

Ultrasound of Shoulder Pathology and Interventional

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Syllabus

1

Disclosures

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

2

Outline:

- Rotator cuff:
 - Cuff tear and tendinosis
 - Secondary signs of cuff tear
 - Calcific tendinosis
 - Post-operative cuff
- Biceps brachii tendon abnormalities
- Subacromial-subdeltoid bursa

3

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

4

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

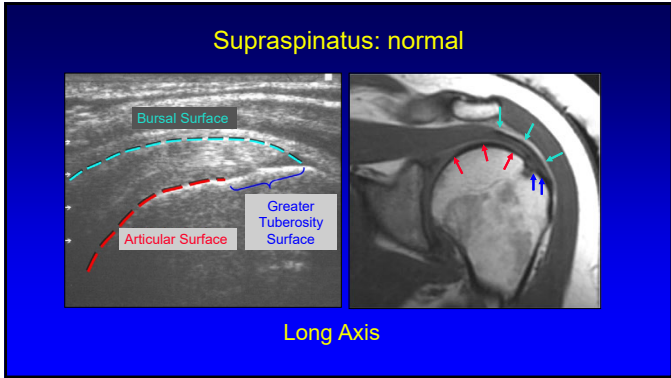
AJR 1998; 171:229
Radiology 2004; 230:234

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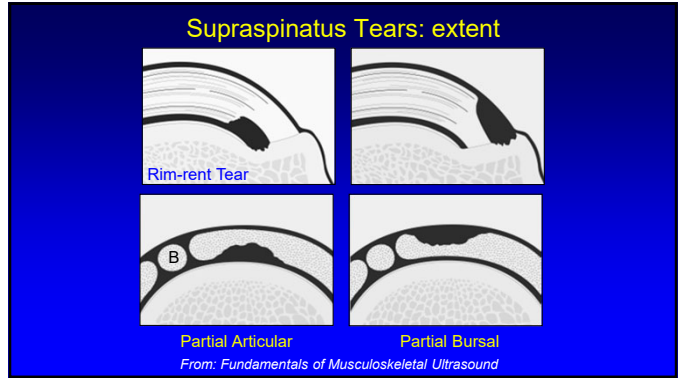
Rotator Cuff Abnormalities:

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

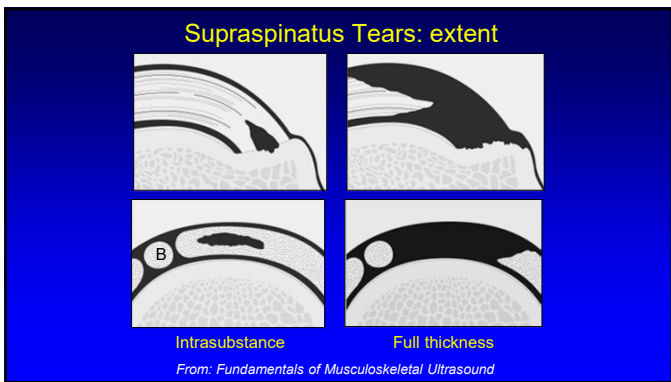
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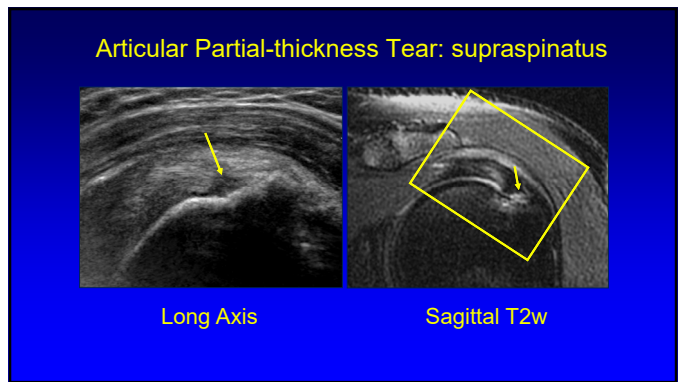
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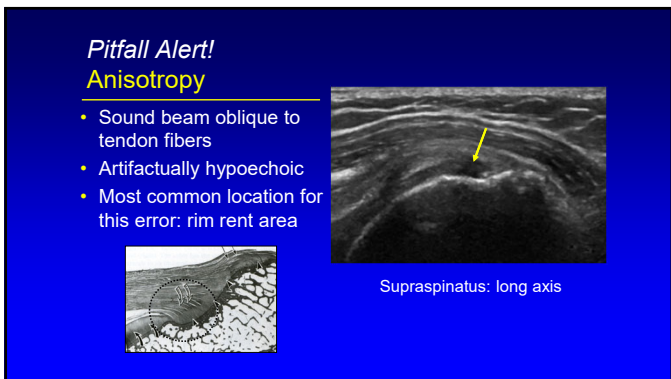
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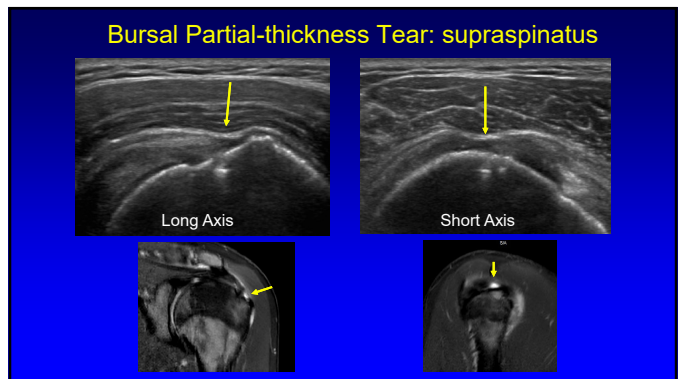
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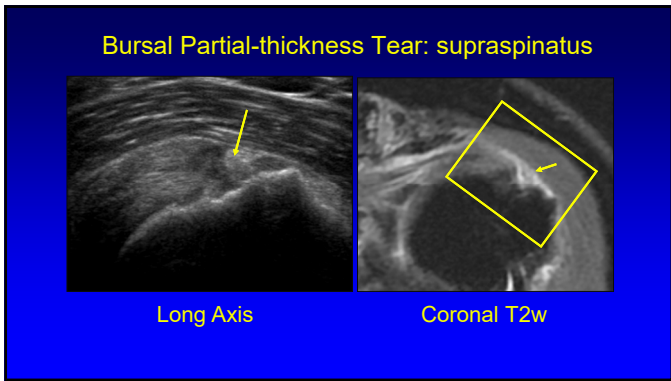
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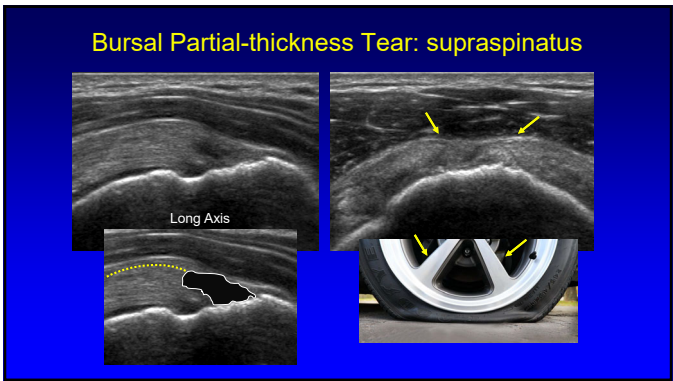
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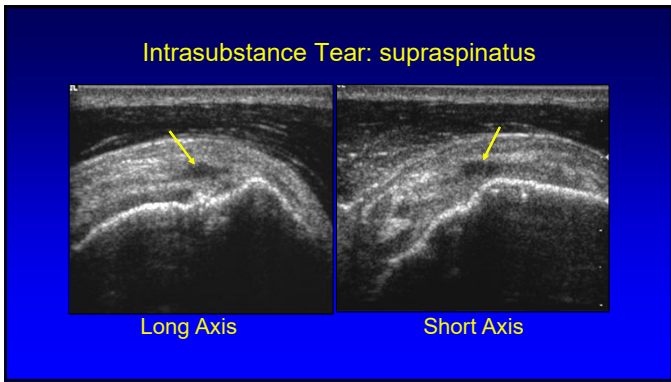
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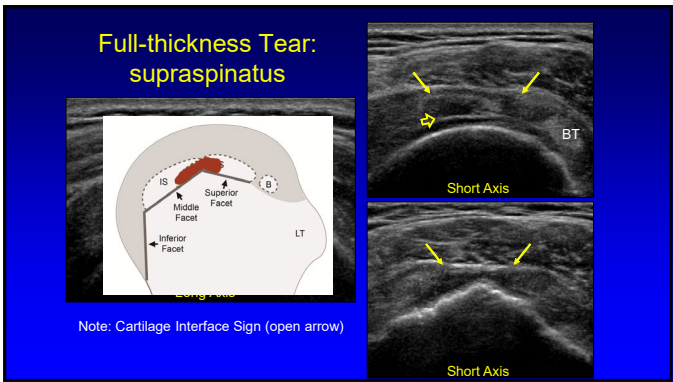
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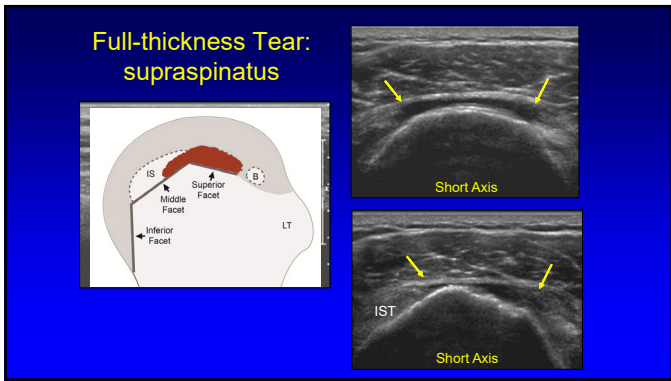
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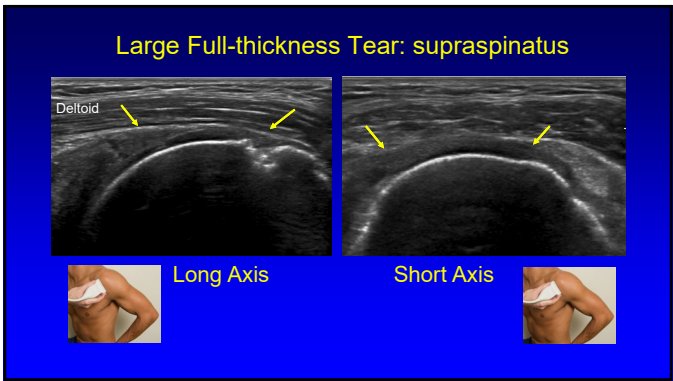
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16



17



18

Pseudofibers with full-thickness tear

- Hyperechoic and fibrillar
- Typically thinner than normal cuff
- Extends beyond greater tuberosity

19

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

20

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

21

Tendinosis: supraspinatus tendon

Longitudinal Coronal-oblique T2w

22

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23

Secondary Findings of Rotator Cuff Tears:


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

24

Cortical Irregularity:

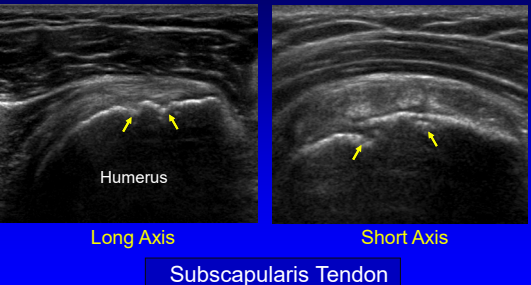
- Greater tuberosity: at **supraspinatus** insertion
- When present: 75% have rotator cuff tears
 - Patient over 40 years old
- When absent: 96% normal cuffs by sonography

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



25

Cortical Irregularity: no significance



Long Axis Short Axis

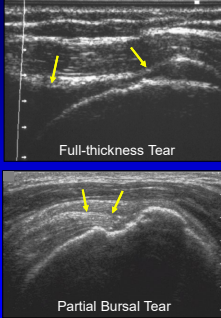
Subscapularis Tendon

26

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



Full-thickness Tear

Partial Bursal Tear

27

Full-thickness Tear: supraspinatus

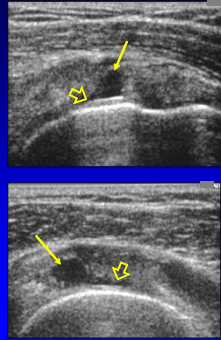


Short Axis

28

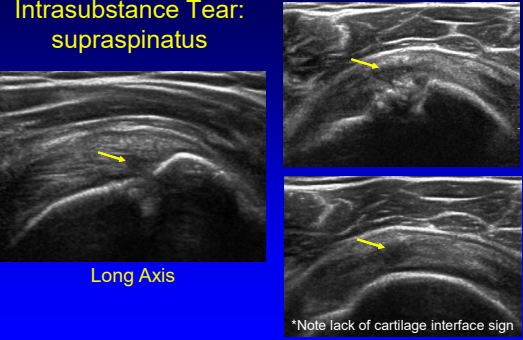
Cartilage Interface Sign

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



29

Intrasubstance Tear: supraspinatus



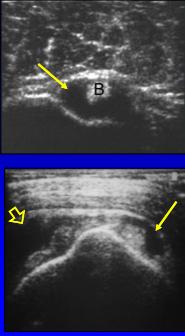
Long Axis

*Note lack of cartilage interface sign

30

Joint & Bursal Effusions

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

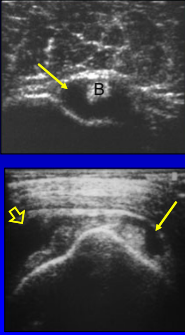


*Hollister et al. AJR 1995; 165:605

31

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

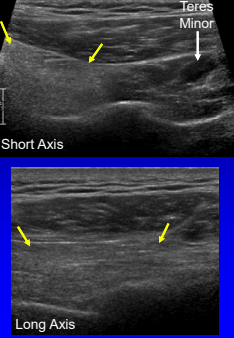


¹Chung et al. Am J Sports Med 2013; 41:16764
²Hodler et al. Radiology 2005; 237:584.
³Wall LB et al. JBJS 2012; 94:e83.
⁴Nazarian et al. 2008; 190:27.

32

Fatty Infiltration and Muscle Atrophy

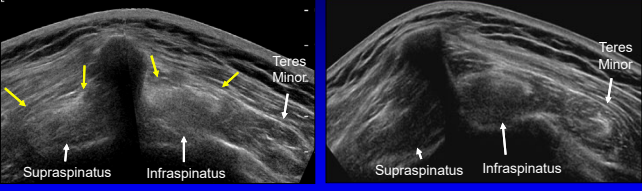
- Indistinct tendon-muscle border
- Increased muscle echogenicity
 - Compare to teres minor
- Decreased muscle bulk
 - Compared to teres minor
 - Bone landmark: ridge in scapula
 - Short axis: infraspinatus 2x size



Short Axis
Long Axis

33

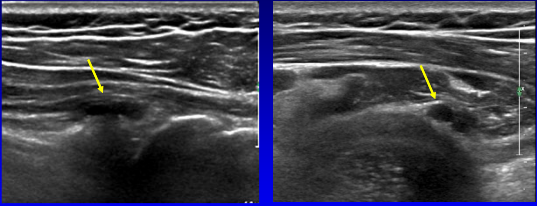
Atrophy: supraspinatus and infraspinatus



Supraspinatus
Infraspinatus
Teres Minor
Normal
Short Axis (extended field-of-view)

34

Labral Tear and Paralabral Cyst



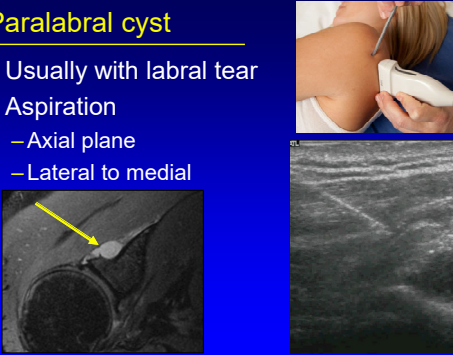
Long Axis: infraspinatus
Short Axis: infraspinatus

*Note: non-compressible

35

Paralabral cyst

- Usually with labral tear
- Aspiration
 - Axial plane
 - Lateral to medial



36

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37

Degenerative Calcification

38

Calcific Tendinosis/Tendinitis

- Tendon metaplasia: calcium hydroxyapatite deposition
- Two phases:
 - Formative: well-defined, dense shadow
 - Resorptive: amorphous
- Percutaneous US-guided lavage/aspiration

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

39

Calcific Tendinosis/Tendinitis

Formative
Defined, shadow

Resorptive
Amorphous, little shadow

40

Calcific Tendinosis: resorptive phase

Patient #1

Patient #2:
Intra-osseous invasion

41

Calcific Tendinosis: supraspinatus
Use of Tendon Anisotropy

Long axis

42

Calcific Tendinosis: aspiration

- Percutaneous lavage and aspiration
 - Best: rounded amorphous calcification
 - Correlate with radiography
- 3- 10 cc syringes: Lidocaine
- 20 – 22 gauge needle
- Position patient: syringe is dependent

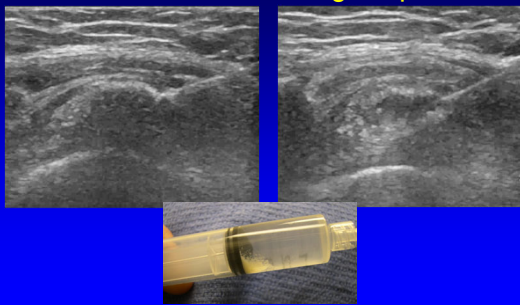
43

Calcific Tendinosis: aspiration

- Inject Lidocaine, then aspirate
 - Dilute calcification
 - Syringe dependent
 - Calcification will flow into needle
 - Repeat until calcification decreases
- Inject steroids into adjacent bursa

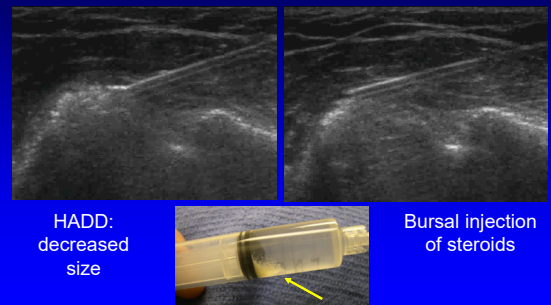
44

Calcific Tendinosis: lavage/aspiration



45

Calcific Tendinosis: lavage/aspiration



46

Calcific Tendinosis



3 weeks after lavage and aspiration

47

Calcific Tendinosis: results

- Calcium decrease correlates with symptom improvement
- Improvement: 91% at 1 year*
 - Calcium gone in 89%
 - Transitory recurrence at 15 weeks: 44%
 - Improved symptoms at 1 year
- No difference at 5, 10 years**

*del Crura, AJR 2007; 189:W128
**Serafini G, Radiology 2009; 252:157

48

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49

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

50

Intact Post-operative Cuff

51

Post-operative Rotator Cuff

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

52

Post-operative cuff: recurrent tear

Open arrow = bioabsorbable suture anchor

Note: echogenic sutures not in tendon

53

Post-operative Cuff: Intact

Subject B.A.

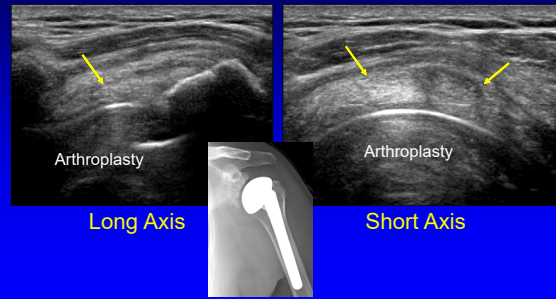
54

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

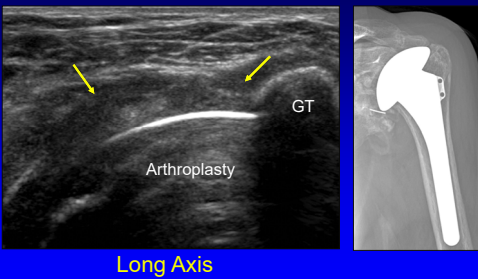
55

Arthroplasty: Intact Cuff



56

Arthroplasty: Cuff Tear



57

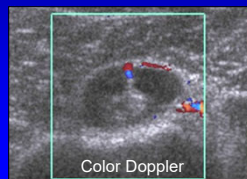
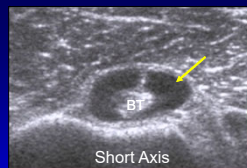
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58

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

59

Shoulder Joint Recesses

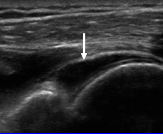
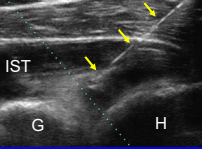
- Long head biceps tendon sheath
- Posterior recess:
 - Image with shoulder in external rotation
- Axillary recess
- Subscapularis recess



60

Glenohumeral Joint

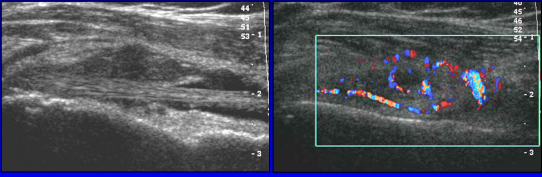
- Posterior joint recess
 - In plane
 - Transducer: axial
 - Lateral to medial
 - Most reliable site*

Eur Radiol 2011; 21:1858

61

Inflammatory Tenosynovitis: biceps tendon

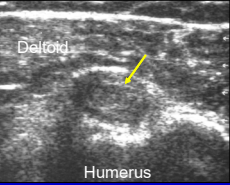


Long Axis

62

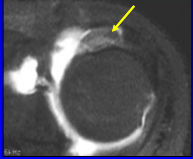
Biceps Tendon:

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



Deltoid

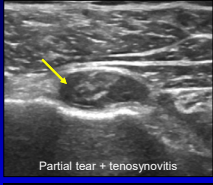
Humerus



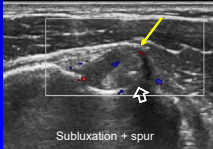
63

Biceps Tendon

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



Partial tear + tenosynovitis



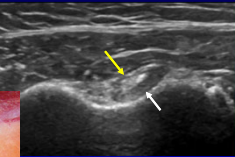


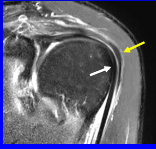
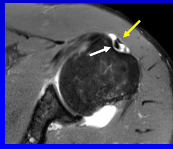
Subluxation + spur

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

64

Aponeurotic Expansion of Supraspinatus Tendon

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

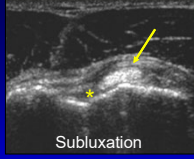






Moser et al. Skeletal Rad 2015; 44:223

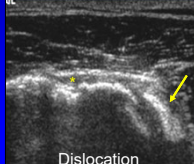
65

Shoulder: biceps tendon

- Subluxation
 - Partial medial displacement
- Dislocation
 - Complete out of groove
 - Possibly located within subscapularis or glenohumeral joint
- Evaluate dynamically



Subluxation



Dislocation

*Farin et al. Radiology 1995; 195:845

66

Biceps Brachii: sheath injection

- Ultrasound-guided: highest accuracy¹
 - Statistically significant difference in pain relief compared with blind injection at 33 weeks²
- In plane, lateral to medial:
 - Deep to tendon: avoid SA-SD bursa
 - Avoid anterior circumflex humeral artery
- Glenohumeral joint extension: if 5 ml injected³

¹Hashiuchi et al. J Sho Elb Surg 2011; 20:1069
²Zhang et al. Ultrasound Med Bio 2011; 37:729
³Nwawka et al. AJR 2016; 206:337

67

Biceps Tendon Sheath Injection

**Injection should surround tendon*
**Confirm post-injection in short and long axis*

68

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- **Subacromial-subdeltoid bursa**

69

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

Rheumatoid Arthritis

*Invest Radiol 1985;20:311

70

Subacromial-subdeltoid Bursa: fluid

Coronal Coronal T2w

71

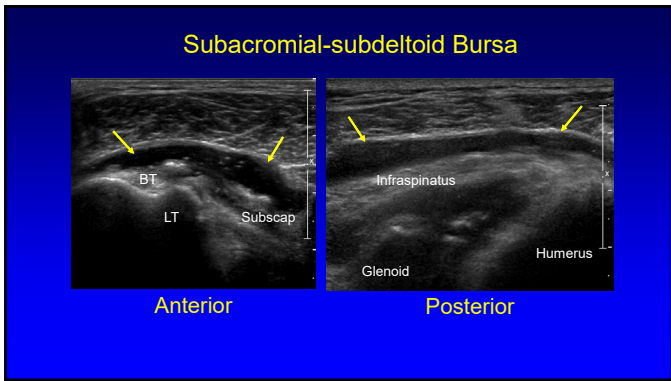
Subacromial-subdeltoid bursa: anterior

Proximal Distal

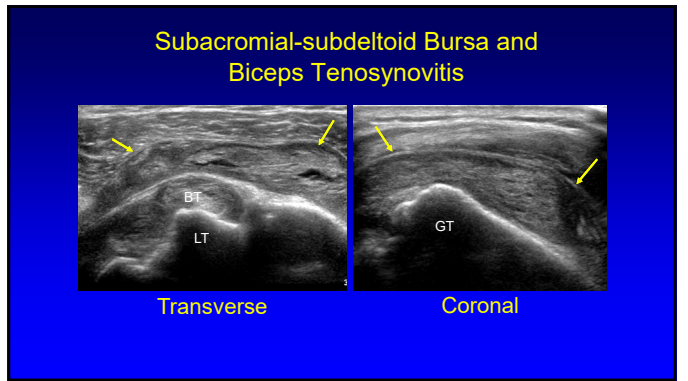
Biceps
Humerus

Sagittal

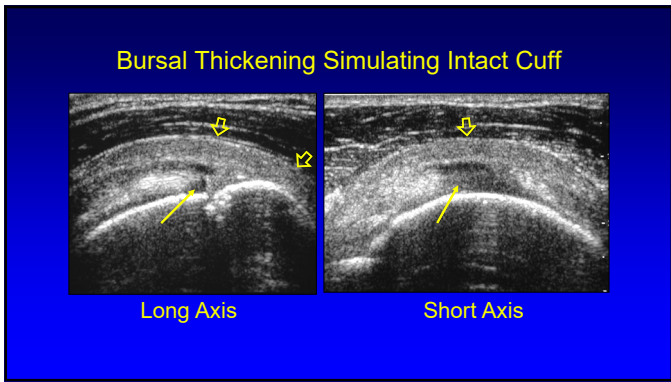
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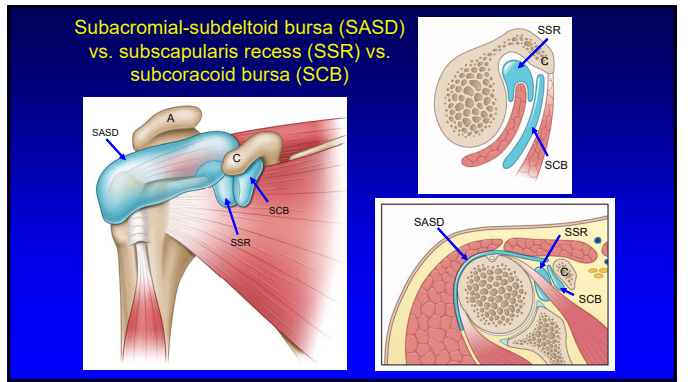
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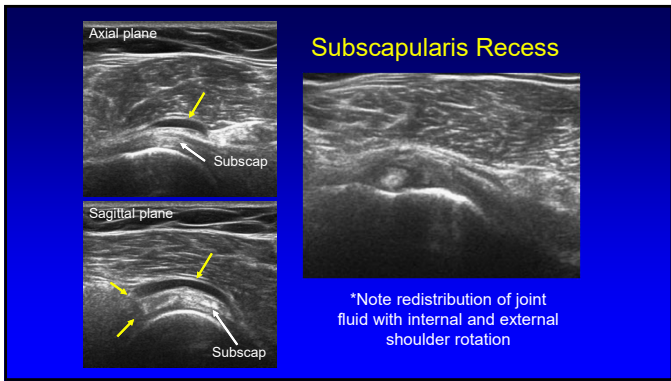
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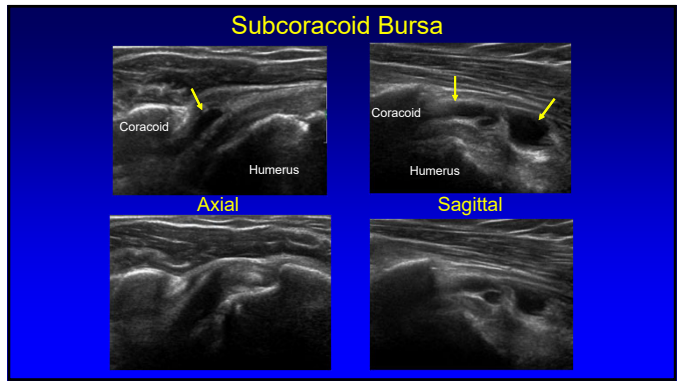
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76



77



78

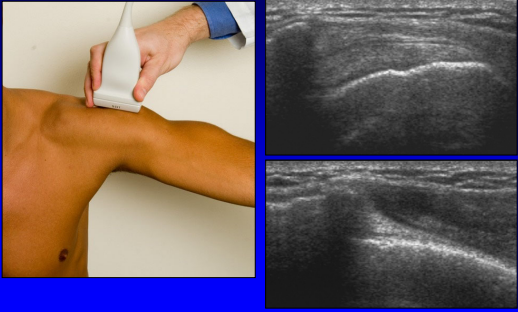
Impingement: bursal fluid

- Abnormal pooling of subacromial-subdeltoid bursal fluid
- Lateral acromion¹:
 - Coronal plane, active arm elevation
 - Not visible in neutral position, no cuff tear
- At coracoid²:
 - Axial plane, active elevation internal rotation

¹Farin et al. Radiology 1990; 176:845
²Stallenberg et al. AJR 2006; 187:894

79

Impingement Test



80


Impingement: supraspinatus



81

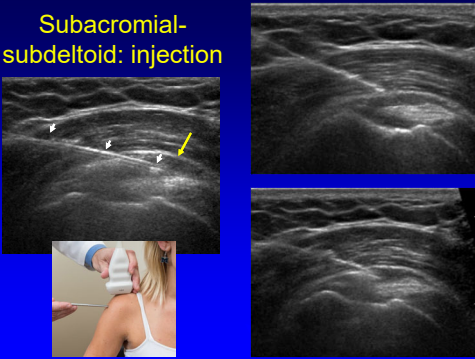
Subacromial-subdeltoid Bursa

- In plane
- Posterior to anterior or lateral to medial
- Patient supine
- Test inject
- Avoid rotator cuff



82

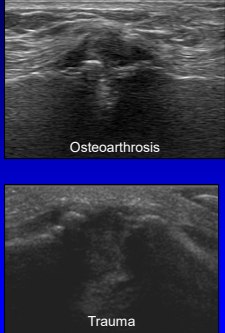
Subacromial-subdeltoid: injection



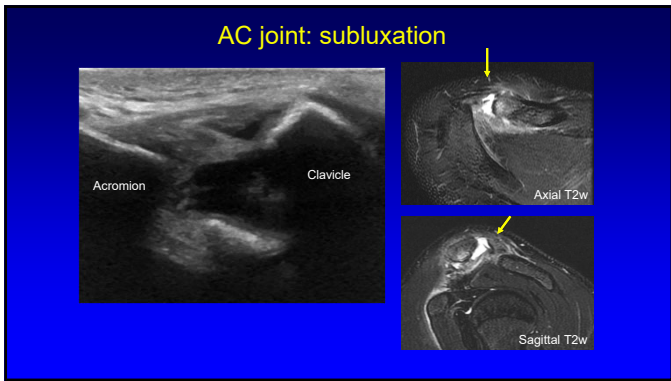
83

Acromioclavicular Joint

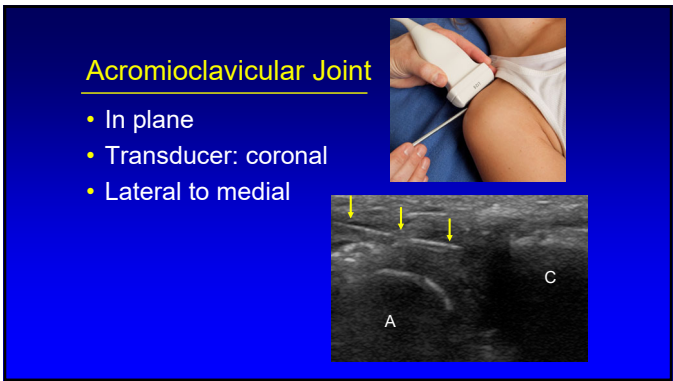
- Dynamic evaluation: clinical sign "cross-arm"
 - Ipsilateral hand to opposite shoulder: pain
- Normal:
 - Maneuver: ACJ narrows, <1 mm, no pain
 - Rest: widens back to normal (up to 5 mm)
- Abnormal:
 - Maneuver: ACJ narrows, > 1 mm, extruded capsule and disc: **osteoarthritis**
 - Rest: ACJ widens > 5 mm: **trauma**



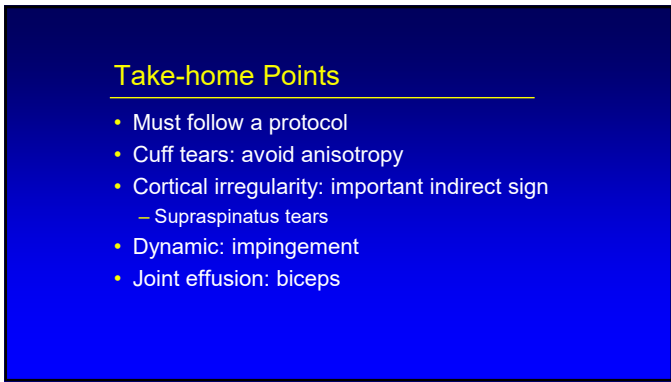
84



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