Ultrasound of Common Shoulder Pathology

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Disclosures

- Consultant: Bioclinica
- Contractor: POCUS PRO
- Advisory Board: Philips
- Book Royalties: Elsevier
- Not relevant to this lecture

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Outline:

- Rotator cuff:
  - Supraspinatus tear and tendinosis
  - Secondary signs of cuff tear
  - Other rotator cuff pathology
- Biceps brachii tendon abnormalities
- Subacromial-subdeltoid bursa

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Rotator Cuff Ultrasound:

- Accuracies:
  - Full-thickness tear: 96%[1]
  - Partial-thickness tear: 94%[2]
  - Equal to MRI: accuracy, size of tear[3]
- Patients prefer ultrasound over MRI[4]

[1]Teefey, JBJS Am 2000; 82:498.
[2]van Holsbeeck, Radiology 1995; 197:443.
[3]Teefey, JBJS Am 2004; 86:708.
[4]Middleton, AJR 2004; 183:1449.

4

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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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 Abnormalities:

Categories:

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

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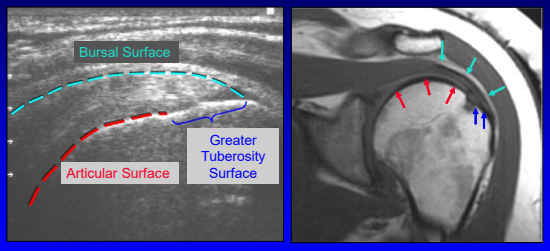
Supraspinatus: normal



Long Axis

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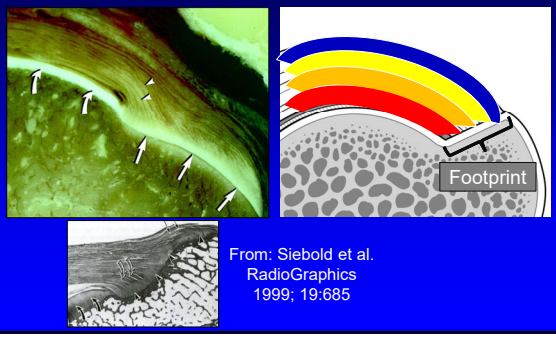
Supraspinatus Insertion



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

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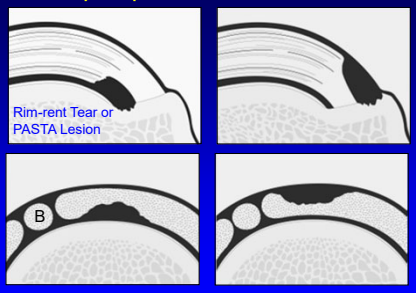
Supraspinatus Tears: extent



Partial Articular Partial Bursal

From: Fundamentals of Musculoskeletal Ultrasound

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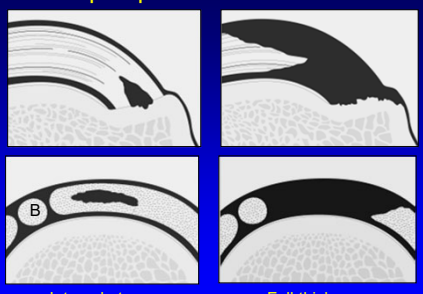
Supraspinatus Tears: extent



Intrasubstance Full thickness

From: Fundamentals of Musculoskeletal Ultrasound

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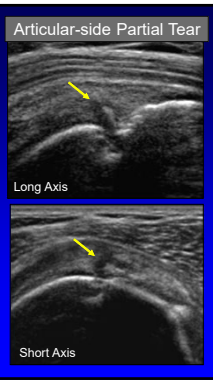
Partial-thickness Tear

- 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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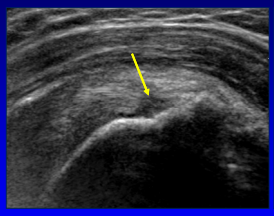
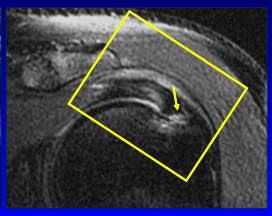
Articular Partial-thickness Tear: supraspinatus



Long Axis



Coronal T2w

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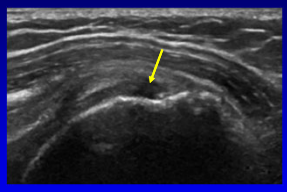
Pitfall Alert! Anisotropy

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



Supraspinatus: long axis

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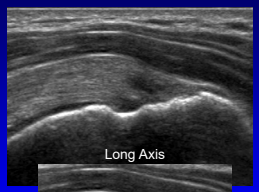
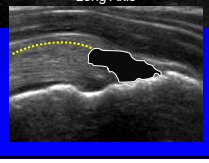
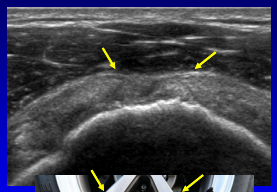
Bursal Partial-thickness Tear: supraspinatus







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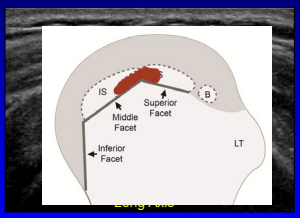
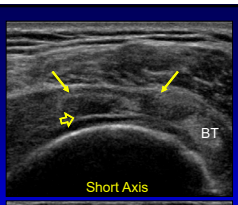
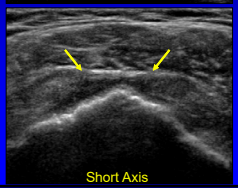
Full-thickness Tear: supraspinatus



Note: Cartilage Interface Sign (open arrow)





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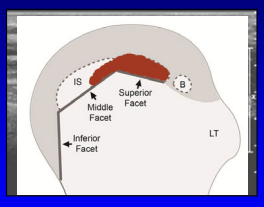
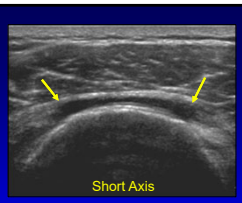
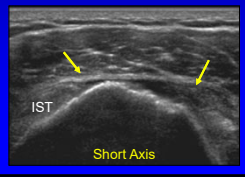
Full-thickness Tear: supraspinatus (full-width)







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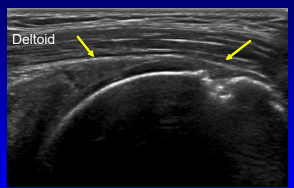
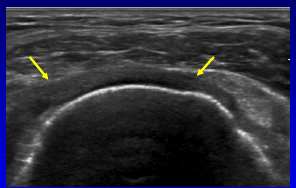
Large Full-thickness Tear: supraspinatus





Long Axis

Short Axis

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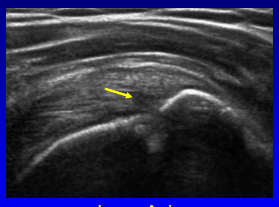
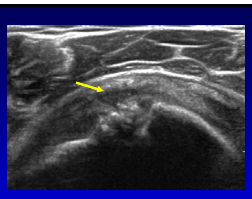
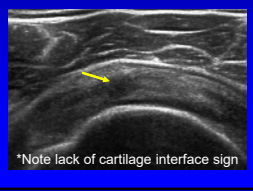
Intrasubstance Tear: supraspinatus



Long Axis





*Note lack of cartilage interface sign

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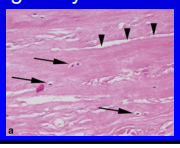
Tendinosis

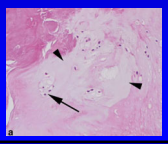
- No inflammatory cells
  - Mucoid degeneration, chondroid metaplasia
- Hypoechoic, ill-defined
- Possible increased thickness
- No cortical irregularity*

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*

Tear	Tendinosis
• 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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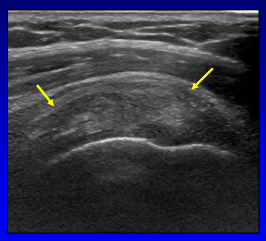
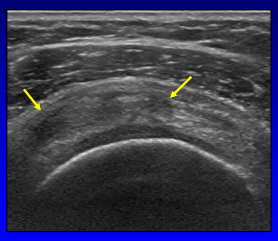
Tendinosis: supraspinatus



Long Axis



Short Axis

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Fatty Infiltration and Muscle Atrophy

- Supraspinatus and infraspinatus
  - Infraspinatus: only variable to predict cuff healing[1]
- Associations:
  - Chronic, large, anterior supraspinatus tears[2]
- Ultrasound:
  - Comparable to MRI[3]
  - Improved reliability with extended field-of-view[4]

[1]Chung et al. Am J Sports Med 2013; 41:16764
[2]Hodler et al. Radiology 2005; 237:584.
[3]Wall LB et al. JBJS 2012; 94:e83.
[4]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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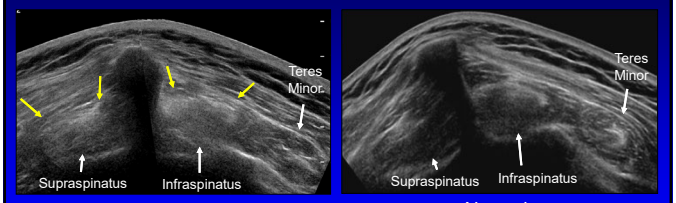
Atrophy: supraspinatus and infraspinatus



Normal

Short Axis (extended field-of-view)

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Outline:

- Rotator cuff:
  - Supraspinatus tear and tendinosis
  - Secondary signs of cuff tear
  - Other rotator cuff pathology
- Biceps brachii tendon abnormalities
- Subacromial-subdeltoid bursa

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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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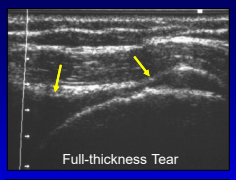
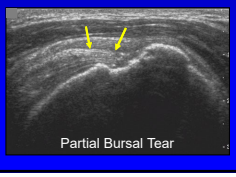
Tendon Volume Loss

- Flat or concave outer margin of supraspinatus*
  - Deltoid muscle dips into tendon gap
- Full-thickness tears
- Bursal sided partial-thickness tears
- Not seen in tendinosis

*Hodler et al. Radiology 1988; 169:791





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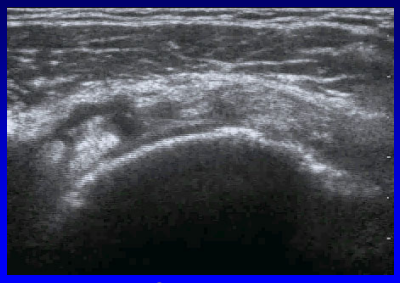
Full-thickness Tear: supraspinatus



Short Axis

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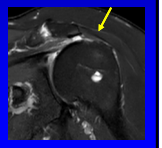
Cortical Irregularity:

- 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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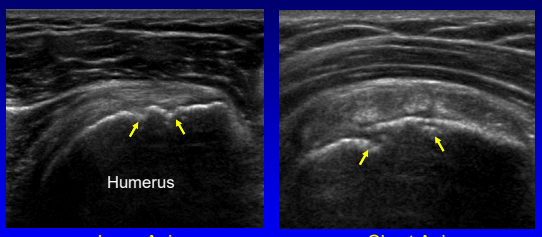
Cortical Irregularity: no significance



Long Axis Short Axis

Subscapularis Tendon

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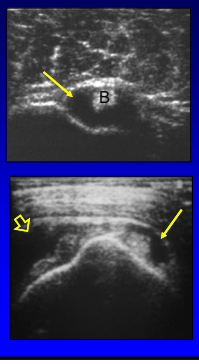
Joint & Bursal Effusions

- 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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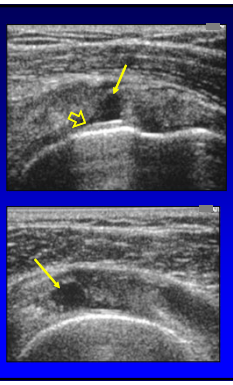
Cartilage Interface Sign

- Reflective interface between hypoechoic hyaline cartilage and adjacent fluid
- Indicates articular tear extension
- Limited value: seen normally but not as pronounced



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Outline:

- Rotator cuff:
  - Supraspinatus tear and tendinosis
  - Secondary signs of cuff tear
  - Other rotator cuff pathology
- Biceps brachii tendon abnormalities
- Subacromial-subdeltoid bursa

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Infraspinatus Tear:

- Isolated tear: rare, trauma
- Part of massive cuff tear:
  - If supraspinatus tear, look for extension
  - Tear extends over middle facet >1.3 cm from rotator interval on transverse image

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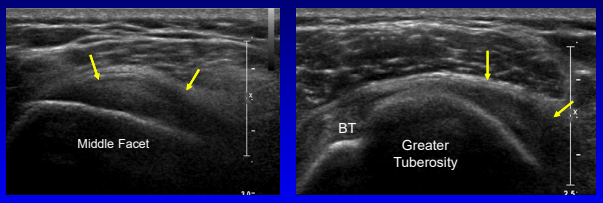
Infraspinatus: tendinosis



Long Axis Short Axis

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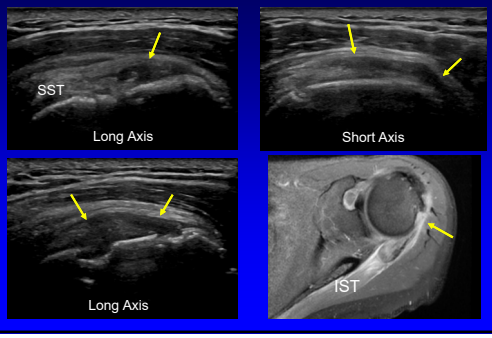
Infraspinatus Tear: full-thickness



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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

Pfirrmann et al. Radiology 1999; 213:709

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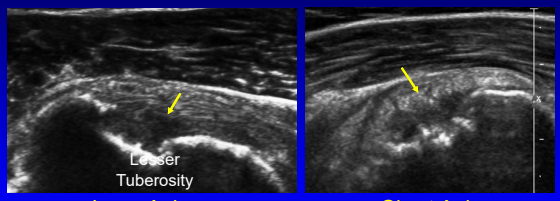
Partial-thickness Articular Tear: subscapularis



Long Axis Short Axis

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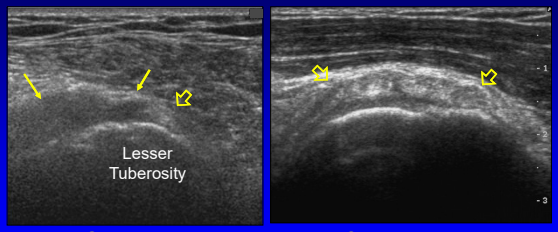
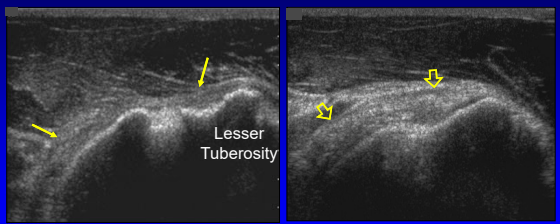
Focal Full-thickness Tear: subscapularis



Short Axis Contralateral

40

Subscapularis Tear: full-thickness



Long Axis Contralateral side

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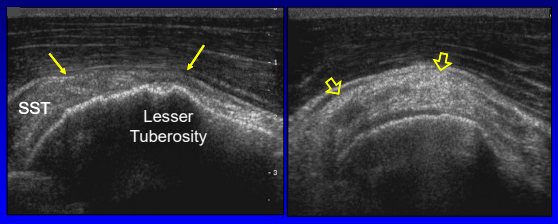
Subscapularis Tear: full-thickness



Transverse Contralateral side

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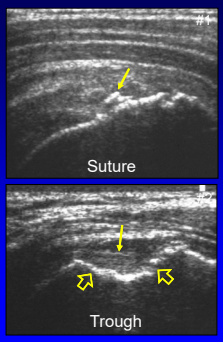
Repaired Cuff: ultrasound

- Post-op intact tendon:
  - Variable and heterogeneous echogenicity
  - Variable thickness
- Reimplantation trough
- Echogenic sutures & anchors

Jacobson et al. Sem Musculo Radiol 2011; 15:320



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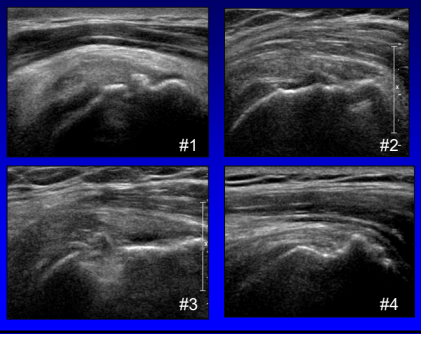
Intact Post-operative Cuff



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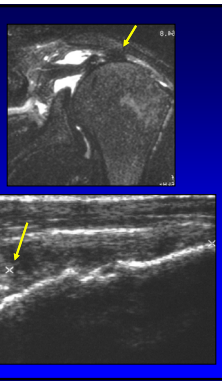
Post-operative Rotator Cuff

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



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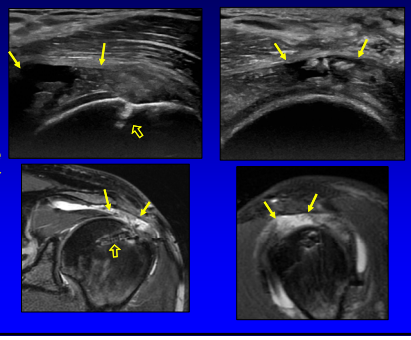
Post-operative cuff: recurrent tear

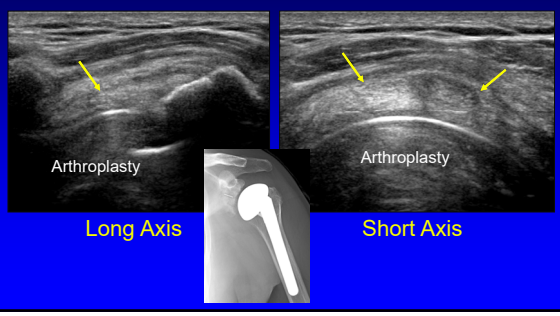
Open arrow = bioabsorbable suture anchor



Note: echogenic sutures not in tendon

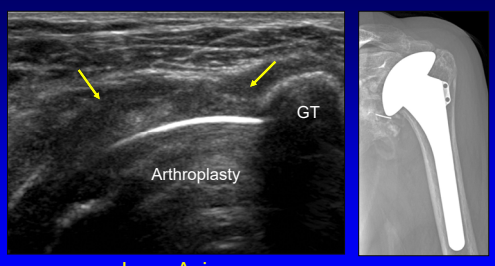
46

Arthroplasty: Intact Cuff



47

Arthroplasty: Cuff Tear



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Tendon Calcification:

- Degenerative: thin, linear deposit
- Calcific tendinosis:
  - Formative: well-defined, dense shadow
  - Resorptive:
    - Globular, amorphous
    - Variable shadow
    - Best success with aspiration

Uhthoff. J Am Acad Ortho Surg 1997; 5:183

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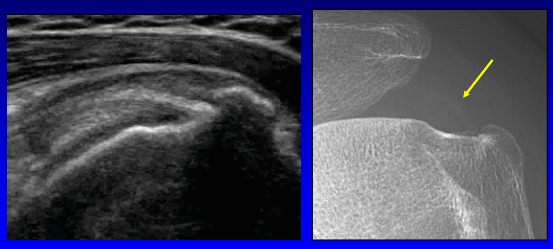
Degenerative Calcification



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Calcific Tendinosis

- Hydroxyapatite deposition: metaplasia
  - Usually do not have cuff tear
- Appearance:
  - 79% hyperechoic & shadowing
  - No shadow: 7%
- Two phases:
  - Formative
  - Resorptive: painful

Farin et al. Skeletal Radiol 1996; 25:551

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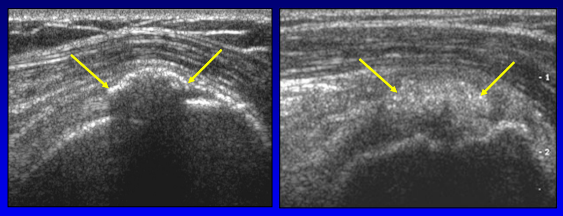
Calcific Tendinosis



Formative
Defined, shadow

Resorptive
Amorphous, little shadow

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Outline:

- Rotator cuff:
  - Supraspinatus tear and tendinosis
  - Secondary signs of cuff tear
  - Other rotator cuff pathology
- Biceps brachii tendon abnormalities
- Subacromial-subdeltoid bursa

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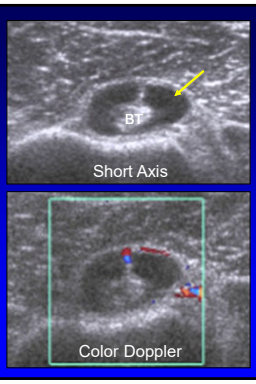
Biceps Tendon:

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

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



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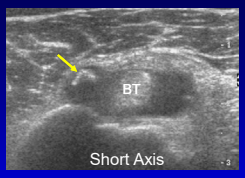
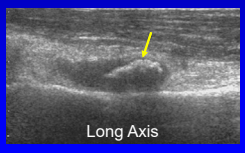
Biceps Tendon Sheath

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





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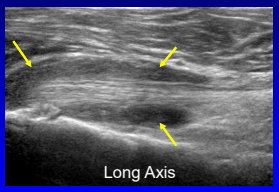
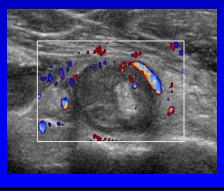
Biceps Tendon: tenosynovitis





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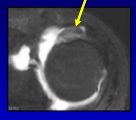
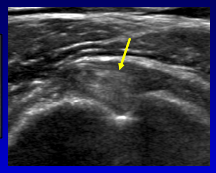
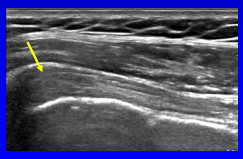
Biceps Tendon

- Tendinosis:
  - Hypoechoic
  - Swollen
  - No inflammatory cells (not tendinitis)
  - Possible tenosynovitis







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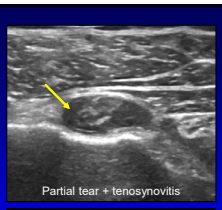
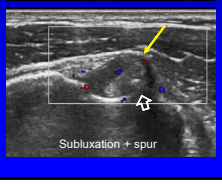
Biceps Tendon

- 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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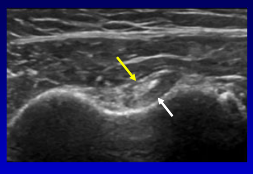
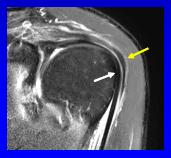
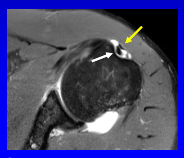
Aponeurotic Expansion of Supraspinatus Tendon

- 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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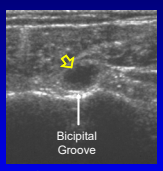
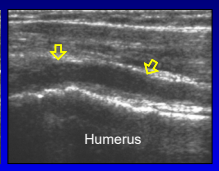
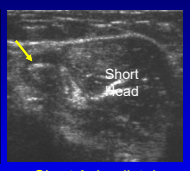
Biceps Tendon: full-thickness tear



Short Axis



Long Axis



Short Axis: distal

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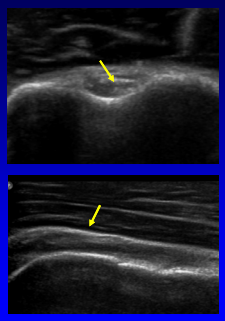
Pitfall Alert!

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



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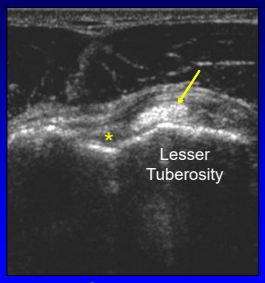
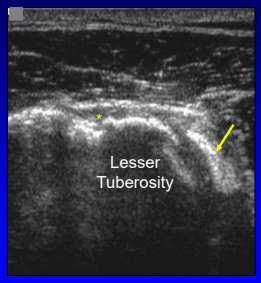
Biceps Tendon



Subluxation



Dislocation

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Biceps Tendon Subluxation

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Outline:

- Rotator cuff:
  - Supraspinatus tear and tendinosis
  - Secondary signs of cuff tear
  - Other rotator cuff pathology
- Biceps brachii tendon abnormalities
- Subacromial-subdeltoid bursa

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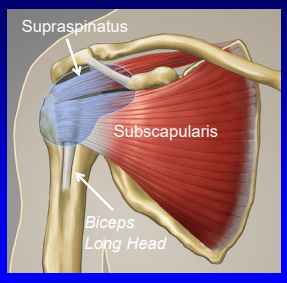
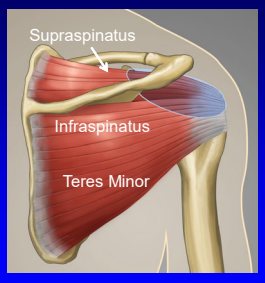
Subacromial-subdeltoid Bursa

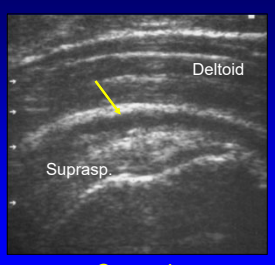




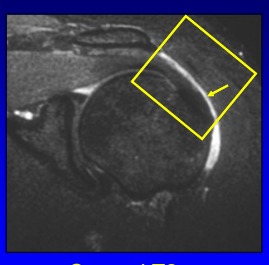
Note: Subacromial-subdeltoid Bursa (light blue)

65

Subacromial-subdeltoid Bursa: fluid



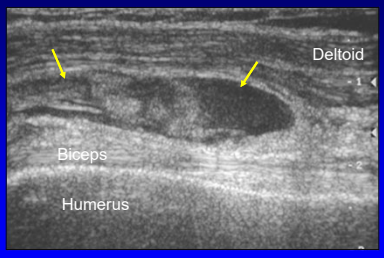
Coronal



Coronal T2w

66

Subacromial-subdeltoid bursa: anterior



Sagittal

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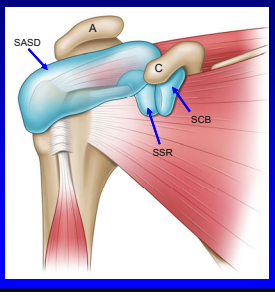
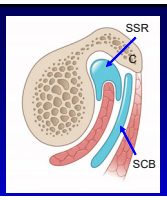
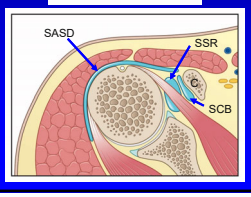
Subacromial-subdeltoid bursa (SASD) vs. subscapularis recess (SSR) vs. subcoracoid bursa (SCB)







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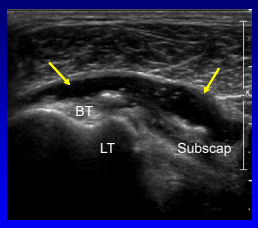
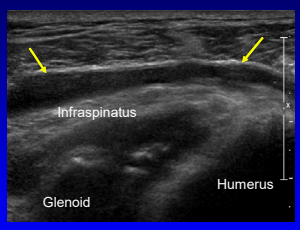
Subacromial-subdeltoid Bursa



Anterior



Posterior

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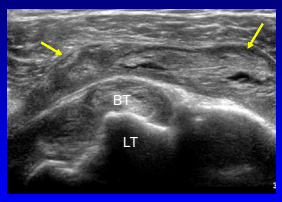
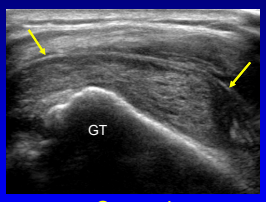
Subacromial-subdeltoid Bursa and Biceps Tenosynovitis



Transverse



Coronal

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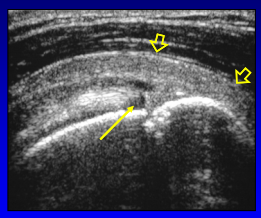
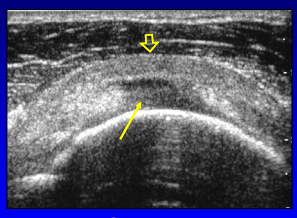
Bursal Thickening Simulating Intact Cuff



Long Axis



Short Axis

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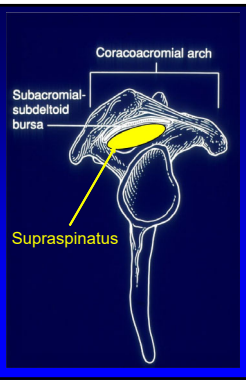
Impingement Syndrome

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



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Impingement: bursal fluid

- Abnormal pooling of subacromial-subdeltoid bursal fluid
- Lateral acromion[1]:
  - 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[2]

[1]Farin et al. Radiology 1990; 176:845
[2]Daghir A et al. Skeletal Radiol 2012; 41:1047

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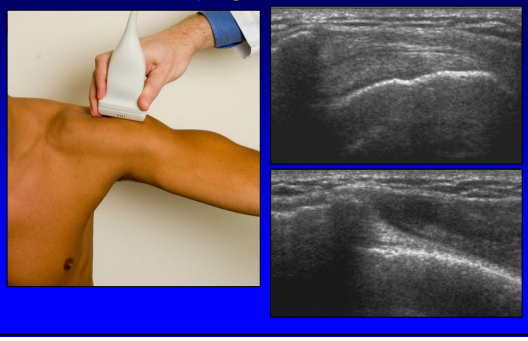
Impingement Test



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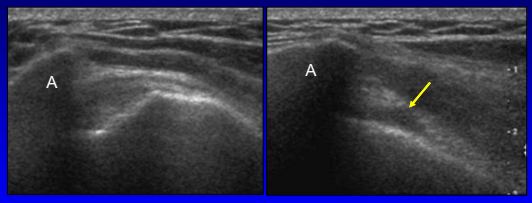
Impingement Syndrome



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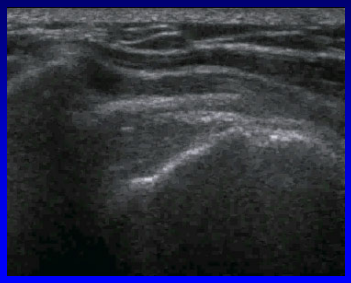
Impingement: supraspinatus



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Subacromial Impingement: anterior

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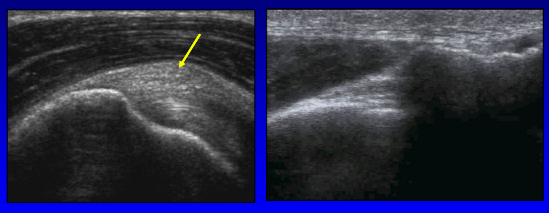
Impingement: supraspinatus



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Take-home Points

- Rotator cuff tears: follow an scanning protocol
- Indirect signs of tendon tear:
  - Cortical irregularity at supraspinatus footprint
  - Volume loss or thinning
  - Cartilage interface sign
- Biceps:
  - Do not overcall tenosynovitis
- Subacromial-subdeltoid bursa
  - Varies from anechoic to hyperechoic

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www.jacobsonmskus.com

Twitter handle: @jjacobsn

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