

# Ultrasound Evaluation of Shoulder Pathology

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## Disclosures

- Consultant: Bioclinica
- Contractor: POCUS PRO
- 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 pathology

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## Rotator Cuff Tears:

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

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## Rotator Cuff Tear:

- Meta-analysis: 65 articles
- Full-thickness tears:
  - MRA, MRI, US = in sensitivity (92 – 95%)
  - MRA more specific
- Partial-thickness tears:
  - MRA most sensitive (86%) and specific
  - MRI (64%), US (67%)

de Jesus, 2009; 192:1701

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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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### Rotator Cuff Tears:

- Patients < 40 years old
  - Not common
  - Partial, articular, anterior
  - Associated labral pathology
- Degenerative tears
  - Posterior aspect of supraspinatus
  - May extend anterior or posterior

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### Supraspinatus: normal

Note: bone landmarks for orientation

Long Axis

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### Supraspinatus Insertion

Footprint

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

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### Rotator Cuff Abnormalities:

Categories:

- Partial-thickness tear
  - Articular-sided
  - Bursal-sided
  - Intrasubstance (or interstitial)
- Full-thickness tear
- Tendinosis

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### Supraspinatus Tears: extent

Rim-vent Tear, PASTA lesion

Partial Articular Partial Bursal

From: Fundamentals of Musculoskeletal Ultrasound

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### Supraspinatus Tears: extent

Intrasubstance Full thickness

From: Fundamentals of Musculoskeletal Ultrasound

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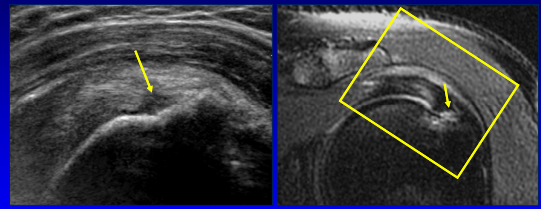
### Partial-thickness Tear:

- Usually hypoechoic / anechoic
  - May see hyperechoic fiber stump\*
- Articular, bursal, or intrasubstance
- Associated cortical irregularity
- Little if any tendon volume loss
  - Unless bursal location

van Holsbeeck et al. Radiology 1995; 197:443

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### Articular Partial-thickness Tear: supraspinatus



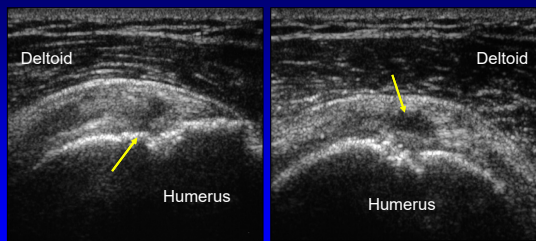
Long Axis

Note: US and MRI have inverted appearance

Coronal T2w

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### Articular Partial-thickness Tear: supraspinatus



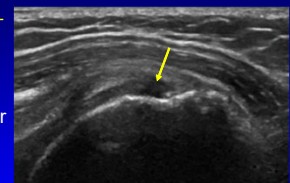
Long Axis

Short Axis

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### Pitfall Alert! Anisotropy

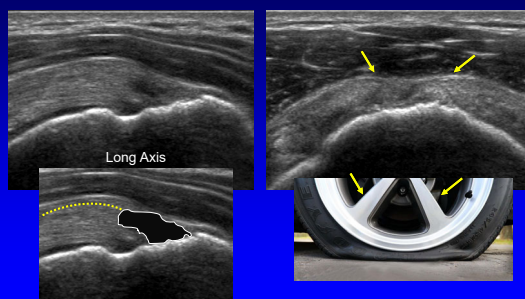
- Sound beam oblique to tendon fibers
- Artificially hypoechoic
- Most common location for this error: rim rent area



Supraspinatus: long axis

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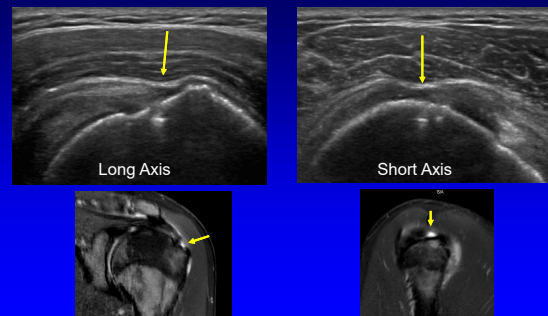
### Bursal Partial-thickness Tear: supraspinatus



Long Axis

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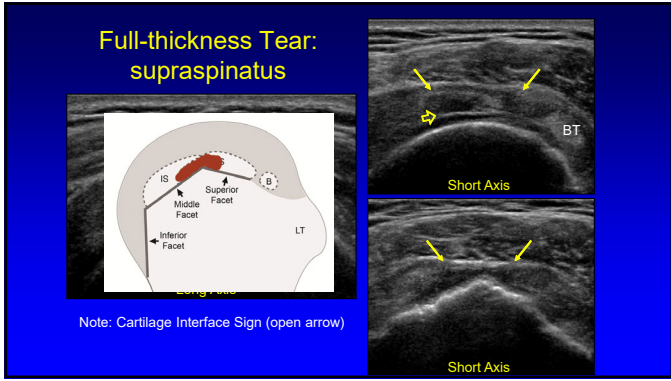
### Bursal Partial-thickness Tear: supraspinatus



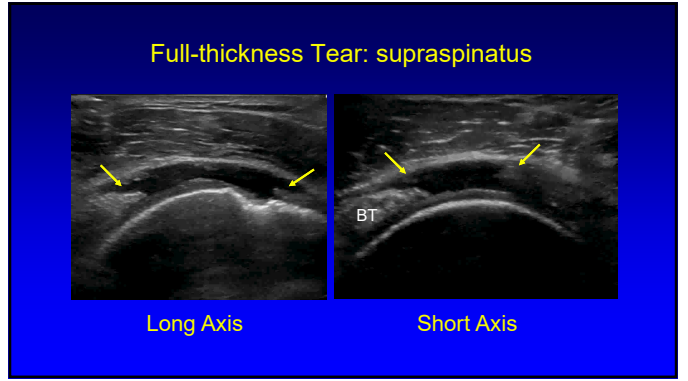
Long Axis

Short Axis

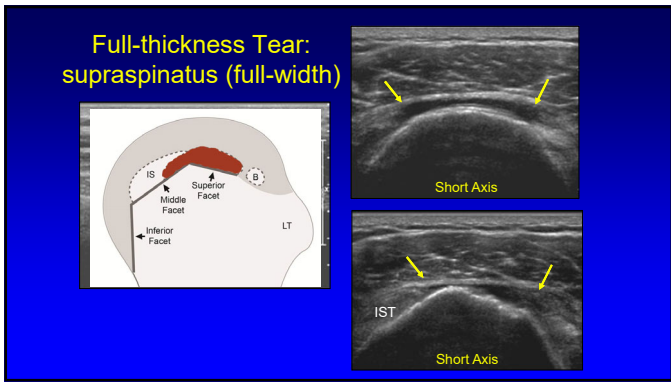
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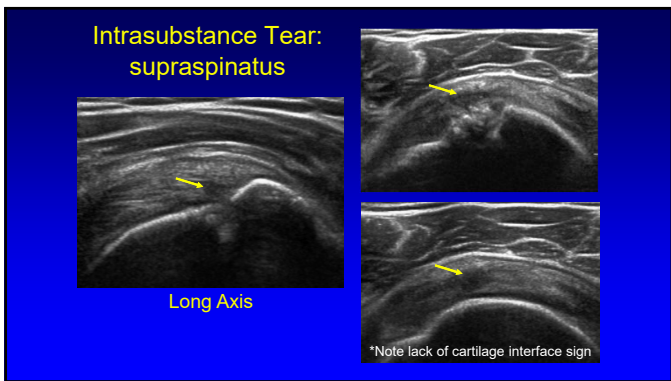
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- ### Intra-substance Tear:
- Hypoechoic or anechoic
  - Well defined
  - Does not extend to articular or bursal surface
    - Isolated greater tuberosity extension

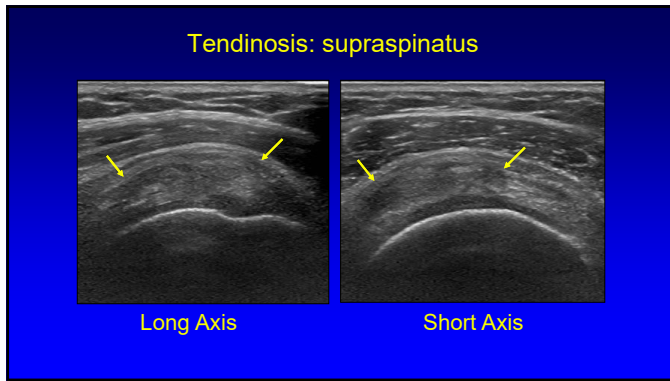
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- ### Tendinosis
- No inflammatory cells
    - Mucoïd degeneration, chondroid metaplasia
  - Hypoechoic, ill-defined
  - Possible increased thickness
  - No cortical irregularity\*
- From: Hodler J, et al. J MRI; 2010; 32:165
- 
- \*Radiology 2004; 230:234

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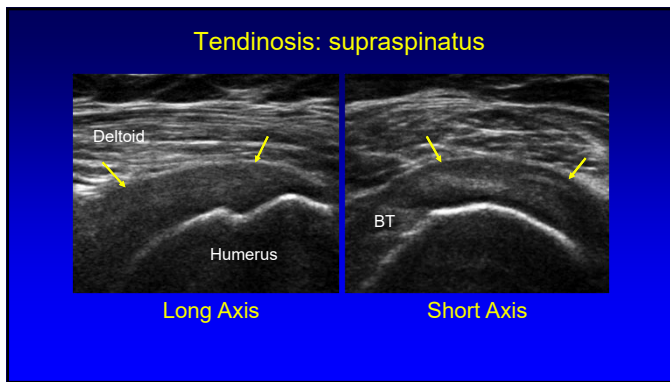
### Tendon Tear versus Tendinosis

*\*both may appear hypoechoic*

Tear	Tendinosis
<ul style="list-style-type: none"> <li>• Anechoic</li> <li>• Well-defined</li> <li>• Homogeneous</li> <li>• Thinned</li> <li>• <b>Bone irregularity*</b></li> </ul>	<ul style="list-style-type: none"> <li>• Hypoechoic</li> <li>• Ill-defined</li> <li>• Heterogeneous</li> <li>• Swollen</li> <li>• Smooth cortex</li> </ul>

\*At supraspinatus tendon footprint in patients over 40 years old

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### Fatty Infiltration and Muscle Atrophy

- Supraspinatus and infraspinatus
  - Infraspinatus: only variable to predict cuff healing<sup>1</sup>
- Associations:
  - Chronic, large, anterior supraspinatus tears<sup>2</sup>
- Ultrasound:
  - Moderate to good correlation with MRI<sup>3</sup>
  - Improved reliability with extended field-of-view<sup>4</sup>

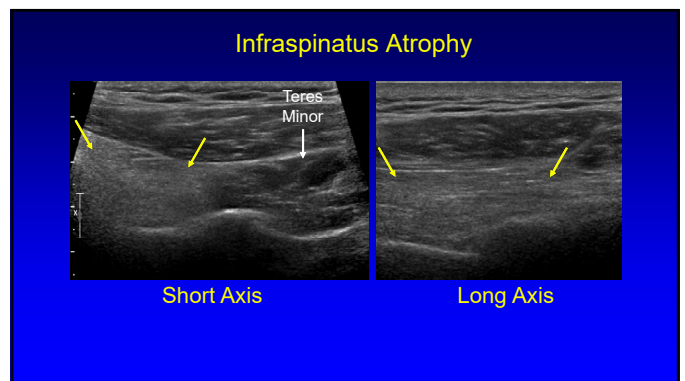
<sup>1</sup>Chung et al. Am J Sports Med; 2013; 41:16764  
<sup>2</sup>Hodler et al. Radiology 2005; 237:584.  
<sup>3</sup>Khoury et al. AJR 2008; 190:1105.  
<sup>4</sup>Nazarian et al. 2008; 190:27.

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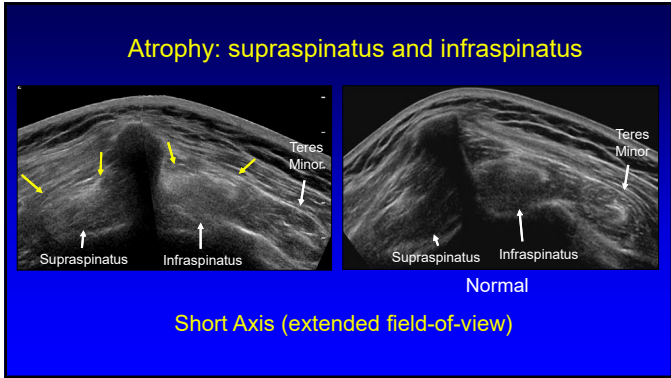
### Fatty Infiltration and Muscle Atrophy

- 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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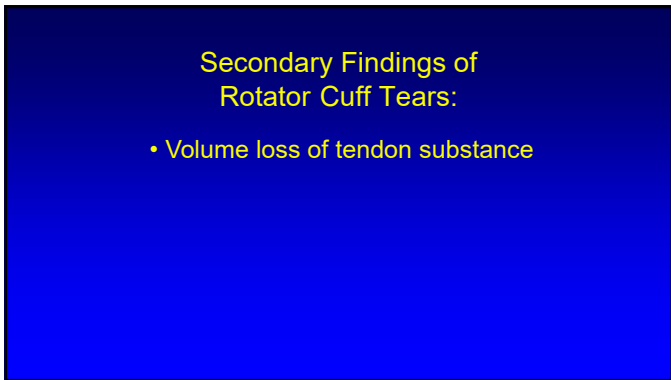
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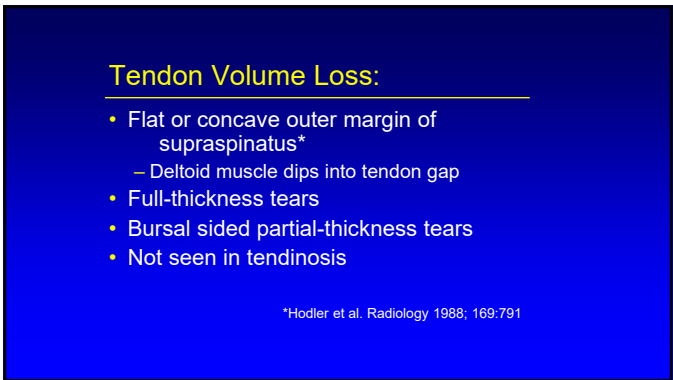
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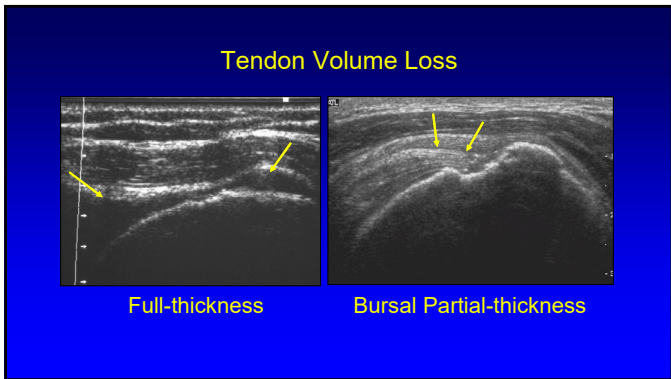
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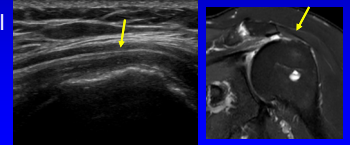
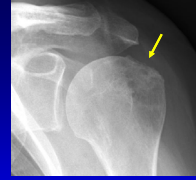
### Secondary Findings of Rotator Cuff Tears:

- Volume loss of tendon substance
- Cortical irregularity

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### Cortical Irregularity:

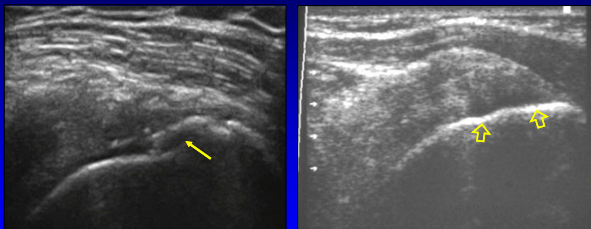
- Greater tuberosity: at **supraspinatus** insertion
- When present: 75% have rotator cuff tears
  - Patient over 40 years old
- When absent: 96% normal cuffs by sonography



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

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### Tendon Tear: cortical irregularity

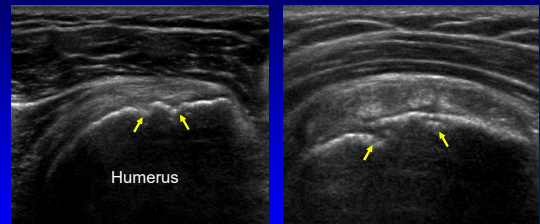


Full-thickness Tear

Tendinosis

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### Cortical Irregularity: no significance



Long Axis

Short Axis

Subscapularis Tendon

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### Secondary Findings of Rotator Cuff Tears:

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

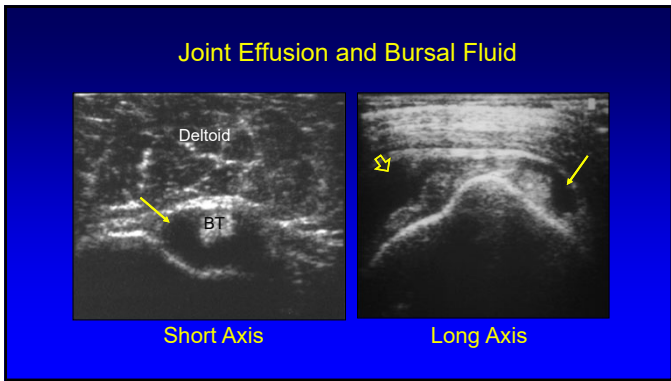
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### Joint & Bursal Effusions:

- Joint effusion (biceps tendon)
- Subacromial-subdeltoid bursal fluid: >1 mm distention
- If both: 95% positive predictive value for rotator cuff tear\*

\*Hollister et al. AJR 1995; 165:605

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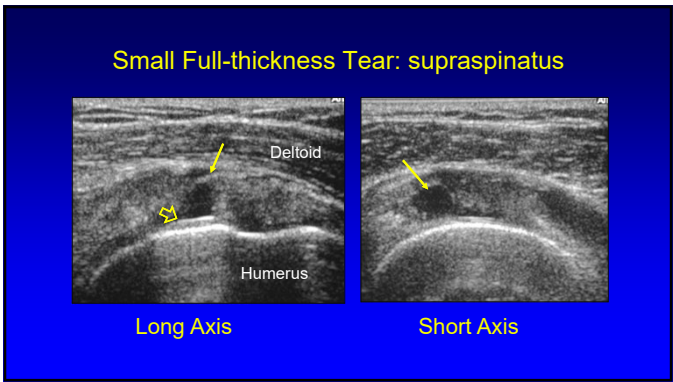
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- ### Secondary Findings of Rotator Cuff Tears:
- Volume loss of tendon substance
  - Cortical irregularity
  - Effusion (articular & bursal)
  - **Cartilage interface sign**

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- ### Cartilage Interface Sign:
- 
- Reflective interface between hypoechoic hyaline cartilage and adjacent fluid
  - Indicates articular extension of tear
  - Limited value

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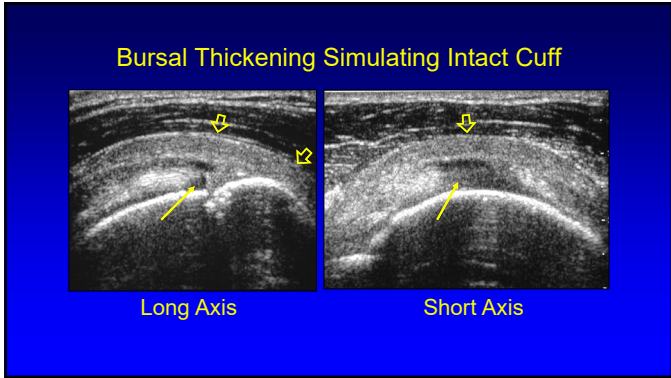
- ### Rotator Cuff Tears:
- 
- General comments
  - Secondary signs of rotator cuff tear
  - **Pitfalls in rotator cuff sonography**

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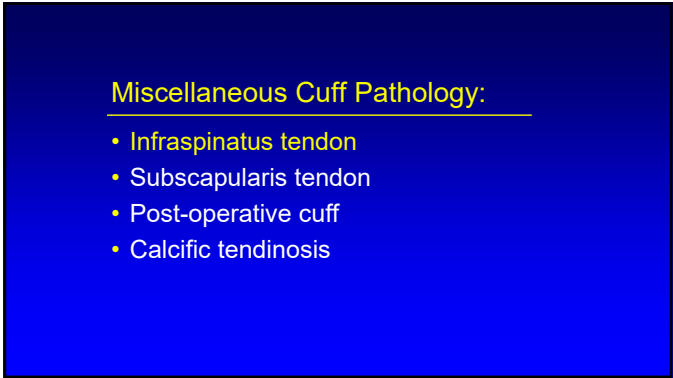
- ### Subacromial-subdeltoid Bursa:
- 
- Hyperechoic synovium may appear similar to tendon fibers
  - Hyperechoic thickness that extends beyond greater tuberosity is synovium and not cuff fibers

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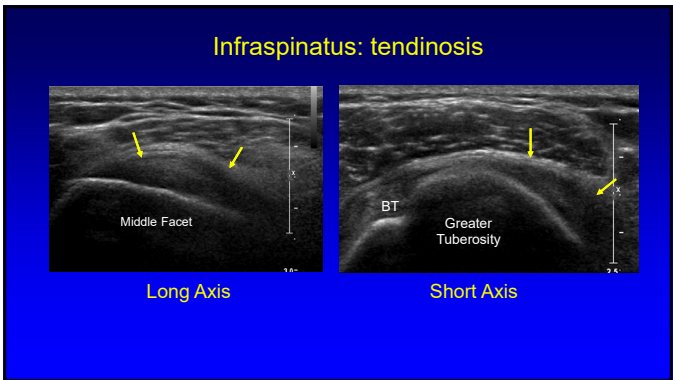
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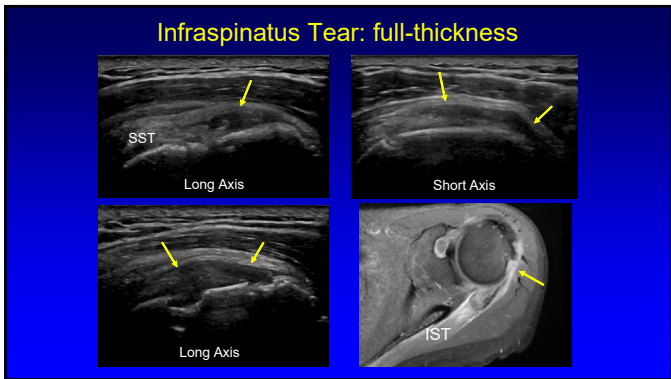
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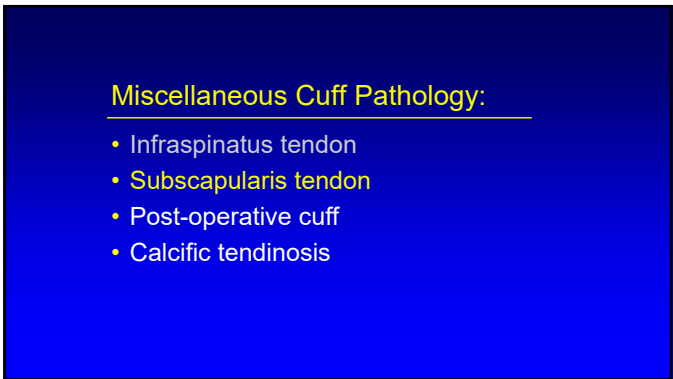
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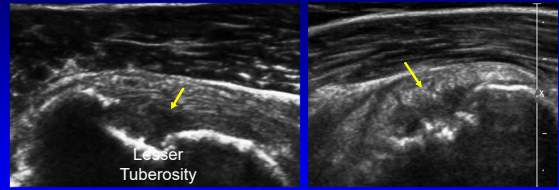
### Subscapularis Tear:

- Isolated tear: rare, trauma
- Part of massive cuff tear
- Anterosuperior cuff tear:
  - Supraspinatus and subscapularis borders of the rotator interval

Pfirschmann et al. Radiology 1999; 213:709

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### Partial-thickness Articular Tear: subscapularis

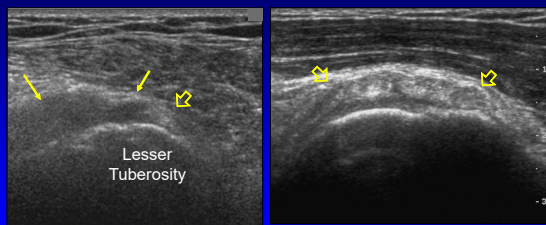


Long Axis

Short Axis

56

### Focal Full-thickness Tear: subscapularis

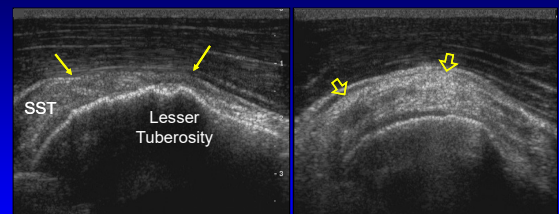


Short Axis

Contralateral

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### Subscapularis Tear: full-thickness

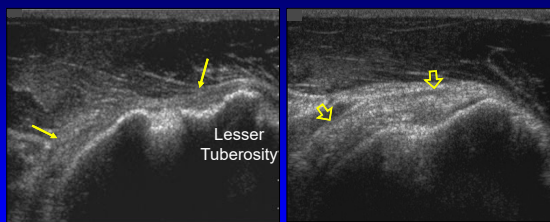


Transverse

Contralateral side

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### Subscapularis Tear: full-thickness



Long Axis

Contralateral side

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### Miscellaneous Cuff Pathology:

- Infraspinatus tendon
- Subscapularis tendon
- Post-operative cuff
- Calcific tendinosis

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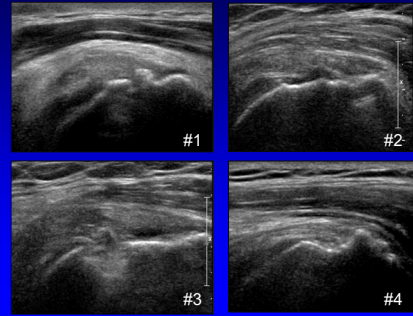
**Post-operative Rotator Cuff:**

- Post-op tendon: echogenic & thin\*
- Reimplantation trough
- Echogenic sutures & anchors

\*Mack et al. AJR 1988; 150:1089

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**Intact Post-operative Cuff**



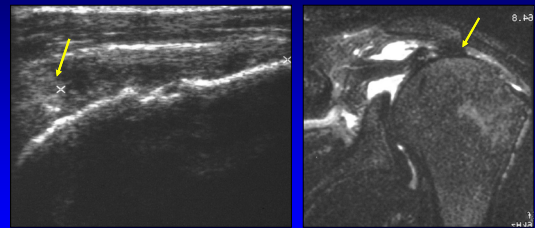
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**Post-operative Rotator Cuff:**

- Recurrent tear: usually large with nonvisualization
- Focal hypoechogenicity: equivocal

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**Post-operative Cuff: retear**

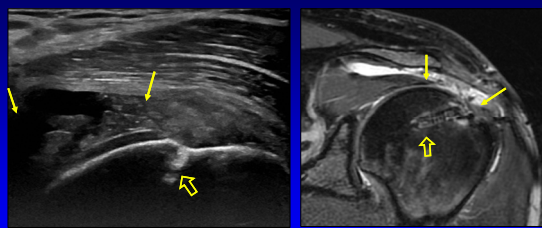


Long Axis

Coronal-obl T2w

64

**Post-operative cuff: recurrent tear**



Long Axis

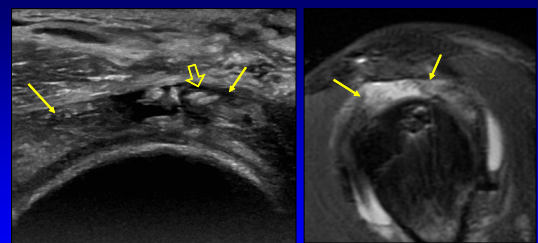
PDw fat-sat coronal

Open arrow = bioabsorbable suture anchor

4

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**Post-operative cuff: recurrent tear**



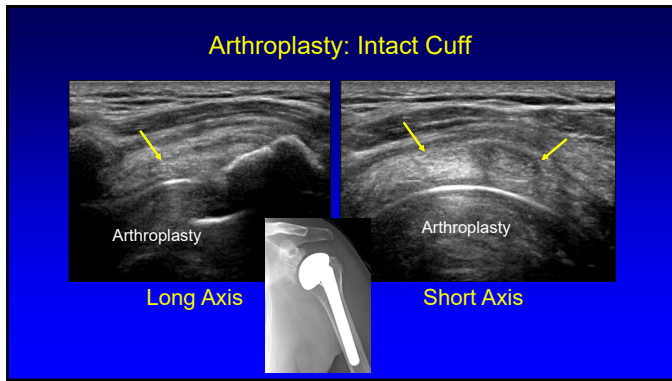
Short Axis

PDw fat-sat sagittal

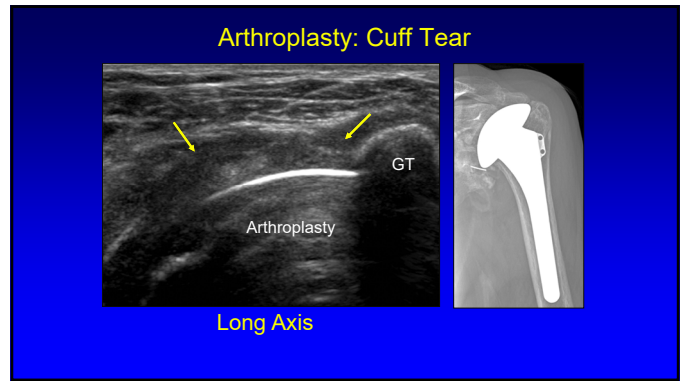
Open arrow = suture

4

66



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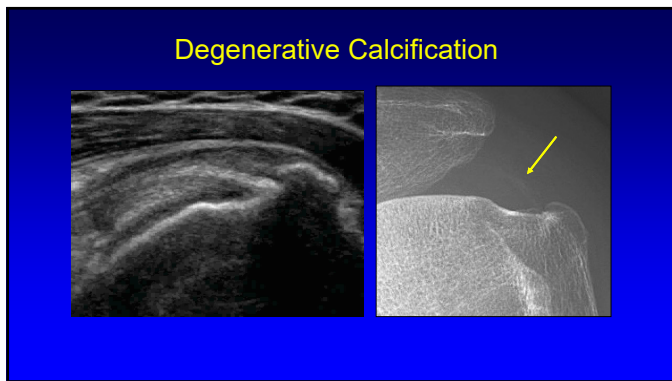
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- ### Miscellaneous Cuff Pathology:
- Infraspinatus tendon
  - Subscapularis tendon
  - Post-operative cuff
  - Calcific tendinosis

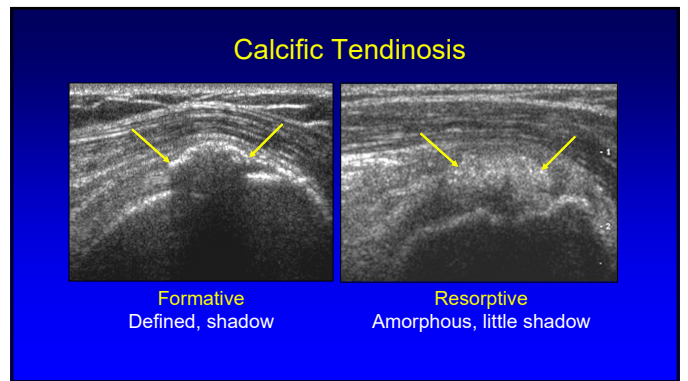
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- ### Tendon Calcification:
- Degenerative: thin, linear deposit
  - Calcific tendinosis: metaplasia
    - Formative: well-defined, dense shadow
    - Resorptive:
      - Globular, amorphous
      - Variable shadow
      - Best success with aspiration
- Uthoff. J Am Acad Ortho Surg 1997; 5:183

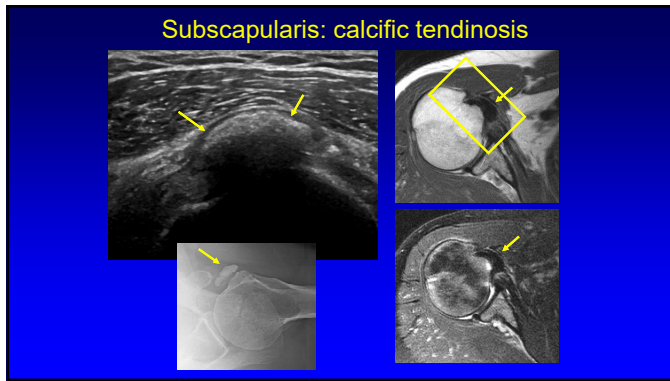
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### Miscellaneous Pathology:

- Biceps brachii tendon
- Subacromial-subdeltoid bursa
- Acromioclavicular joint

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### Biceps Tendon:

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

<sup>1</sup>Zubler 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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### Biceps Tendon Sheath

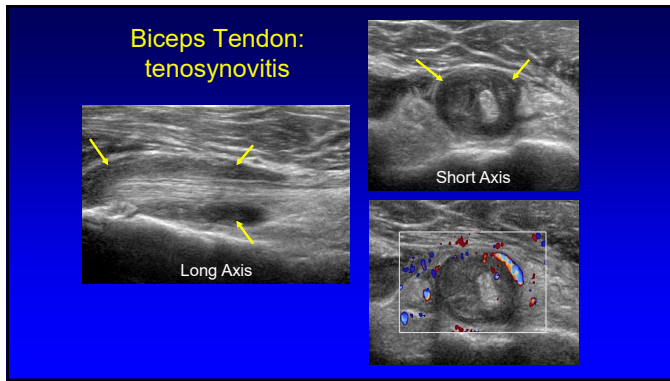
- Intra-articular body
  - Echogenic
  - Possible shadowing
  - Single or multiple
  - Associated with glenohumeral joint osteoarthritis

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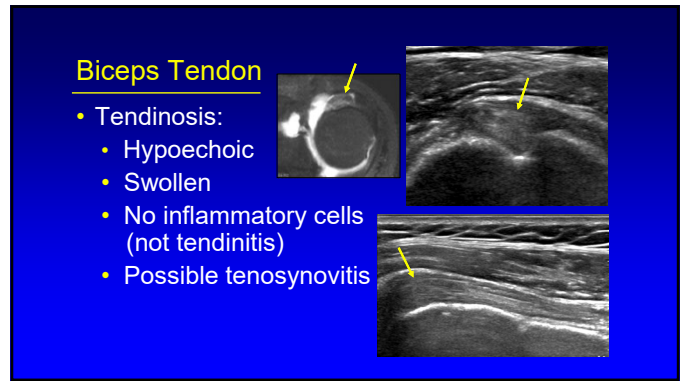
### Biceps Tendon:

- Tenosynovitis
  - *Unlike joint effusion:*
    - Focal distention
    - Hyperemia with color Doppler
    - Pain with transducer pressure
    - No effusion in posterior recess

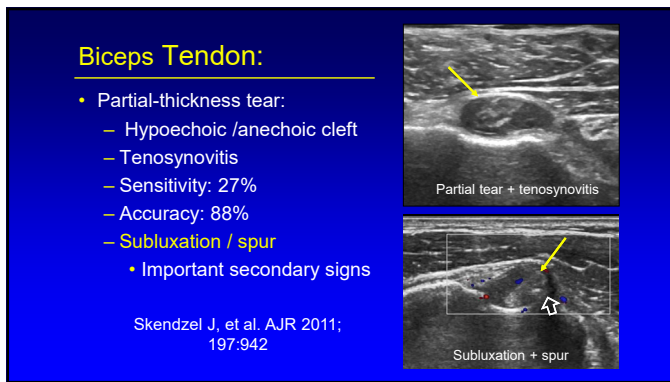
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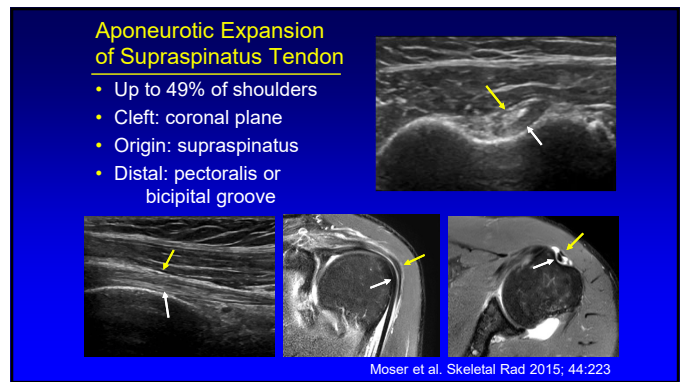
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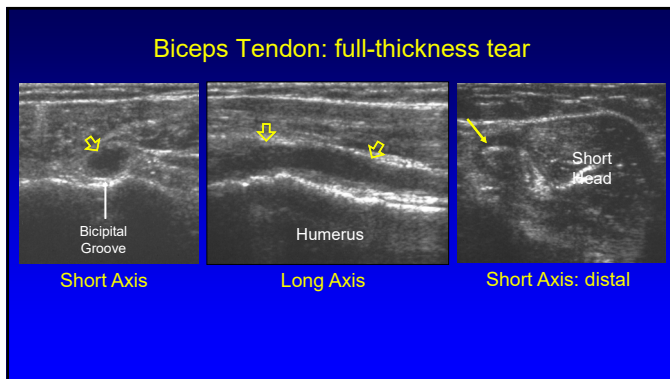
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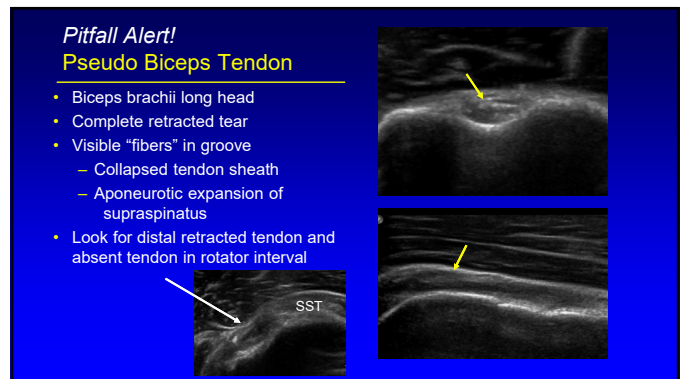
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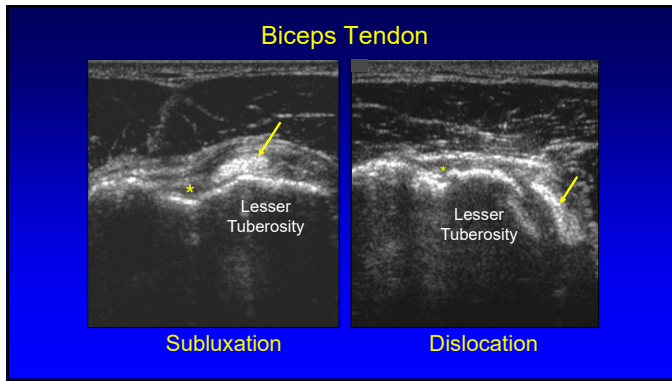
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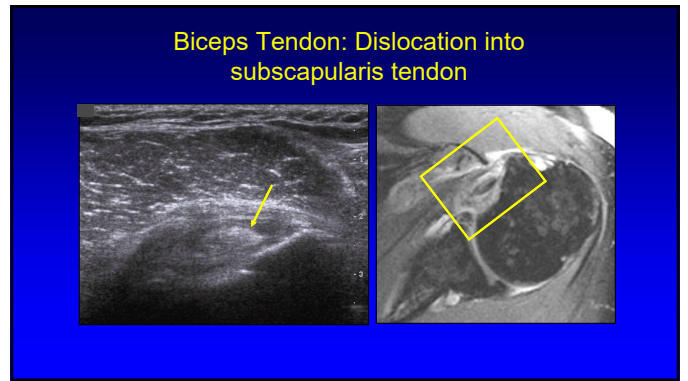
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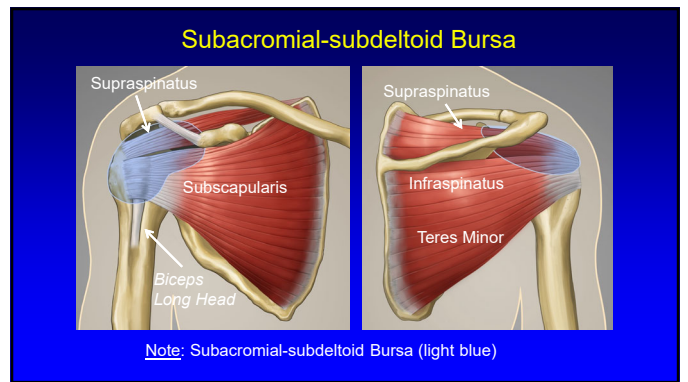
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- ### Miscellaneous Pathology:
- Biceps brachii tendon
  - Subacromial-subdeltoid bursa
  - Acromioclavicular joint

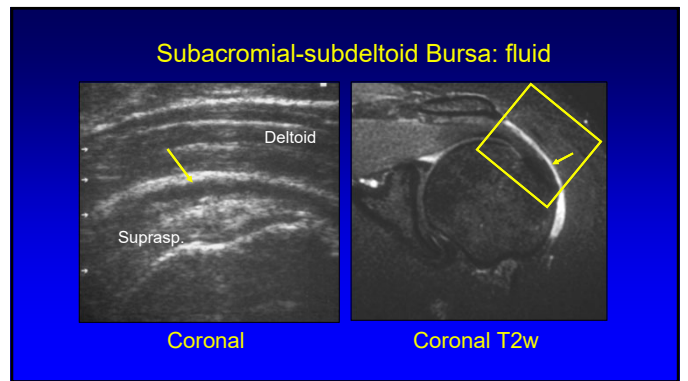
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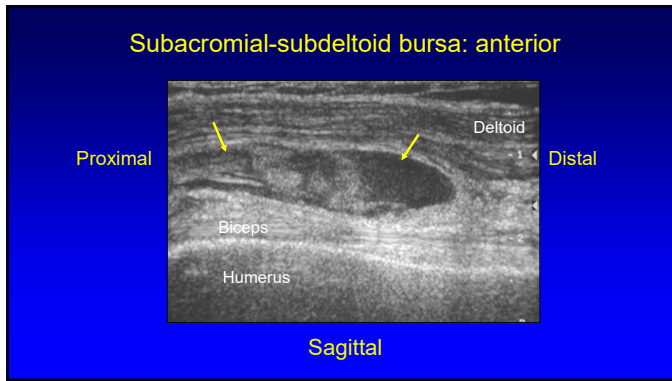
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- ### Subacromial-subdeltoid Bursa:
- Normal:
    - Thin hypoechoic layer: fluid, synovium
    - Hyperechoic: bursal walls and peribursal fat
  - Abnormal: >1 mm thick\*
    - Fluid: anechoic
    - Synovial tissue: hypoechoic to hyperechoic
- \*Invest Radiol 1985;20:311

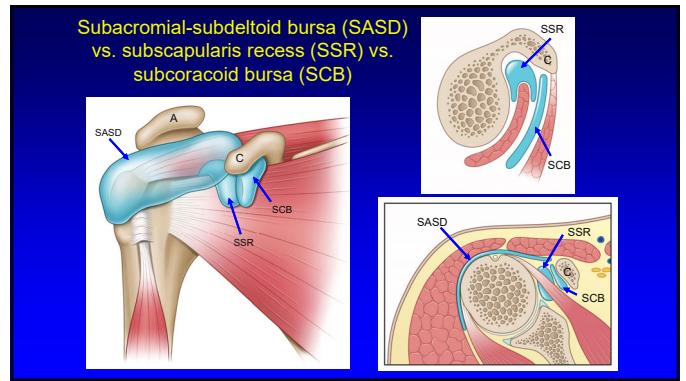
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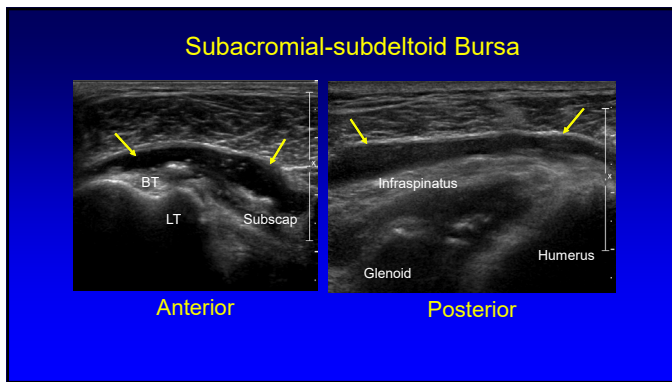
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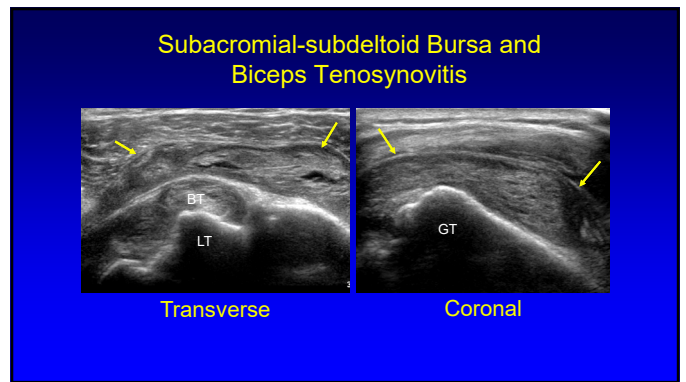
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### Impingement Syndrome

- Cuff impingement
- Subacromial enthesophyte or acromioclavicular joint osteophyte
- Associated tendon degeneration and tear

Coracoacromial arch

Subacromial-subdeltoid bursa

Supraspinatus

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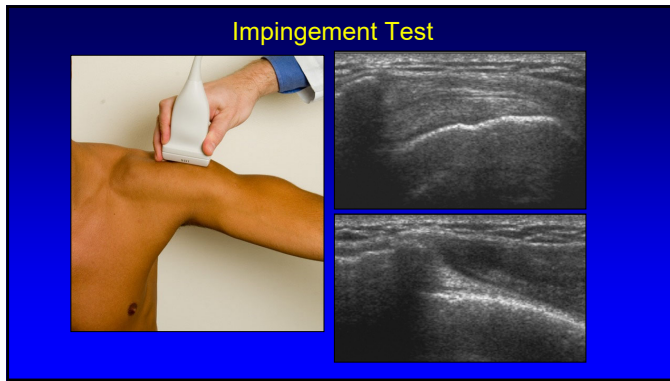
### Impingement: bursal fluid

- Abnormal pooling of subacromial-subdeltoid bursal fluid
- Lateral acromion<sup>1</sup>:
  - Coronal plane, active arm elevation
  - Not visible in neutral position, no cuff tear
- Thickened tendon or bursa
  - Possible snapping of thickened bursa
  - “Gathering” of bursa: may be asymptomatic<sup>2</sup>

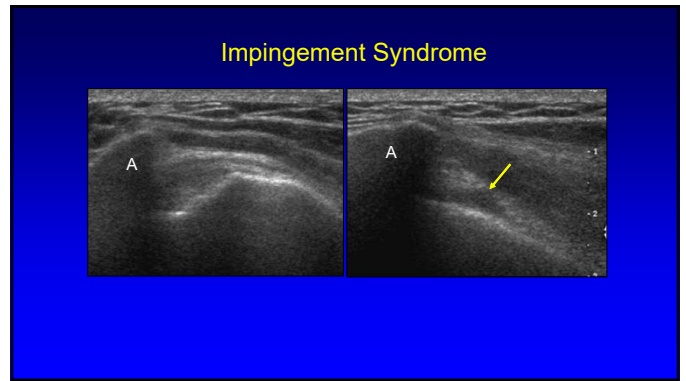
<sup>1</sup>Farin et al. Radiology 1990; 176:845  
<sup>2</sup>Daghir A et al. Skeletal Radiol 2012; 41:1047

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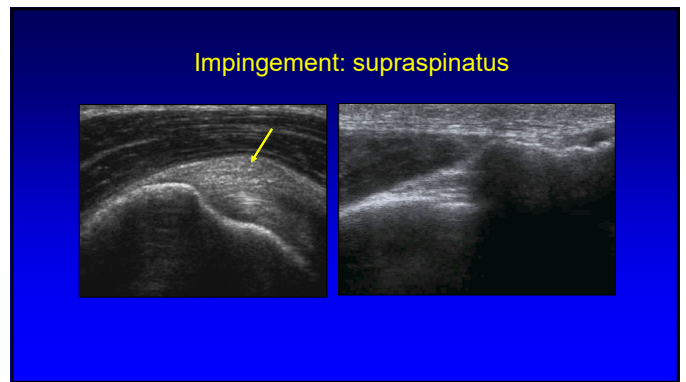
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### Miscellaneous Pathology:

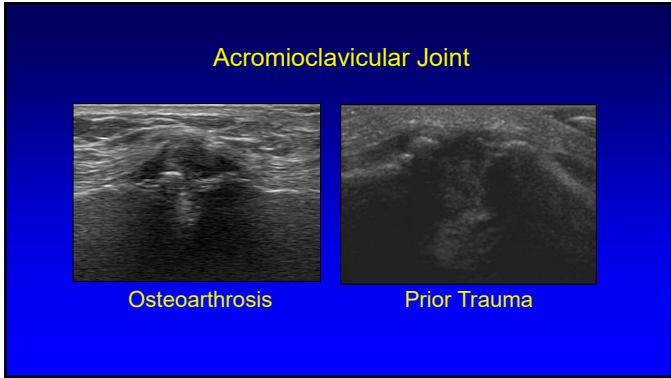
- Biceps brachii tendon
- Subacromial-subdeltoid bursa
- **Acromioclavicular joint**

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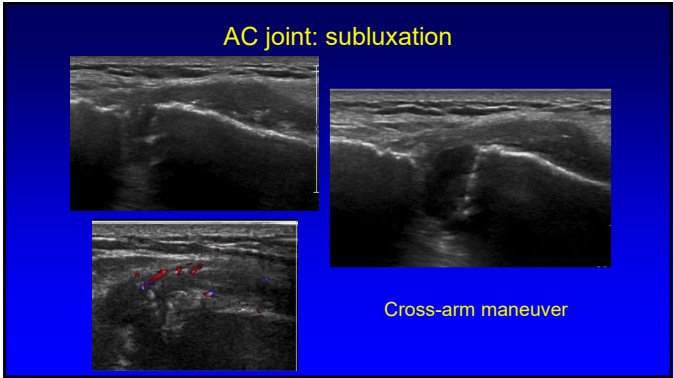
### Acromioclavicular Joint:

- Osteoarthritis: common by age 40
  - Thick capsule > 2 mm
  - Narrow, irregular, osteophytes
- Trauma:
  - Wide, possible subluxation
  - Thick capsule >2 mm
- Cyst versus geyser sign
  - Geyser: joint fluid tracking through ACJ via full-thickness rotator cuff tear

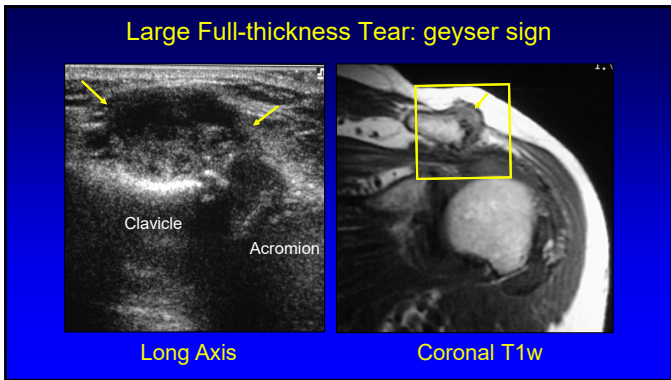
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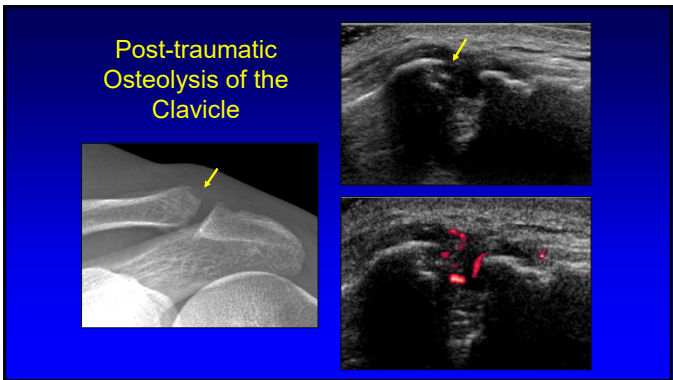
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- Take-home Points**
- Must follow a protocol
  - Most cuff tears: supraspinatus
    - Use rotator interval and facets as landmarks
  - Cortical irregularity: important indirect sign
    - Supraspinatus tears
  - Dynamic: impingement, biceps
  - Joint effusion: biceps tendon sheath

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Thank you!

Syllabus on line and other educational material:  
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