

MRI of the Rotator Cuff with Ultrasound Correlation

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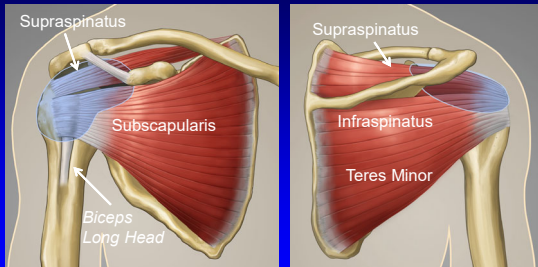
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Disclosures

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

2

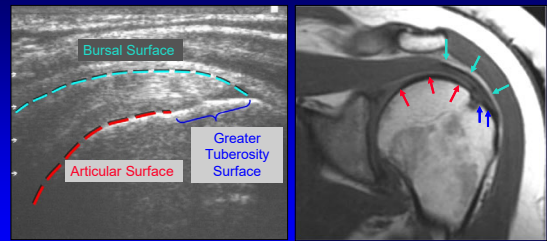
Rotator Cuff



Note: Subacromial-subdeltoid Bursa (light blue)

3

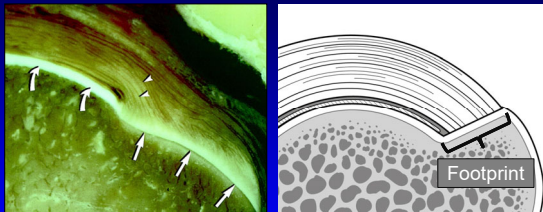
Supraspinatus: 3 surfaces



Long Axis

4

Supraspinatus Insertion

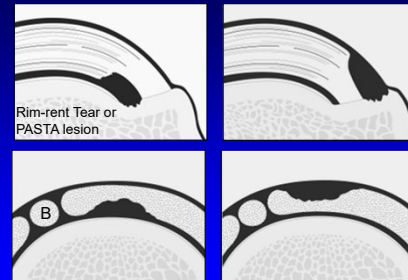


From: Siebold et al.
RadioGraphics
1999; 19:685

*Note:
Tendon
Footprint

5

Supraspinatus Tears: extent

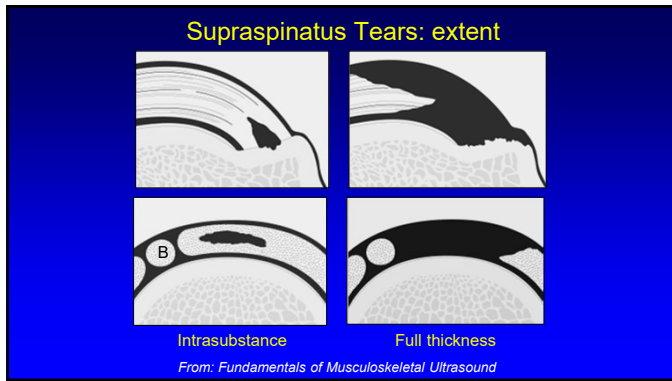


Partial Articular

Partial Bursal

From: Fundamentals of Musculoskeletal Ultrasound

6



7

Rotator Cuff: pathogenesis

- Extrinsic:
 - Repetitive microtrauma: microtears
 - Subacromial impingement
- Intrinsic:
 - Degeneration: predispose to tear
 - Avascular region: critical zone
- Usually over age of 40 years

8

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

9

Rotator Cuff: MRI

- Normal: low signal
- Magic angle phenomenon
 - T1w and PDw (low TE)
 - Increased signal
 - Tendon 55° to field
 - T2w (long TE): **normal**
 - SE: >40 msec
 - FSE: >70 msec

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

Br J Radiology 1998; 71:31

10

Rotator Cuff: ultrasound

Long Axis Sub Short Axis

- Hyperechoic, fibrillar

11

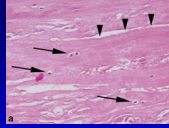
Anisotropy: supraspinatus

Long Axis Short Axis

12

Rotator Cuff: tendinosis

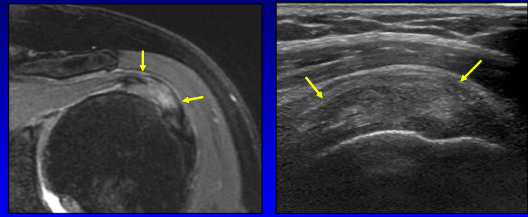
- No inflammatory cells
 - Mucoïd degeneration
 - Chondroid metaplasia
- MRI: T2w **intermediate** signal = muscle
- US: hypoechoic, thickened
- No cortical irregularity at supraspinatus footprint



Hodler J, et al. J MRI; 2010; 32:165
Jacobson, JA, et al. Radiology 2004; 230:234

13

Tendinosis: supraspinatus

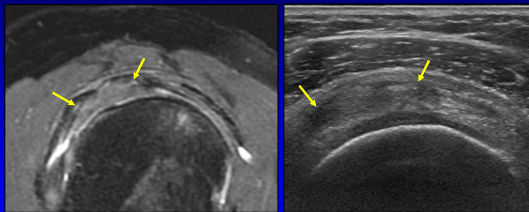


PDw + FS Coronal

Long Axis

14

Tendinosis: supraspinatus



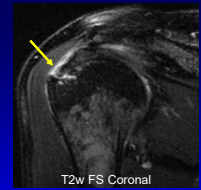
PDw + FS Sagittal

Short Axis

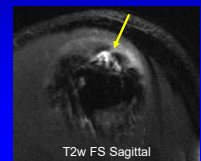
15

Rotator Cuff: MRI

- Tendon tear
 - T1w and PDw: increased signal
 - T2w: **fluid** signal
 - Some tears: low or intermediate signal
 - Intra-articular contrast in tendon
 - Abnormal morphology
 - Possible tendon thinning
 - Bursal and full-thickness



T2w FS Coronal

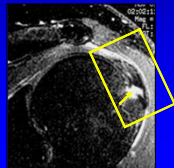
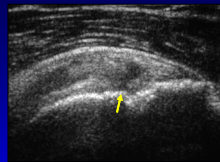


T2w FS Sagittal

16

Rotator Cuff Tear: ultrasound findings

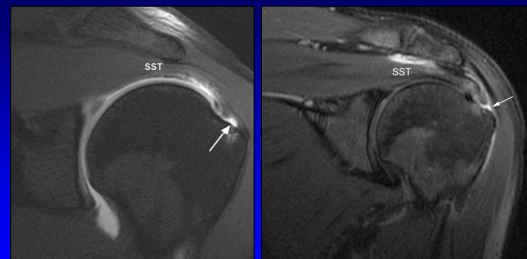
- Direct:
 - Anechoic or hypoechoic defect
 - Tendon discontinuity or retraction
- Indirect:
 - Cortical irregularity footprint (supraspinatus)
 - Abnormal morphology: thinning
 - Cartilage interface sign
 - Joint and bursal fluid (non-specific)



Radiology 2004; 230:234

17

Partial Thickness Tears

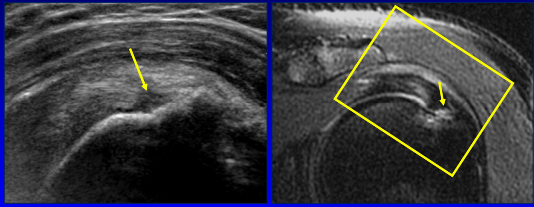


Articular:
MR arthrogram

Bursal

18

Articular Partial-thickness Tear: supraspinatus

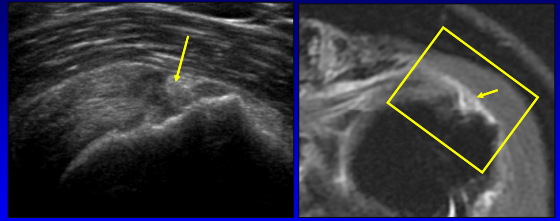


Long Axis

Sagittal T2w

19

Bursal Partial-thickness Tear: supraspinatus

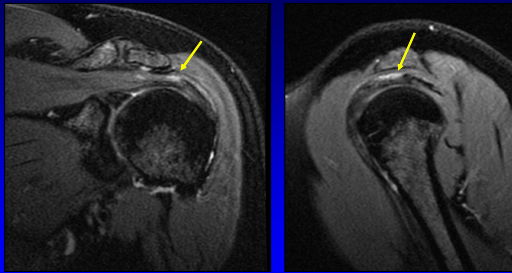


Long Axis

Coronal T2w

20

Partial Bursal Tear: supraspinatus

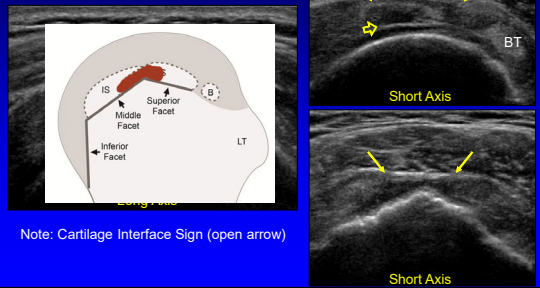


T2w Coronal-obl

T2w Sagittal-obl

21

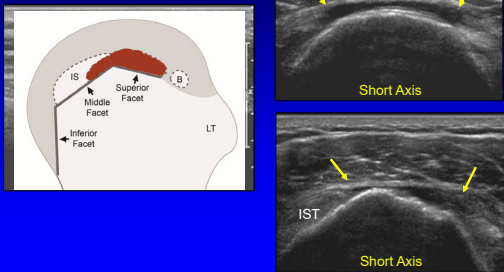
Full-thickness Tear: supraspinatus



Note: Cartilage Interface Sign (open arrow)

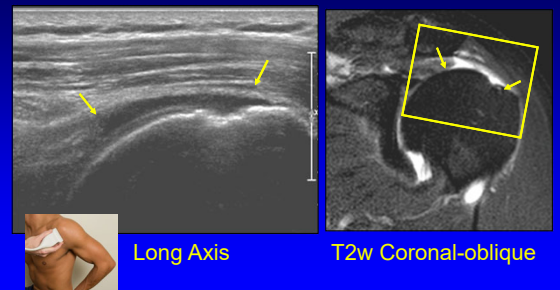
22

Full-thickness Tear: supraspinatus



23

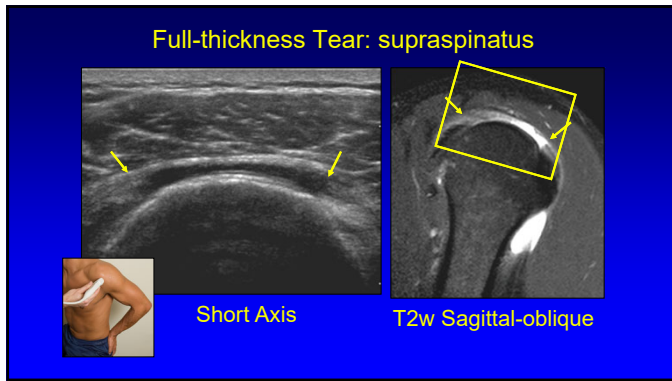
Full-thickness Tear: supraspinatus



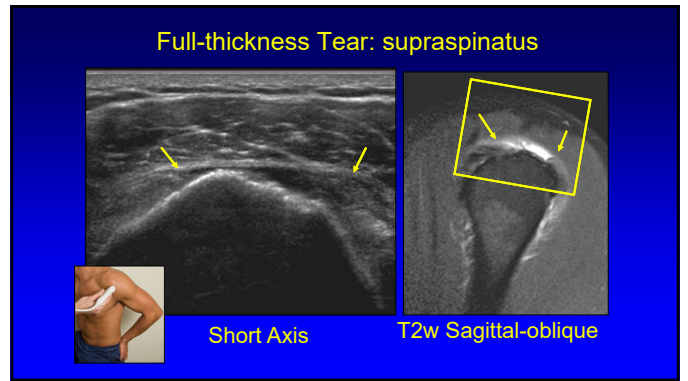
Long Axis

T2w Coronal-oblique

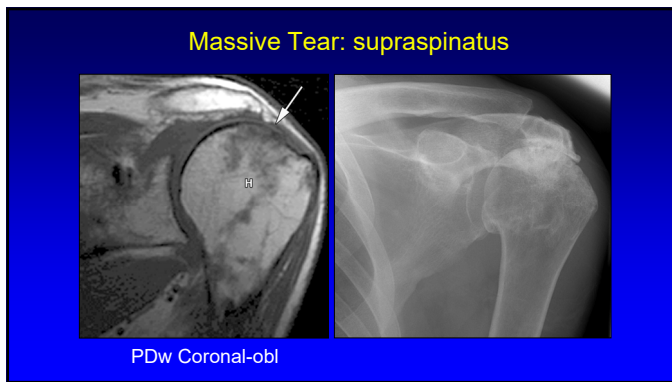
24



25



26



27

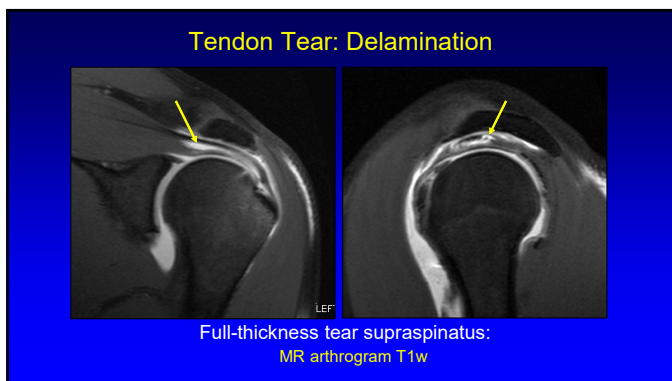
Rotator Cuff Tear: Extent

- Intrasubstance
 - Does not contact articular or bursal surface
 - May contact greater tuberosity

PDw FS Coronal

PDw FS Coronal

28



29

Rotator Cuff Tear: Location

- Young patients: <40 years
 - 56% of cuff tears involved the footprint
 - 50%: PASTA or rim-rent: anterior
 - 34%: interstitial tears, posterior supraspinatus
 - 38%: SLAP or labral tears
- Older patients: 65 years +/- 10 years
 - Degenerative tears: 15 – 16 mm posterior to biceps
 - Center of rotator crescent
 - Full-thickness and larger tears

Eur Radiol 2011; 21:1477
JBJS 2010; 92:1088

30

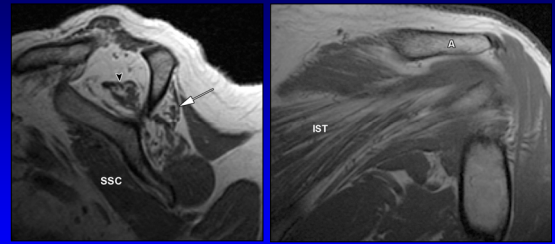
Rotator Cuff Tear: *Fatty atrophy*

- Related to extent and chronicity of rotator cuff tear
 - Poor surgical outcome
- MRI
 - Fatty infiltration, decreased size
- Ultrasound
 - Increased echogenicity, decreased size

JBJS 2012; 94:e83

31

Supraspinatus and Infraspinatus Atrophy



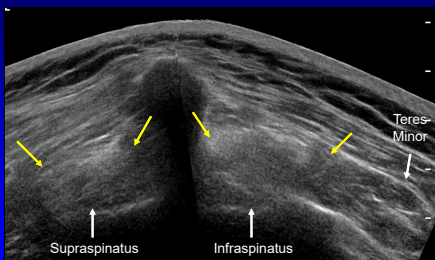
T1w Sagittal-obl

T1w Coronal-obl

From: Morag et al. Radiographics 2006; 26:1045

32

Atrophy: supraspinatus and infraspinatus

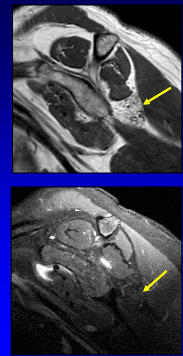


Short Axis (extended field-of-view)

33

Teres Minor Atrophy

- Isolated finding: 3%
- Usually without visible pathology in quadrilateral space:
 - Mass, paralabral cyst, etc.
- May relate to variation in origin and length of teres minor innervation



Sofka, Skeletal Radiol 2004; 33:514
Friend, Surg Radiol Anat 2010; 32:243

34

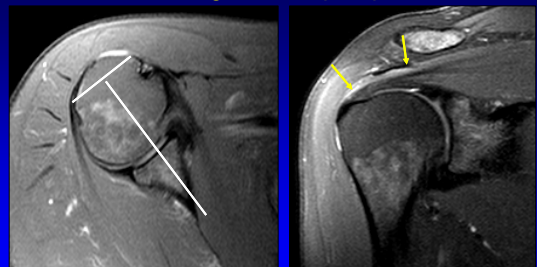
Rotator Cuff MRI: Pitfalls

- Positioning:
 - Internal rotation of shoulder
 - Causes supraspinatus to angle anterior at footprint oblique to imaging planes
 - Far anterior cuff tears: volume average with rotator interval
- Intermediate signal tear (uncommon)
- Musculotendinous junction heterogeneity

Vinson E, AJR 2007; 189:943

35

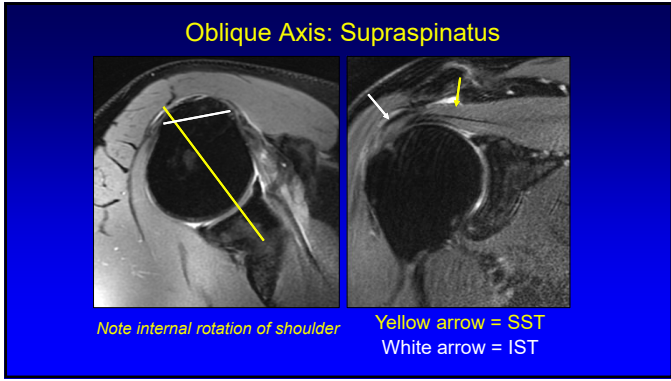
True Long Axis: Supraspinatus



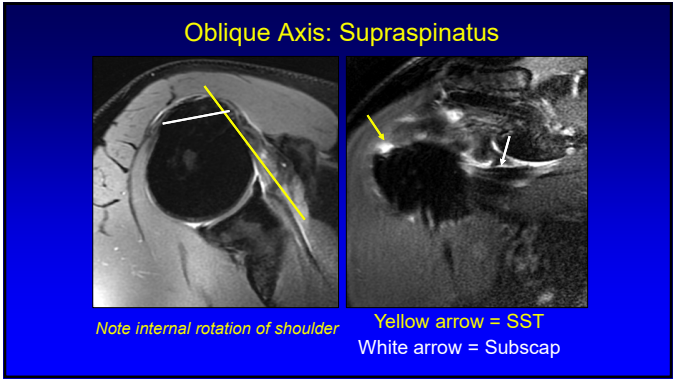
T2w + fat-sat axial

T2w + fat sat coronal-oblique

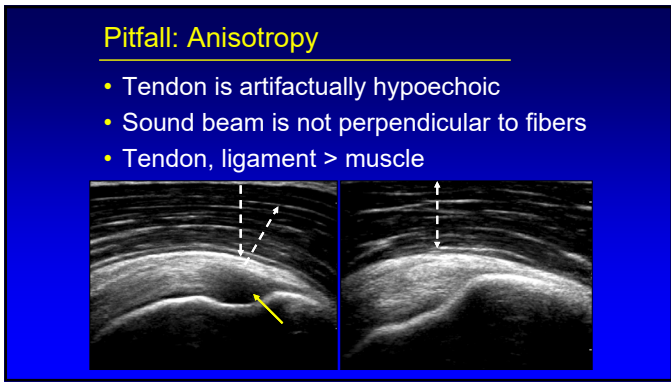
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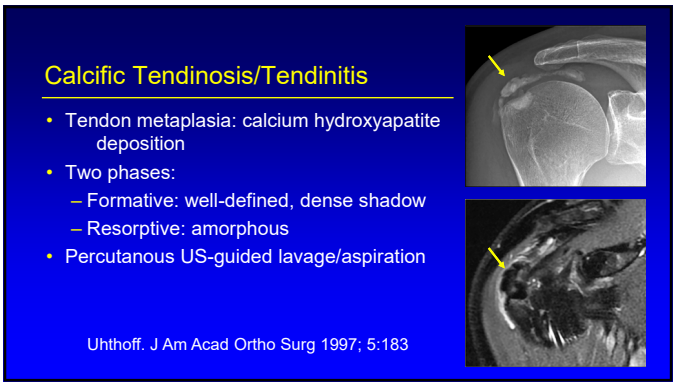
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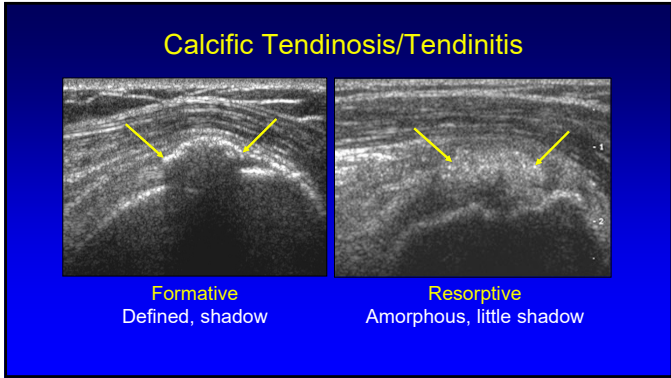
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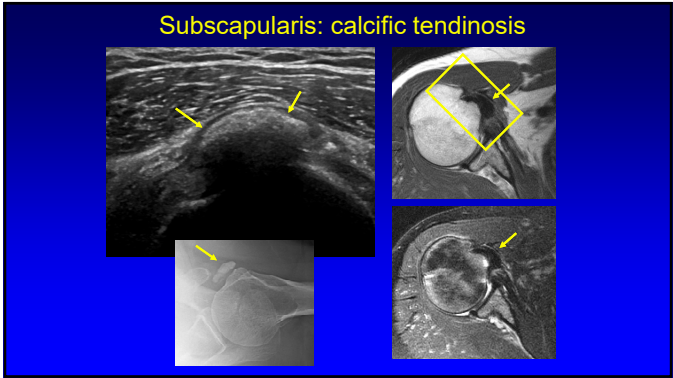
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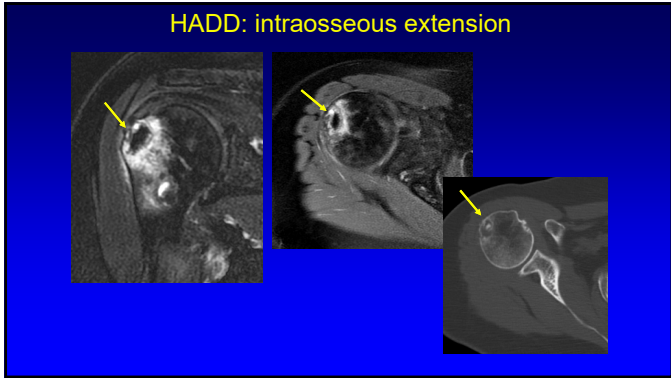
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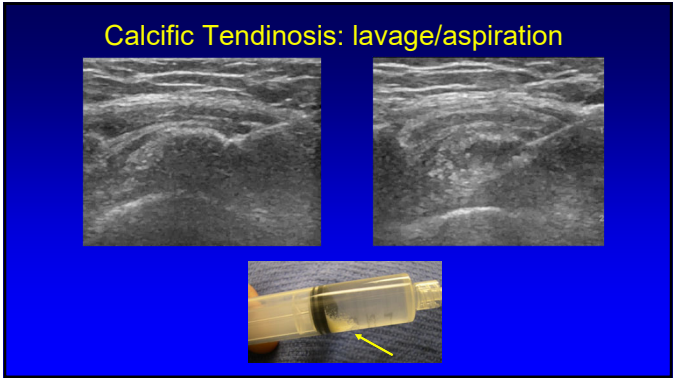
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42



43



44

- Take Home Points**
- Cuff tears:
 - Understand anatomy, facets, footprint
 - Characterization of rotator cuff pathology
 - Pitfall: shoulder rotation
 - Calcific tendinosis:
 - May be difficult to identify: radiographs
 - Intra-osseous extension
 - Ultrasound-guided aspiration

45

Syllabus on line and other educational material:
www.jacobsonmskus.com
 Twitter handle: @jjacobsn

46