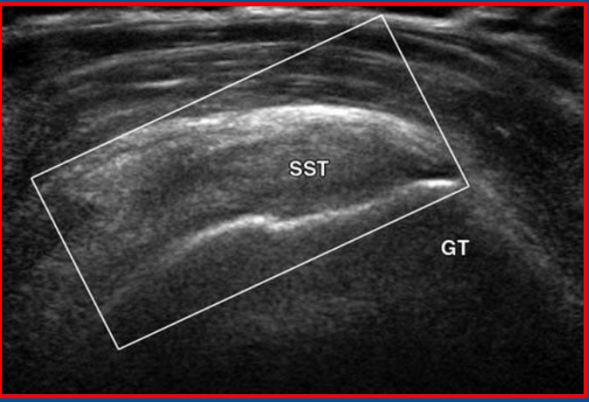
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Supraspinatus - Long Axis

Normal (<7mm)




Moderate tendinosis




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Supraspinatus - Long Axis



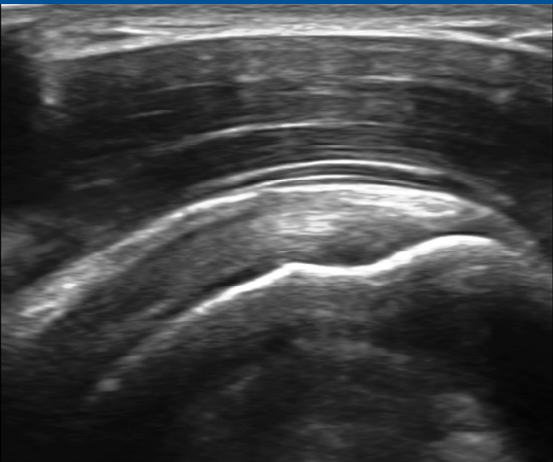
Calcific tendinosis



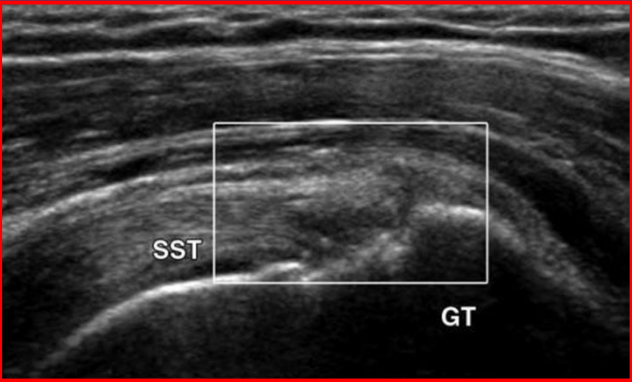
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Supraspinatus - Long Axis

Normal



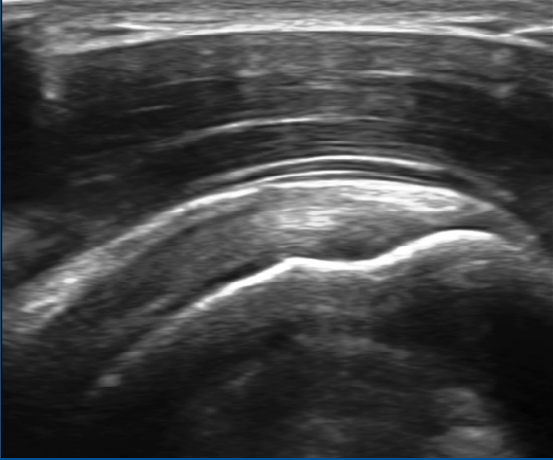
Partial thickness tear
Bursal Sided



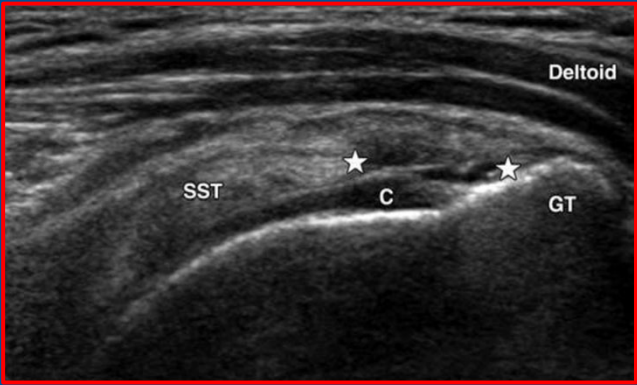
40

Supraspinatus - Long Axis

Normal



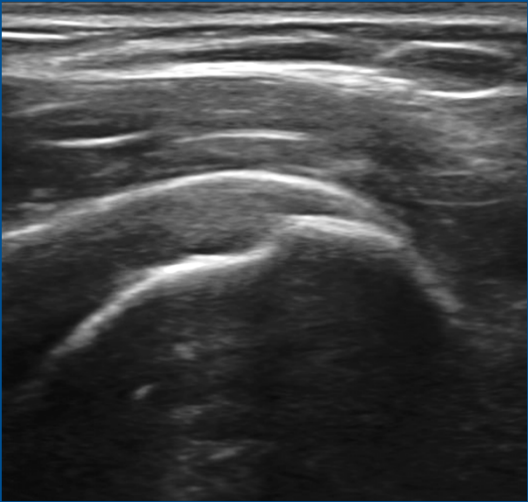
Partial thickness tear
Articular Sided




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Supraspinatus - Long Axis

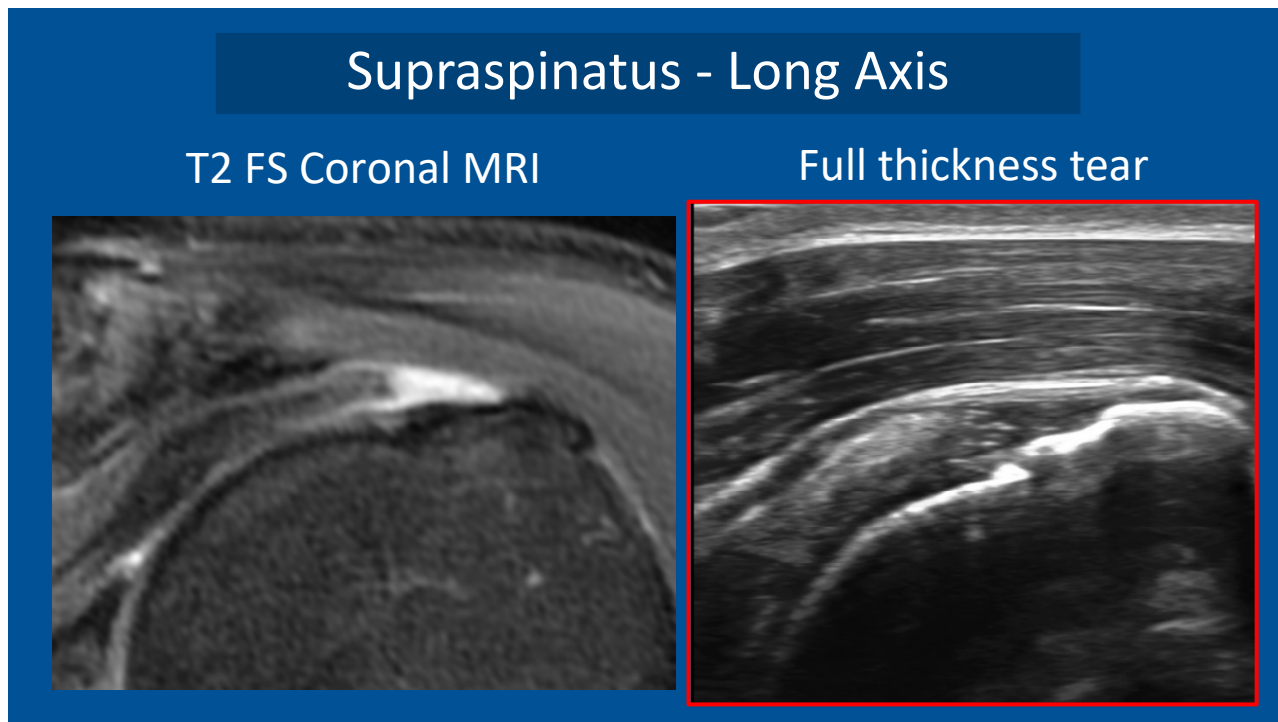
Normal



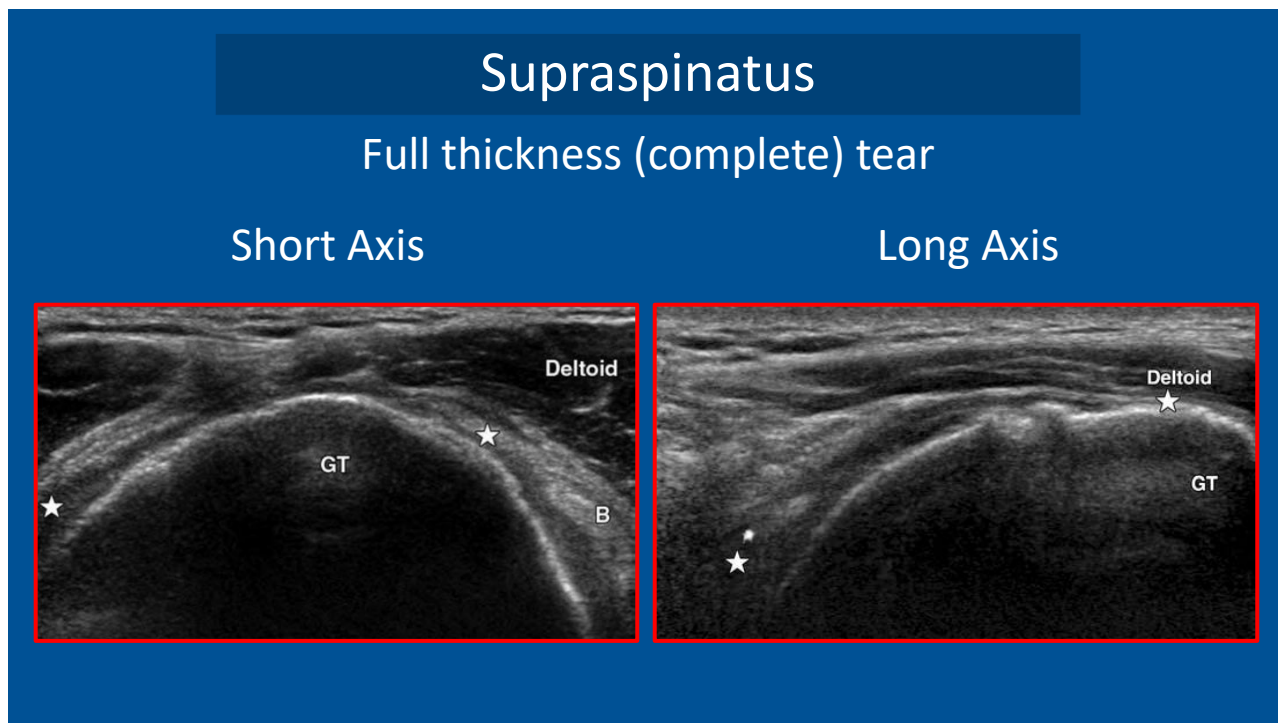
Full thickness (incomplete) tear



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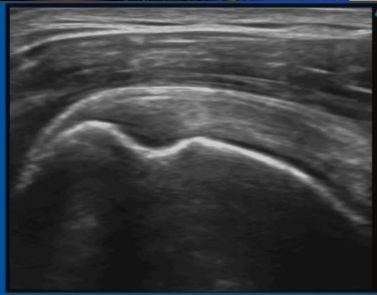


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Normal Infraspinatus Tendon

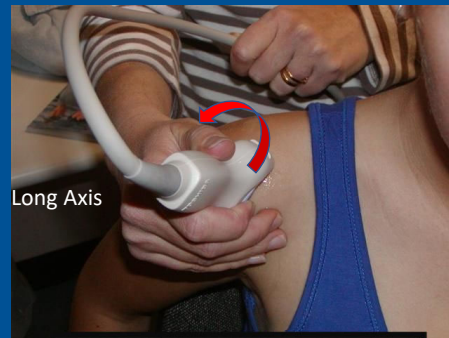


Start at the supraspinatus long axis position and move posteriorly until the greater tuberosity is flat.

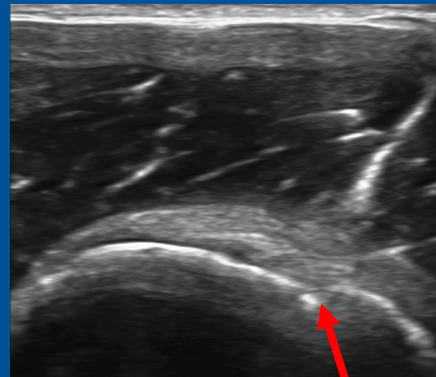
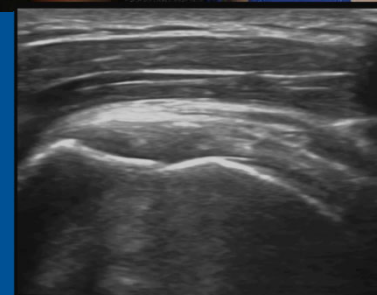


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Normal Teres Minor Tendon



Continue from the infraspinatus long axis position and move posteriorly until you see a nutrient foramen in the humerus.



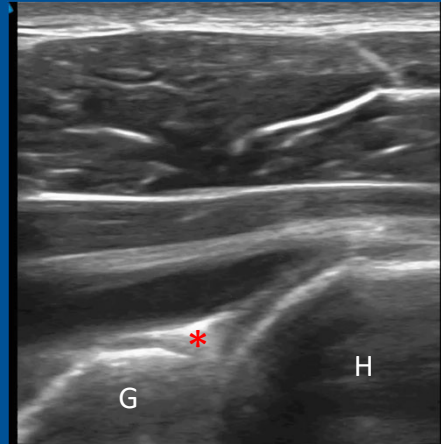
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Posterior Shoulder – Glenohumeral Joint



Center transducer over posterior glenohumeral joint space.

Have the patient actively externally rotate shoulder to look for GH effusion.



* = Posterior glenoid labrum
G = Glenoid process
H = Humerus

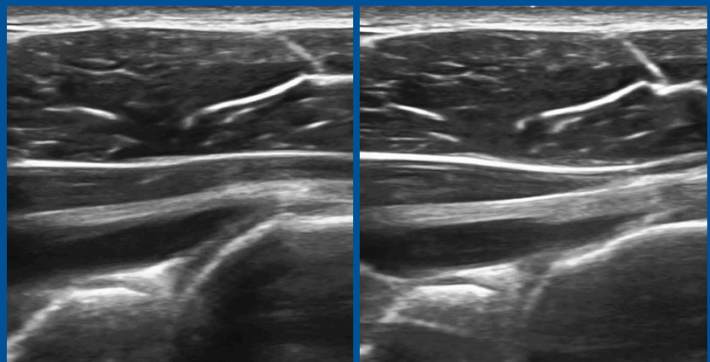
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Posterior Shoulder – Glenohumeral Joint

Glenohumeral Joint Effusion



Normal Posterior GH Joint

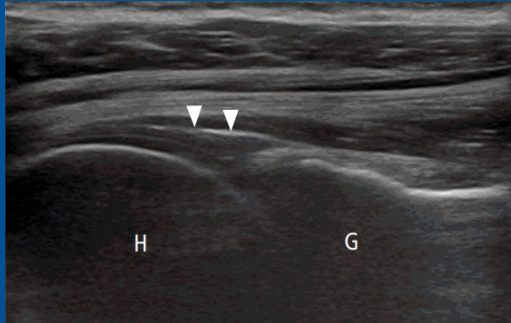


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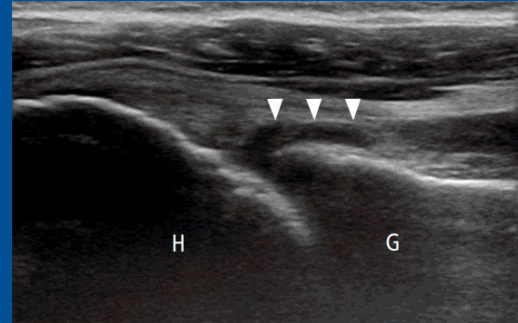
Posterior Shoulder – Glenohumeral Joint

Glenohumeral Joint Effusion

Neutral

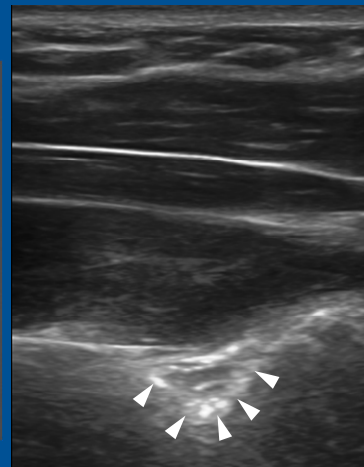


External Rotation



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Posterior Shoulder – Spinoglenoid Notch

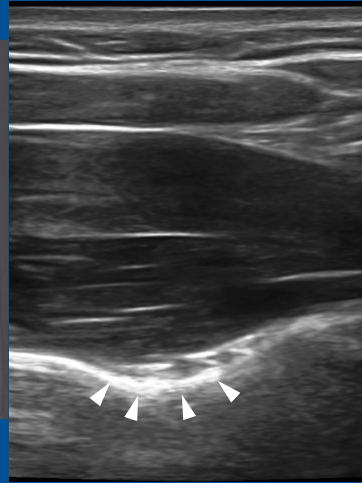
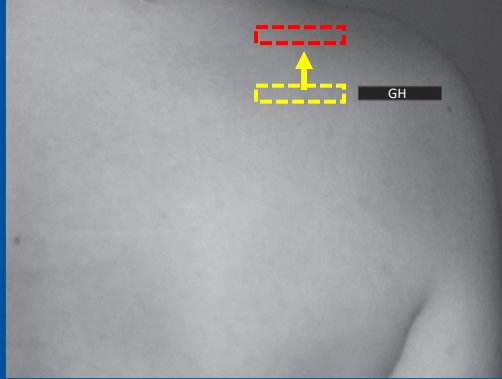


Glide directly medial from posterior glenohumeral joint position

◀ = Spinoglenoid Notch

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Posterior Shoulder – Suprascapular Notch



Glide directly superior from spinoglenoid notch position over the spine of the scapula

*Note that this is a deeper structure and in order to see it, your depth may need to be increased

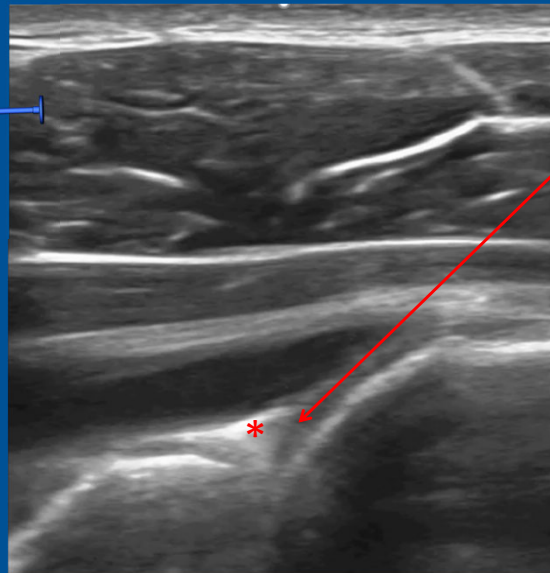
◀ = Suprascapular Notch

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Glenohumeral Joint Injections

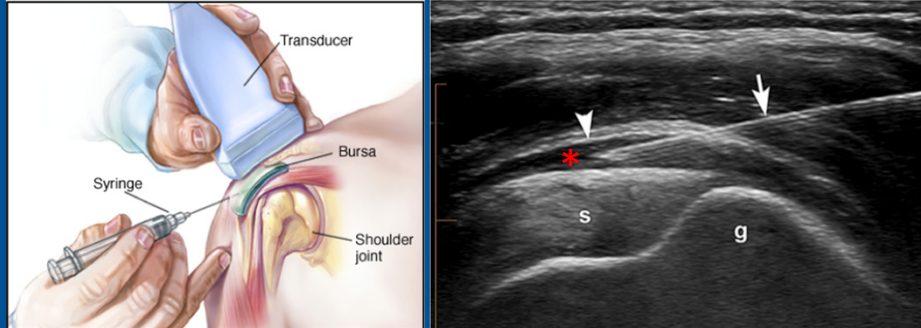


- Lateral to medial approach posteriorly
- Aiming for just below the posterior labrum (*)



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Subacromial/Subdeltoid Bursa Injections



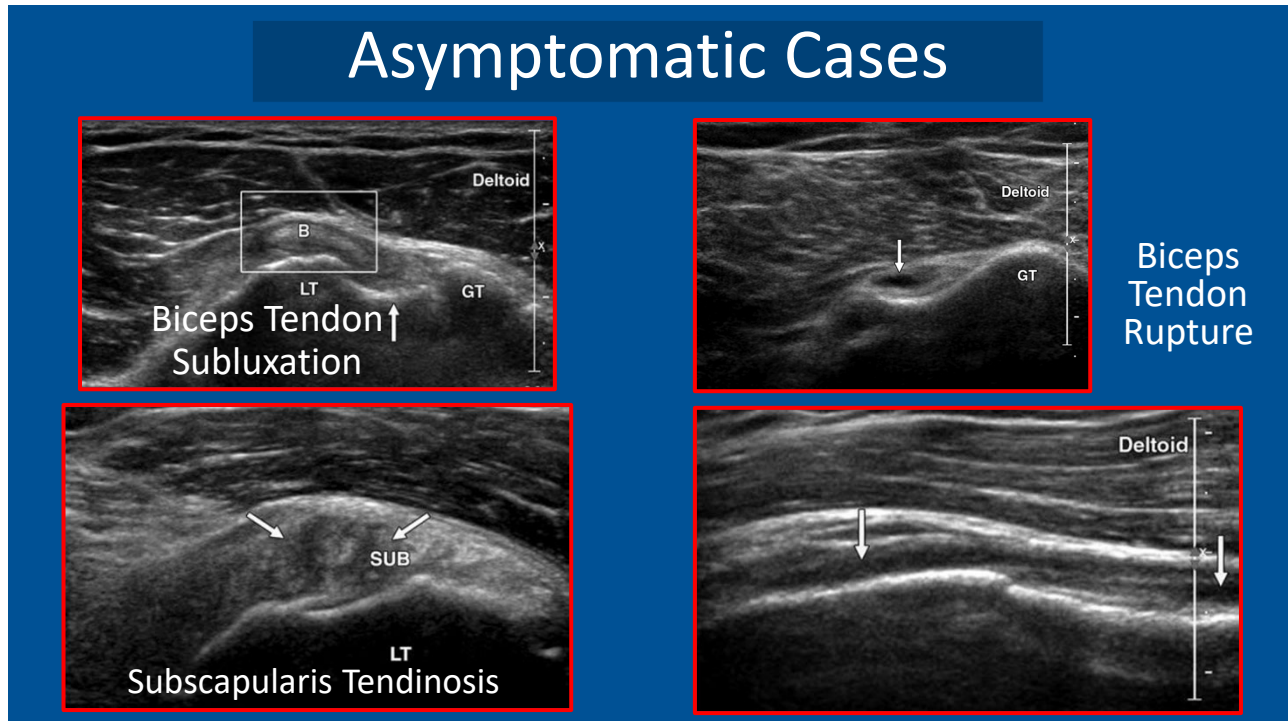
- Lateral to medial approach
 - Aiming for bursa (*) between Supraspinatus tendon (S) and subdeltoid fat (▲)
 - ↙ = Needle
 - g = Greater tuberosity of humerus

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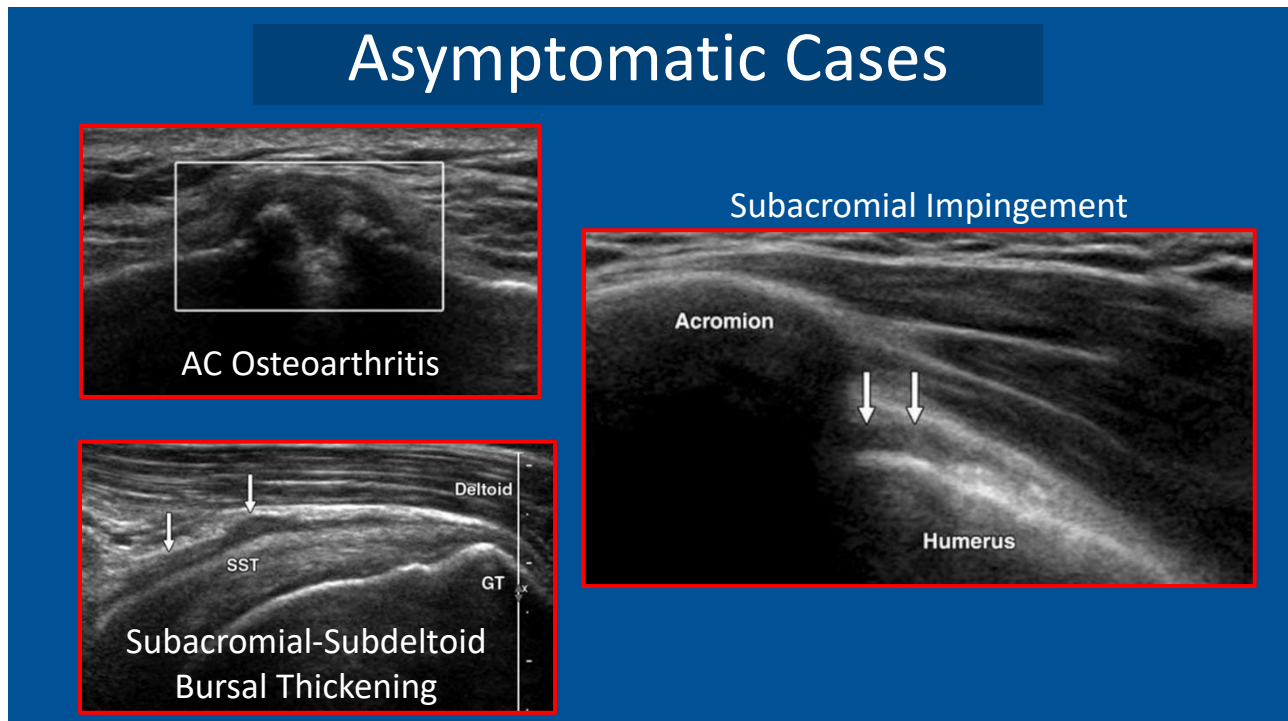
Asymptomatic Ultrasound Findings

- Study Published in 2011 in the American Journal of Radiology
 - **96%** of men scanned (ages 40-70) showed some asymptomatic positive finding on ultrasound
 - Most common asymptomatic findings
 - Subacromial-subdeltoid bursal thickening: **78%**
 - Acromioclavicular Osteoarthritis: **65%**
 - Supraspinatus tendinosis: **39%**
 - Subscapularis tendinosis: **25%**
 - Supraspinatus partial thickness tear: **22%**
 - Posterior glenoid abnormality: **14%**

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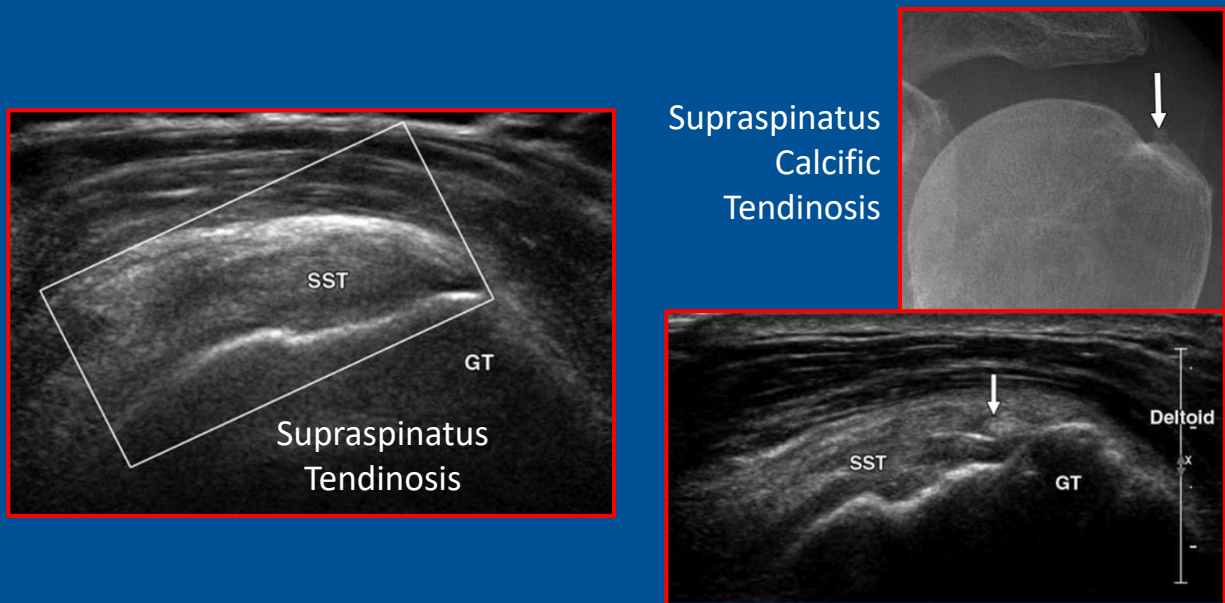


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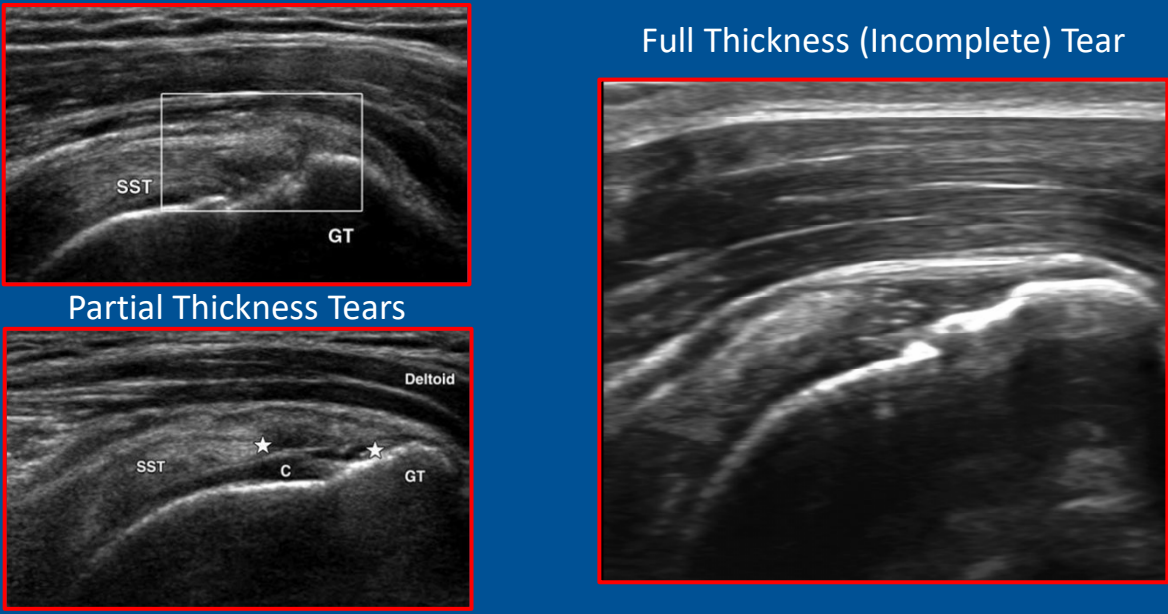
Asymptomatic Cases



The slide displays three images related to asymptomatic supraspinatus calcific tendinosis. On the left, a large ultrasound image shows a cross-section of the supraspinatus tendon (SST) and the greater tuberosity (GT). A white box highlights the SST, and the text 'Supraspinatus Tendinosis' is written below it. To the right, a smaller ultrasound image shows a similar view with a white arrow pointing to a bright echogenic area within the SST, and the text 'Supraspinatus Calcific Tendinosis' is written above it. A vertical scale bar labeled 'Deltoid' is on the right side of this image. Above the smaller ultrasound image is a radiographic image of the shoulder, with a white arrow pointing to a bright white area representing calcification in the supraspinatus tendon.

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Asymptomatic Cases

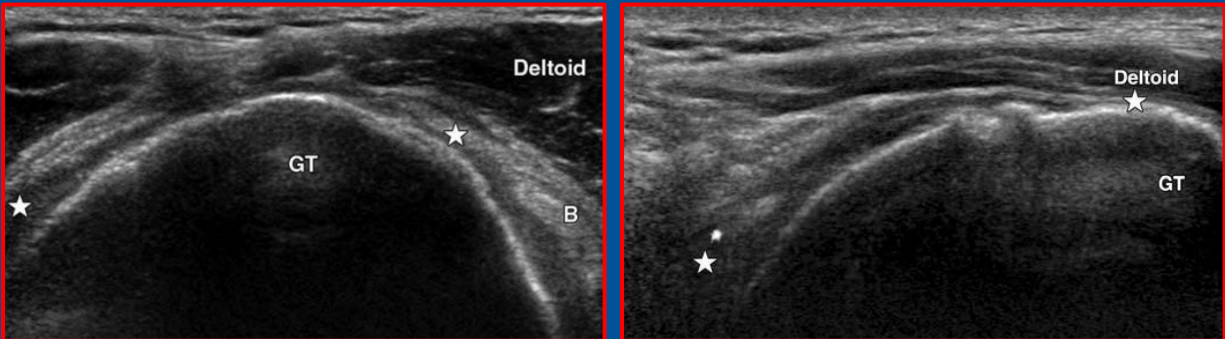


The slide displays three ultrasound images related to asymptomatic tears. On the left, a large ultrasound image shows a cross-section of the SST and GT. A white box highlights the SST, and the text 'Partial Thickness Tears' is written below it. Below this is another ultrasound image showing a similar view with two white stars marking the tear sites, and the text 'Deltoid', 'SST', 'C', and 'GT' are labeled. On the right, a large ultrasound image shows a cross-section of the SST and GT with a white arrow pointing to a full thickness (incomplete) tear, and the text 'Full Thickness (Incomplete) Tear' is written above it.

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Asymptomatic Cases

Full Thickness (Complete) Tear



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Asymptomatic Ultrasound Findings

- Study Published in 2017 in the Journal of Physical Therapy Science
 - Looked at asymptomatic shoulders in women 19-56 years old
 - Most common asymptomatic findings
 - Rotator Cuff Calcific Tendinosis: **15%**
 - Humeral head geodes (subcortical cysts): **6%**
 - Lack of tendon uniformity: **6%**
 - Rotator Cuff Tendinosis: **5%**
 - Acromioclavicular osteoarthritis: **1%**
 - Subacromial-subdeltoid bursal distension: **0.5%**
 - Hill-Sachs lesion: **0.5%**
 - This study excluded any subject who performed repetitive arm movements or carried heavy loads in their occupations

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Asymptomatic Ultrasound Findings

- Study Published in 2007 in the South African Journal of Sports Medicine
 - 54% of patients scanned for a suspected rotator cuff tear had an asymptomatic tear on the contralateral shoulder

TABLE I. Percentage with tears in asymptomatic shoulder for each age group

Age group (years)	Percentage
40 - 59 (20 patients)	35
60 - 69 (13 patients)	54
70 - 83 (17 patients)	77

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When Are Findings Likely To Matter?

- Study Published in 2007 in the South African Journal of Sports Medicine
 - Significant % of other positive findings

TABLE IV. Number of other imaging findings (N = 50)

Imaging findings	Both shoulders	Only symptomatic shoulder
Biceps tendinopathy	26% 13	24
SASD bursitis	76% 38	11
Glenohumeral joint effusion	22% 11	24

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When Are Findings Likely To Matter?

- Study Published in 2007 in the South African Journal of Sports Medicine
 - Symptomatic tears were significantly larger in width and length

TABLE II. Size of tears in symptomatic and asymptomatic shoulders

Size of tears (mm)	Symptomatic shoulder (N = 27)	Asymptomatic shoulder (N = 27)	Wilcoxon's p-value
Mean width	16.70	3.44	0.0113
Standard deviation of width	9.59	11.30	
Minimum width	2.00	2.00	
Maximum width	40.00	40.00	
Mean length	18.19	15.33	0.0487
Standard deviation of length	10.70	10.24	
Minimum length	2.00	3.00	
Maximum length	36.00	32.00	

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When Are Findings Likely To Matter?

- Study Published in 2007 in the South African Journal of Sports Medicine
 - Symptomatic tears were more likely to show supraspinatus atrophy

TABLE III. AP dimensions of the supraspinatus muscle (N = 49) and fat (N = 50) between the supraspinatus and trapezius muscles

AP dimensions (mm)	Symptomatic shoulder	Asymptomatic shoulder	Wilcoxon's p-value
Mean supraspinatus	18.90	20.47	0.0001
Standard deviation of supraspinatus	4.36	4.58	
Minimum supraspinatus	6.00	8.00	
Maximum supraspinatus	27.00	29.00	
Mean fat	6.92	5.32	0.0002
Standard deviation of fat	2.57	2.49	
Minimum fat	0	0	
Maximum fat	14.00	11.00	

- Suggests that chronic tears are more likely to be symptomatic

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Asymptomatic Ultrasound Findings

- Study Published in 2007 in the South African Journal of Sports Medicine
 - Having more findings was linked to having symptoms

TABLE VI. Number of other findings per shoulder

Findings	0	1	2	3	4	5
Symptomatic	0	0	0	7	15	28
Asymptomatic	5	1	17	15	5	7

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Take Home Points

- Rotator Cuff well visualized with ultrasound
 - And much more!
 - Labrum, not so much
- High Percentage of asymptomatic shoulders will show pathology
 - Positive findings increase with age
 - Larger rotator cuff tears tend to be more symptomatic
 - The more findings you have the greater the likelihood of symptoms
 - Supraspinatus tears with atrophy are more likely to be symptomatic
 - Look for Biceps tendinopathy and glenohumeral effusions (posteriorly in ER) as positive predictors of glenohumeral dysfunction
- Check contralateral side for comparison, but don't be surprised if it's also abnormal

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Thank You!



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