

Advanced Shoulder Ultrasound

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Disclosures

- Consultant: Bioclinica
- Advisor: Philips
- Book Royalties: Elsevier
- Not relevant to this lecture

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Fundamentals of Musculoskeletal Ultrasound are
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Outline:

- Rotator cuff tears:
 - Primary and secondary signs
 - Pitfalls
- Miscellaneous pitfalls

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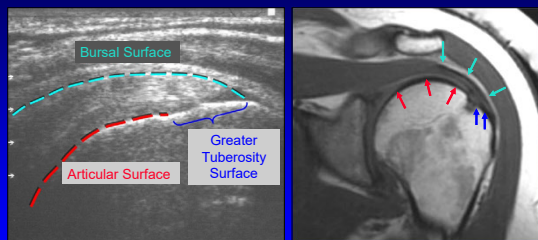
Rotator Cuff Tears

- Tears are hypoechoic / anechoic
- Indirect signs at ultrasound:
 - Cortical irregularity: supraspinatus footprint
 - If present on radiographs, 75% have tear
 - Volume loss
- Massive tear: non-visualization

AJR 1998; 171:229
Radiology 2004; 230:234

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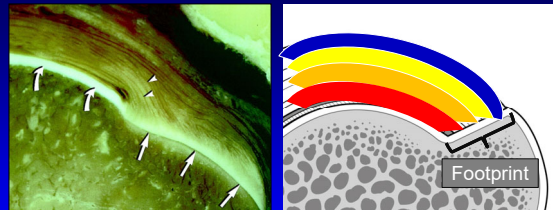
Supraspinatus: normal



Long Axis

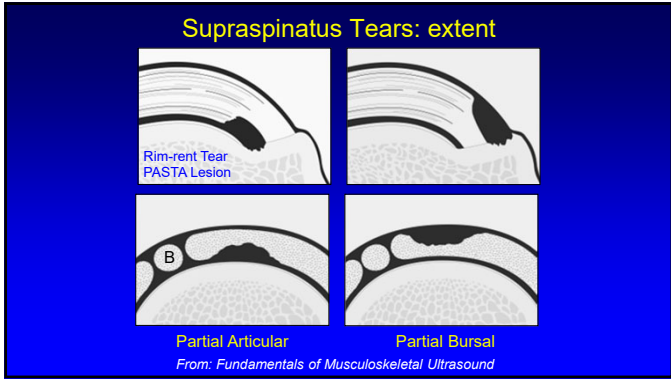
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Supraspinatus Insertion

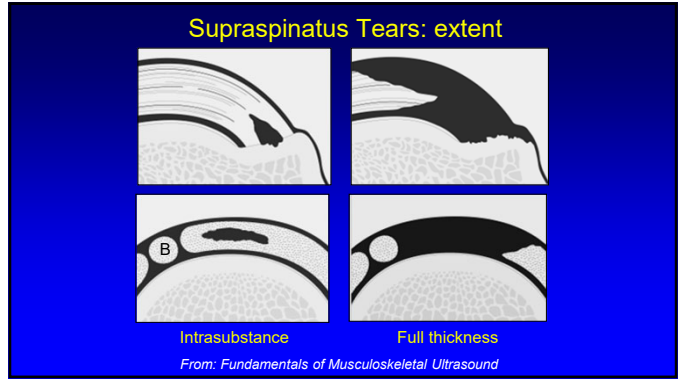


From: Siebold et al.
RadioGraphics
1999; 19:685

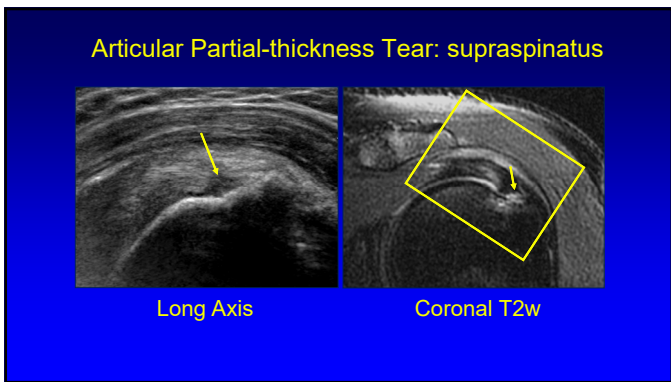
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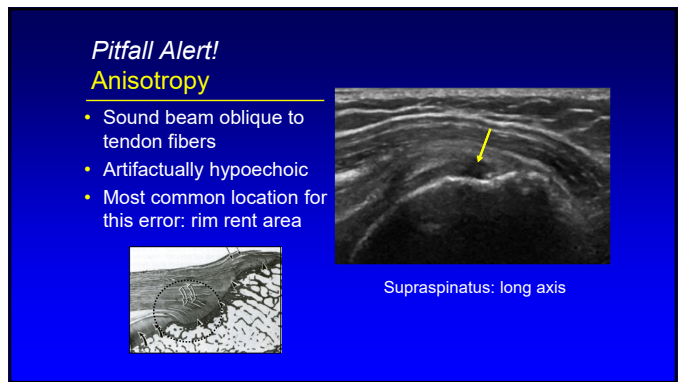
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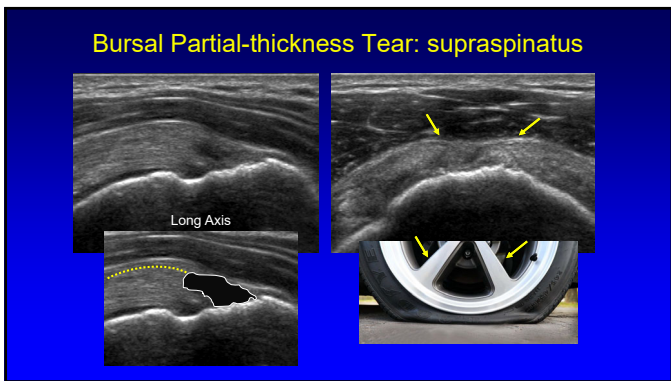
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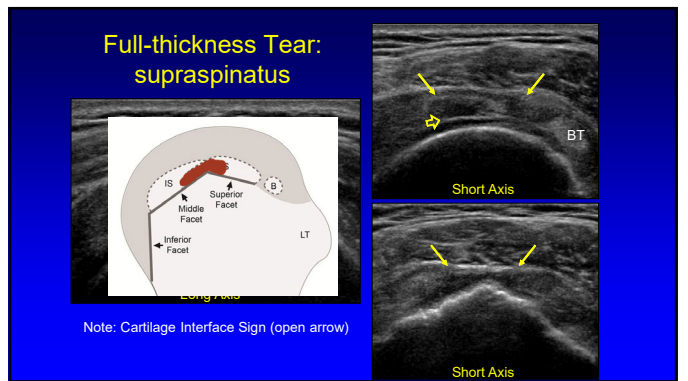
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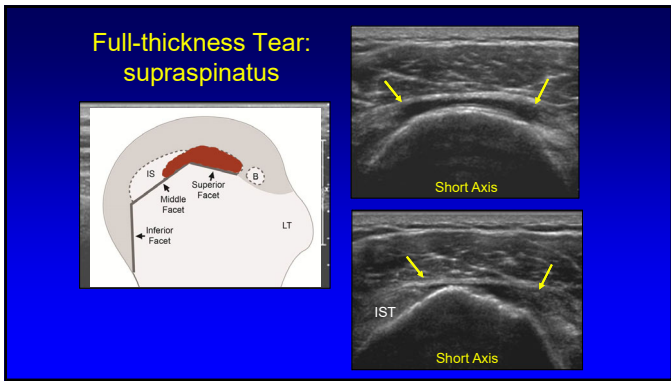
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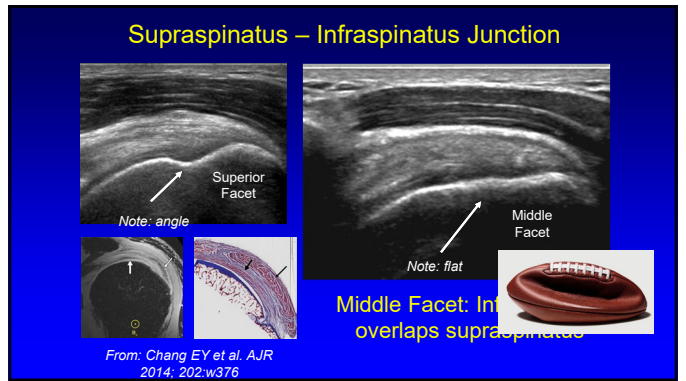
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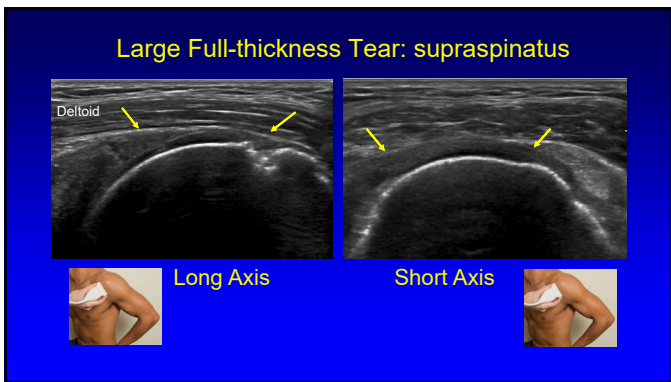
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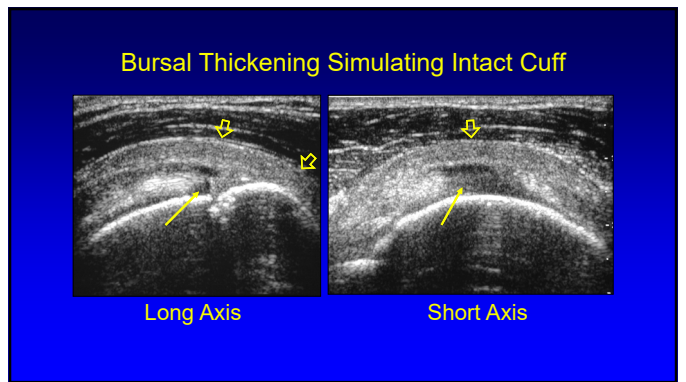
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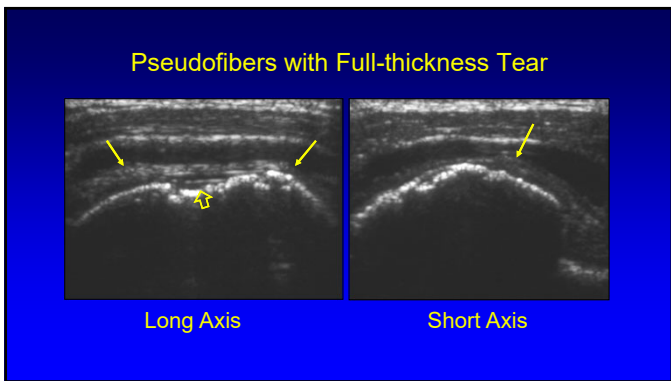
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Tendinosis

- No inflammatory cells
 - Mucoid degeneration, chondroid metaplasia
- Hypochoic, ill-defined
- Possible increased thickness
- No cortical irregularity*

From: Wilson JJ, et al. Am Fam Physician; 2005. 32:165

From: Hodler J, et al. J MRI; 2010. 72:811

*Radiology 2004; 230:234

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Tendon Tear versus Tendinosis

**both may appear hypoechoic*

<u>Tear</u>	<u>Tendinosis</u>
• Anechoic	• Hypoechoic
• Well-defined	• Ill-defined
• Homogeneous	• Heterogeneous
• Thinned	• Swollen
• Bone irregularity*	• Smooth cortex

*At supraspinatus tendon footprint in patients over 40 years old

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Tendinosis: supraspinatus tendon

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Fatty Infiltration and Muscle Atrophy

- Supraspinatus and infraspinatus
 - Infraspinatus: only variable to predict cuff healing¹
- Associations:
 - Chronic, large, anterior supraspinatus tears²
- Ultrasound:
 - Comparable to MRI³
 - Improved reliability with extended field-of-view⁴

¹Chung et al. Am J Sports Med 2013; 41:16764
²Hodler et al. Radiology 2005; 237:584.
³Wall LB et al. JBJS 2012; 94:e83.
⁴Nazarian et al. 2008; 190:27.

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Fatty Infiltration and Muscle Atrophy

- Indistinct tendon-muscle border
- Increased muscle echogenicity
 - Compare to teres minor
- Decreased muscle bulk
 - Compared to teres minor
 - Bone landmark: ridge in scapula
 - Short axis: infraspinatus 2x size

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Atrophy: supraspinatus and infraspinatus

Normal

Short Axis (extended field-of-view)

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Rotator Cuff Tears:

- General comments
- Secondary signs of rotator cuff tear
- Pitfalls in rotator cuff sonography

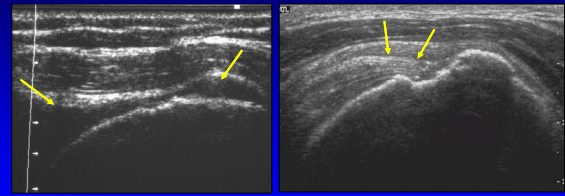
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Secondary Findings of Rotator Cuff Tears:

- Volume loss of tendon substance
- Cortical irregularity
- Effusion (articular & bursal)
- Cartilage interface sign

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Tendon Volume Loss



Full-thickness

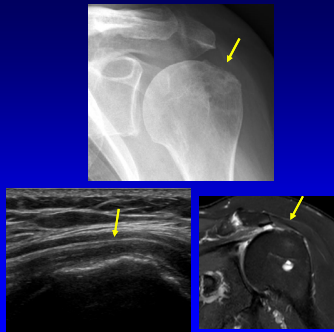
Bursal Partial-thickness

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Cortical Irregularity:

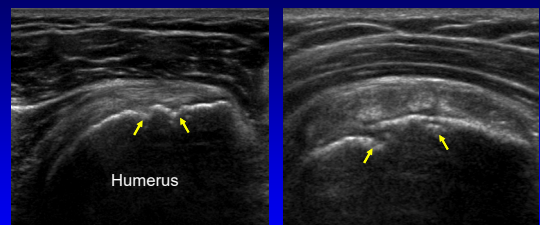
- Greater tuberosity: at **supraspinatus** insertion
- When present: 75% have rotator cuff tears
 - Patient over 40 years old
- When absent: 96% normal cuffs by sonography

AJR 1998; 171:229
Radiology 2004; 230:234



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Cortical Irregularity: no significance



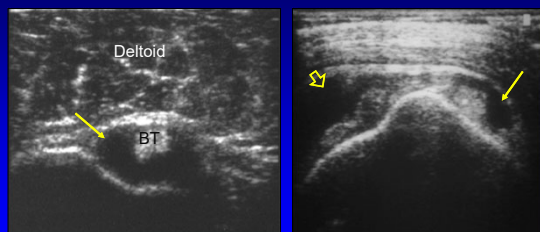
Long Axis

Short Axis

Subscapularis Tendon

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Joint Effusion and Bursal Fluid

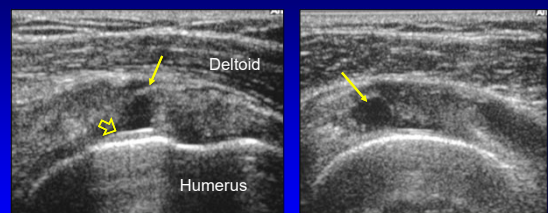


Short Axis

Long Axis

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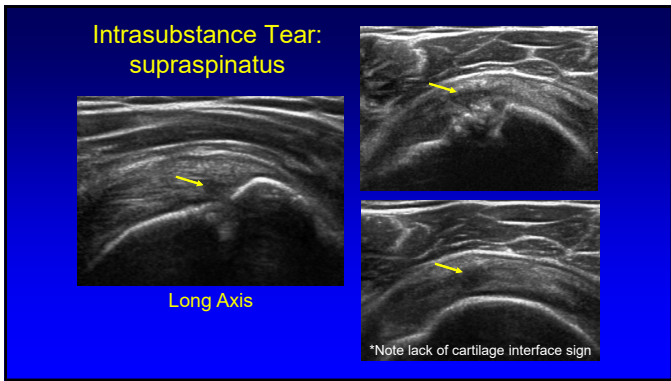
Small Full-thickness Tear: supraspinatus



Long Axis

Short Axis

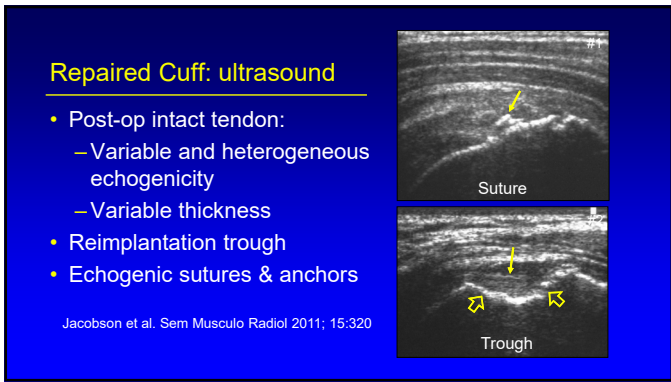
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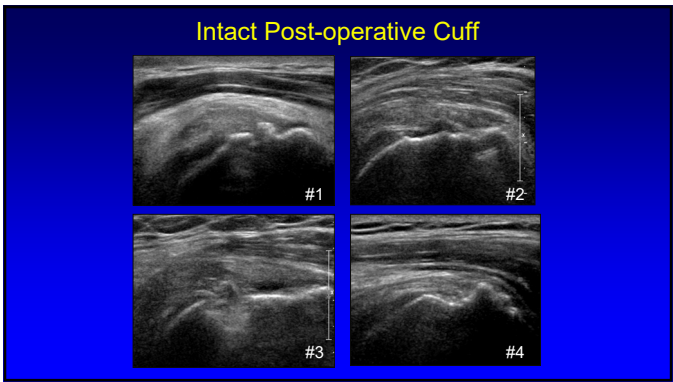
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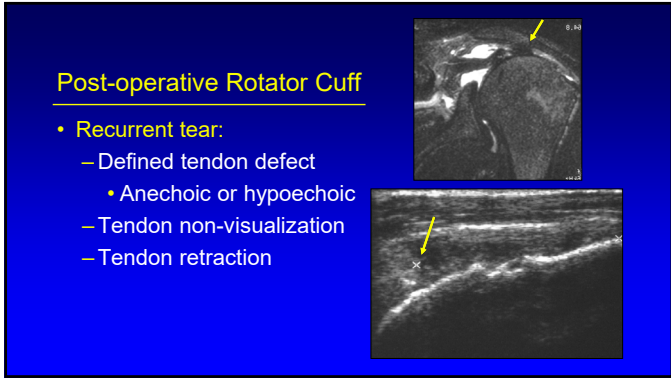
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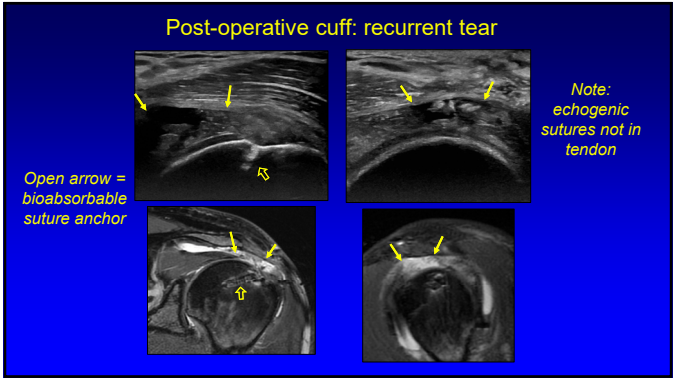
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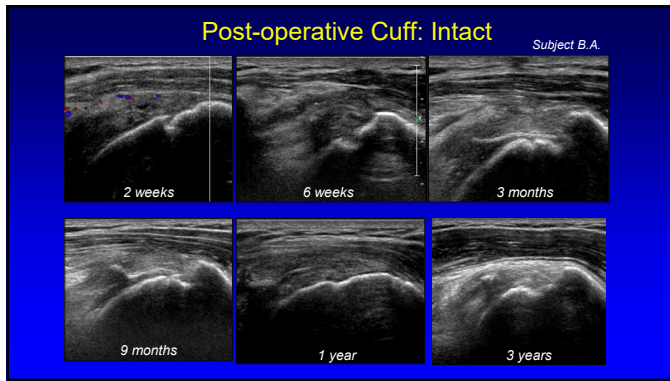
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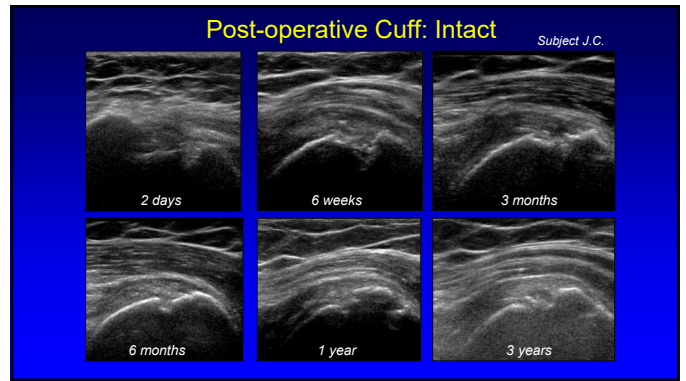
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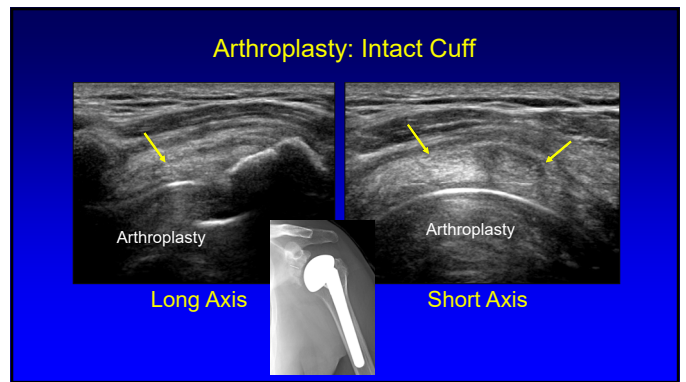
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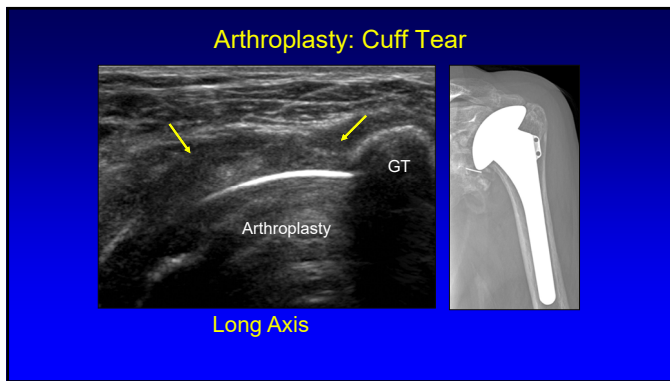
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- Rotator Cuff Repair:**
- Most recurrent tears: within 3 months
 - Tendons start to look "normal" by 6 to 9 months
 - Focal defects are equivocal, may be post-surgical, may disappear
 - Recurrent tears tend to be larger or get larger
 - If unsure, get follow-up scan

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- Miscellaneous Pathology**
- Post-operative shoulder
 - Non-cuff pitfalls
 - Pectoralis major tear

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Biceps Tendon:

- Glenohumeral joint effusion:
 - Collects around biceps tendon
 - Tendon sheath communication
 - Seen in 97% with joint effusion
 - Abnormal: > 1 mm¹

¹Zubler et al. Eur Radiol 2011; 21:1858

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Shoulder Joint Recesses

- Long head biceps tendon sheath
- Posterior recess:
 - Image with shoulder in external rotation
- Axillary recess
- Subscapularis recess

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Subacromial-subdeltoid bursa (SASD) vs. subscapularis recess (SSR) vs. subcoracoid bursa (SCB)

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Subscapularis Recess

*Note redistribution of joint fluid with internal and external shoulder rotation

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Subcoracoid Bursa

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Inflammatory Tenosynovitis: biceps tendon

Long Axis

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Biceps Tendon:

- Partial-thickness tear:
 - Hypoechoic /anechoic cleft
 - Tenosynovitis
 - Sensitivity: 27%
 - Accuracy: 88%
 - **Subluxation / spur**
 - Important secondary signs

Skendzel J, et al. AJR 2011; 197:942

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Aponeurotic Expansion of Supraspinatus Tendon

- Up to 49% of shoulders
- Cleft: coronal plane
- Origin: supraspinatus
- Distal: pectoralis or bicipital groove

Moser et al. Skeletal Rad 2015; 44:223

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Pitfall Alert! Pseudo Biceps Tendon

- Biceps brachii long head
- Complete retracted tear
- Visible "fibers" in groove
 - Collapsed tendon sheath
 - Aponeurotic expansion of supraspinatus
- Look for distal retracted tendon and absent tendon in rotator interval
 - SST

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Biceps Tendon Dislocation

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Large Full-thickness Tear: geyser sign

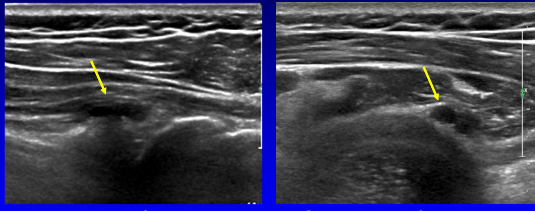
Long Axis Coronal T1w

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Post-traumatic Osteolysis of the Clavicle

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Labral Tear and Labral Cyst



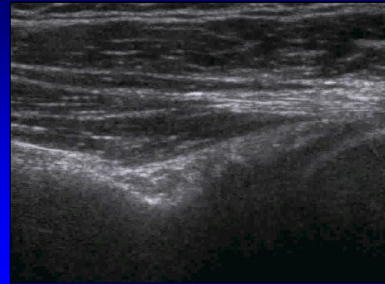
Long Axis: infraspinatus

Short Axis: infraspinatus

*Note: non-compressible

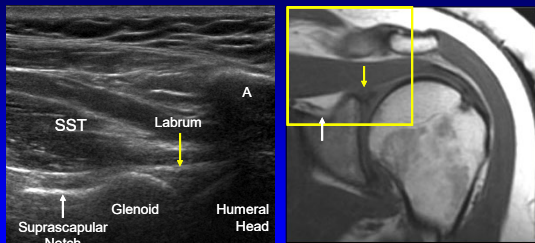
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Pitfall: suprascapular vein dilation



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Suprascapular Notch and Superior Labrum



Coronal Plane

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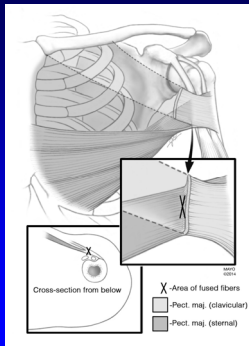
Miscellaneous Pathology

- Post-operative shoulder
- Non-cuff pitfalls
- Pectoralis major tear

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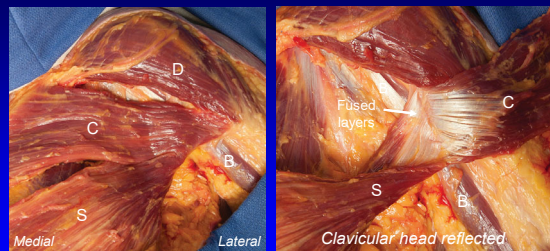
Pectoralis Major

- Clavicular head:
 - Forms anterior layer
- Sternal head:
 - Forms posterior layer and inferior aspect of anterior layer
- Each layer: 2 mm thick
- “U” shaped
- Fuses 11 mm proximal to insertion



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Pectoralis Major



S = sternal head; C = clavicular head
D = deltoid; B = biceps brachii

Chievaras MM et al.
Skeletal Radiol
2015; 44:157

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Pectoralis Major: ultrasound

- Begin short axis over bicipital groove
- Identify biceps brachii long head
- Scan inferior to identify pectoralis major tendon superficial to biceps tendon

Curved arrow = anterior layer
 Straight arrow = posterior layer
 S = sternal head
 C = clavicular head
 B = biceps brachii long head
 H = humerus
 (Right side of image = lateral)

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Pectoralis Major: short axis (sagittal plane)

S = sternal and C = clavicular heads; Arrowheads: sternal head tendons
 Curved arrow = anterior layer; Straight arrow = posterior layer

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Pectoralis Major: ultrasound

- Distal tendon: short axis (sagittal)
- Fused anterior and posterior layers
- Identified over biceps brachii tendon

Arrowheads: fused anterior and posterior layers
 B = biceps brachii long head
 H = humerus
 (Right side of image = inferior)

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Pectoralis Tear: imaging findings

- **Full-thickness** (anterior + posterior layers):
 - Retracted tendon + hemorrhage over coracobrachialis / short head biceps
 - No tendon over biceps brachii long head
 - Fluid/edema at humerus
 - Anterior displacement of biceps brachii tendon

Connell DA, et al. Radiology 1999;210:785
 Weaver JS, et al. J Ultrasound Med 2005;24:25

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Case 1: full-thickness, full-width tear

Curved arrow = torn and retracted pectoralis major
 * = short head biceps brachii + coracobrachialis
 Arrowhead = biceps brachii long head; D = deltoid

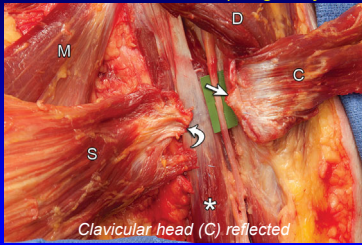
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Pectoralis Tear: imaging findings

- **Partial thickness**
 - Posterior layer torn (sternal head)
 - Medial to fused anterior / posterior layers
 - Intact tendon superficial to biceps long head (fused anterior + posterior layers)
 - Fluid: musculotendinous junction or deltopectoral groove
 - Intact clavicular head

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Case 3: partial-thickness, full-width sternal head tear (surgically created)

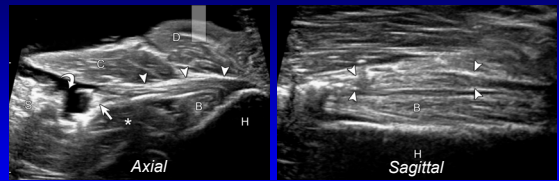


Curved arrow = torn sternal head (S); Arrow = posterior layer
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 M = pectoralis minor; D = deltoid

Chiavaras MM et al. Skeletal Radiol 2015; 44:1157

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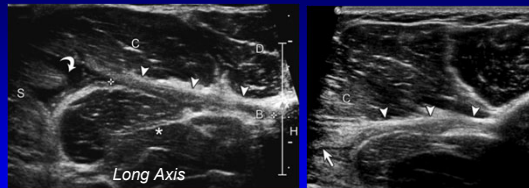
Case 3: partial-thickness, full-width sternal head tear (surgically created)



Curved arrow = torn sternal head (S); Arrow = posterior layer
Note: intact fused anterior and posterior layers (arrowheads) over biceps brachii long head tendon (B)
 * = short head biceps brachii + coracobrachialis
 D = deltoid; H = humerus

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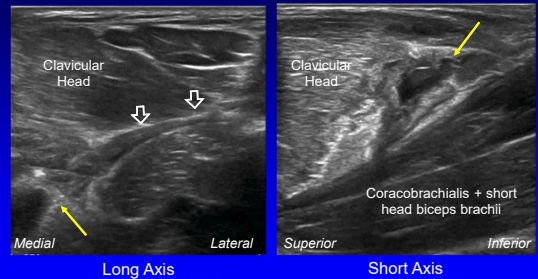
Case 4: partial-thickness, full-width sternal head tear



Curved arrow = torn sternal head (S)
Note: intact fused anterior and posterior layers (arrowheads) over biceps brachii long head tendon (B)
 * = short head biceps brachii + coracobrachialis
 C = clavicular head; D = deltoid; H = humerus

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Case 5: partial-thickness, full-width sternal head tear (arrow)



Note: intact fused anterior and posterior layers (open arrows)

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Take-home Points

- Rotator cuff pitfalls:
 - Partial articular: focal anisotropy
 - Partial bursal: SA-SD bursal thickening
 - Full-thickness: extent, chronic tear
- Secondary signs of cuff tear:
 - Cortical irregularity (SST), thinning, cartilage interface
- Post-op cuff: 6 – 9 months
- Pectoralis major: partial, sternal, musculotendinous

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Thank you!



Syllabus on line and other educational material:
www.jacobsonmuskus.com



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