Shoulder:
From MRI Scan to OR Table
Does the Read Match the Surgical Findings?

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SMRI
sports medicine research institute

Mary Lloyd Ireland, M.D.
University of Kentucky
Dept. of Orthopaedic Surgery
and Sports Medicine
Lexington, Kentucky
www.MaryLloydIreland.com

UK HealthCare
Orthopaedic Surgery
& Sports Medicine

Michael Otte MD, FACR
Radiology Imaging Associates
Invision Sally Jobe Medical Imaging

We have nothing to disclose.

Introduction

Biceps / SLAP

Instability

Rotator Cuff

Subscapularis

Conclusions

Imaging Decisions in MSK

- Indications for Imaging
  - Mass
  - Infection
  - Trauma
  - Pain
  - Postoperative

Imaging Decisions in MSK

- Modalities
  - Xray
  - Ultrasound
  - CT
  - Nuclear Medicine
  - MRI
- There is no “cookbook” for ordering imaging studies!

Clinical Indications for Musculoskeletal ultrasound – Shoulder

Recommended

- Tendons & soft tissue
- Bursitis
- Full/partial thickness tears
- Calcific tendonitis
- Septic arthritis
- Long head of biceps tendon (LHB)
  - Dislocation
  - Tendinopathy
  - Rupture

Not recommended

- Adhesive capsulitis
- Glenohumeral joint trauma and dynamic instability
- Parsonage-Turner Syndrome
- Rotator cuff muscle atrophy
- Quadrilateral space syndrome
- Thoracic outlet syndrome

*Clinical indications for musculoskeletal ultrasound: A Delphi-based consensus paper of the European Society of Musculoskeletal Radiology;A Klauser,;A Tagliafico et.al/RaEur Radiology (2012)

When Do I Order?

Gadolinium - With or Without Intraarticular

- SLAP
- Failed Labral Repair

Other Intraarticular Dye

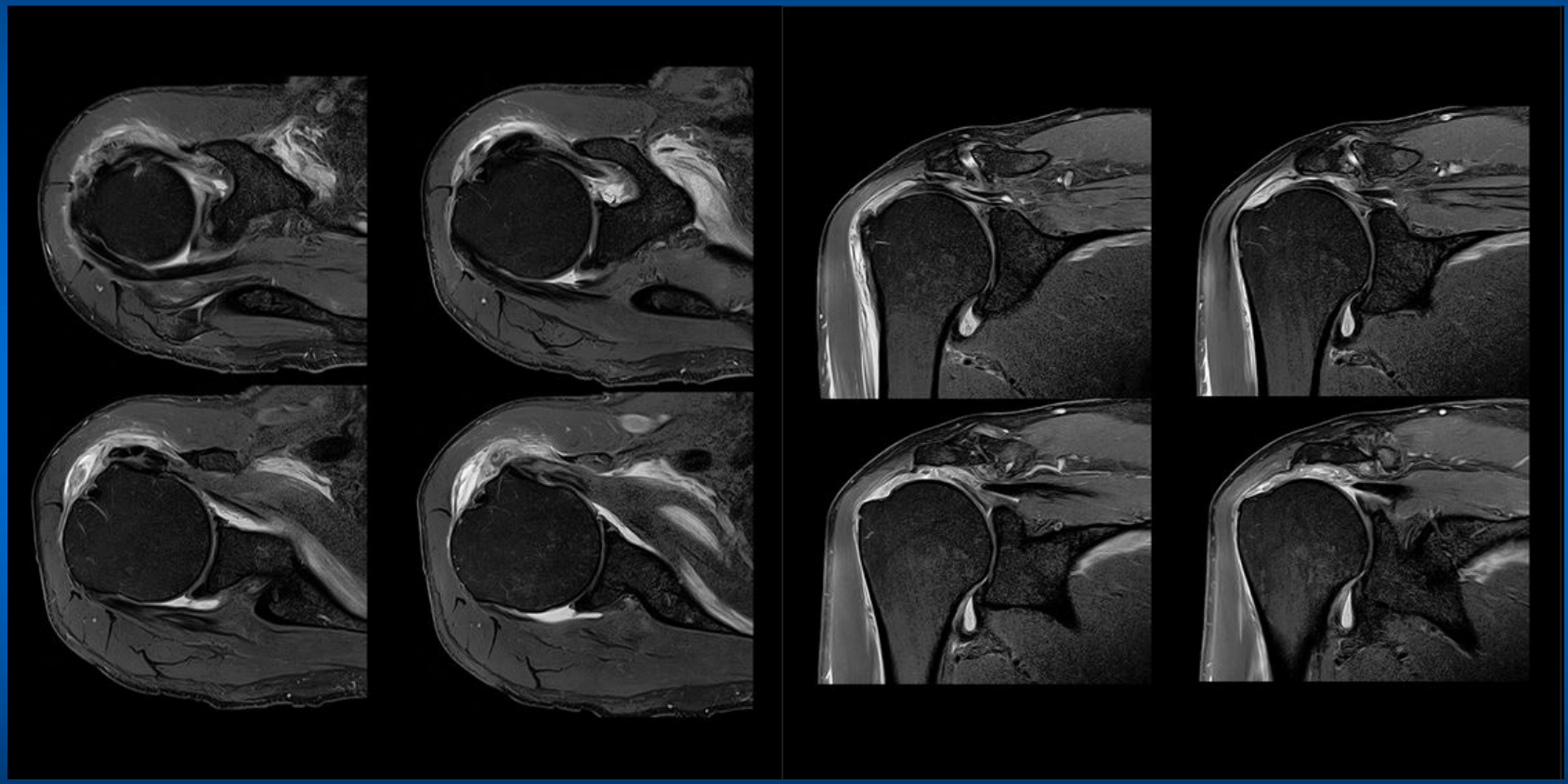
No Dye Adjust Arm Position

IV Gadolinium

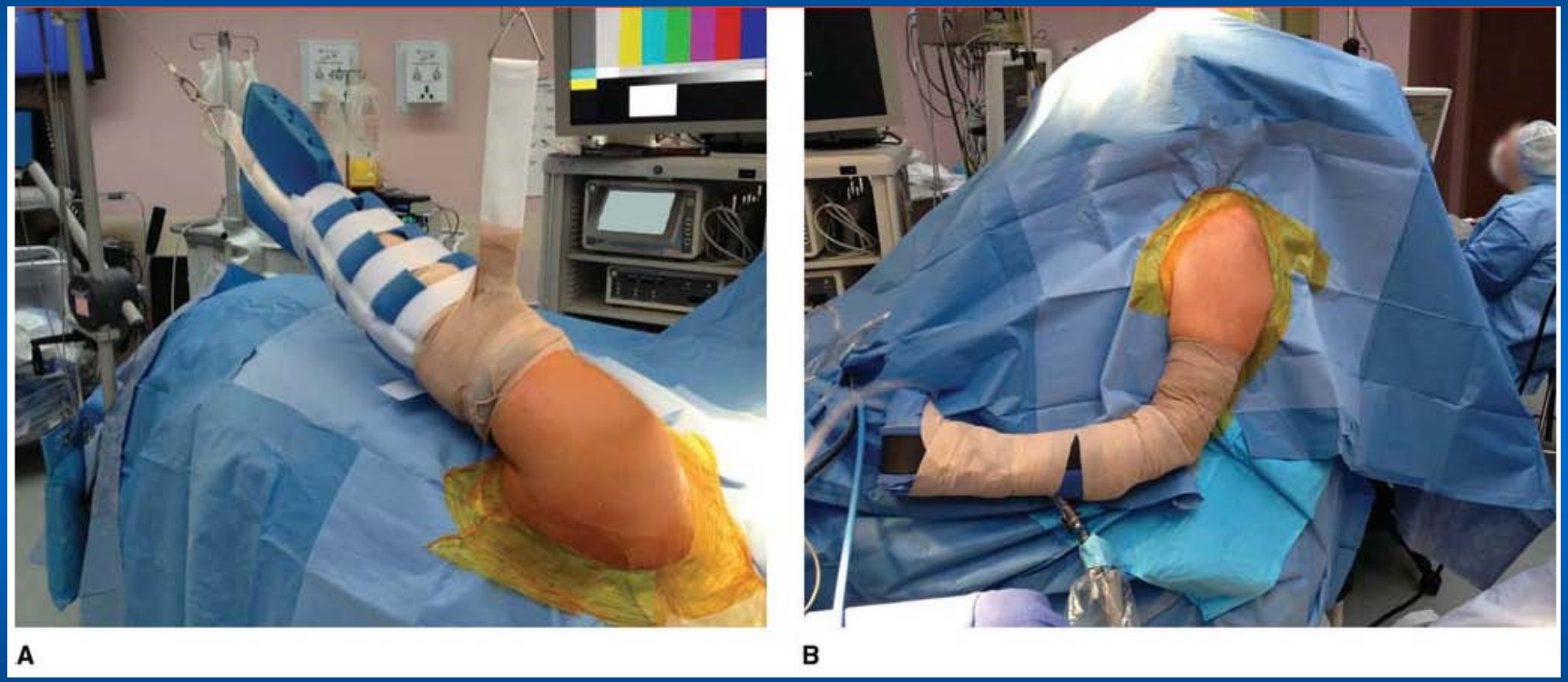
Better Scanners More Tesla better?

Imaging Modalities - MRI

Scanner types

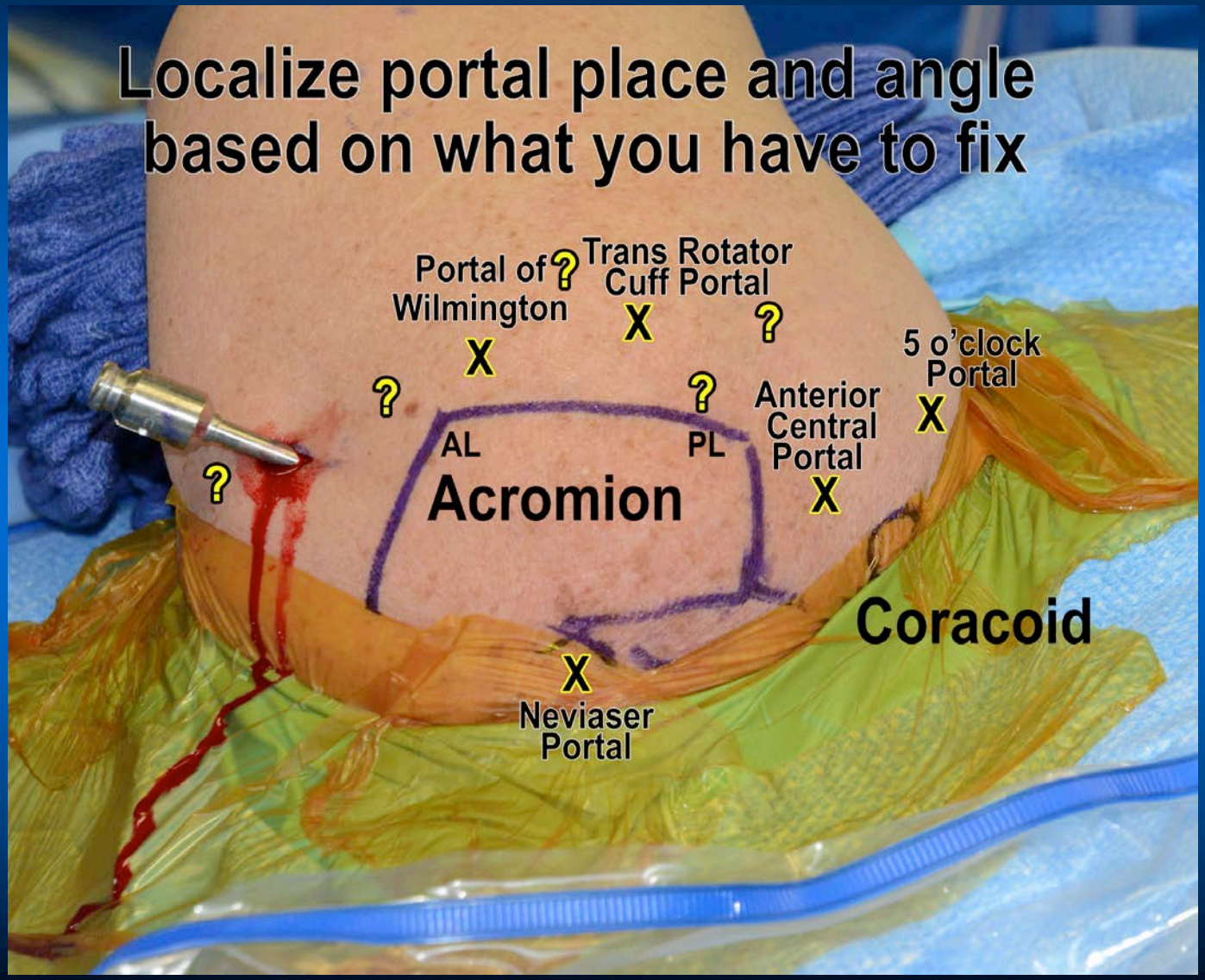


Toshiba 3T 2017

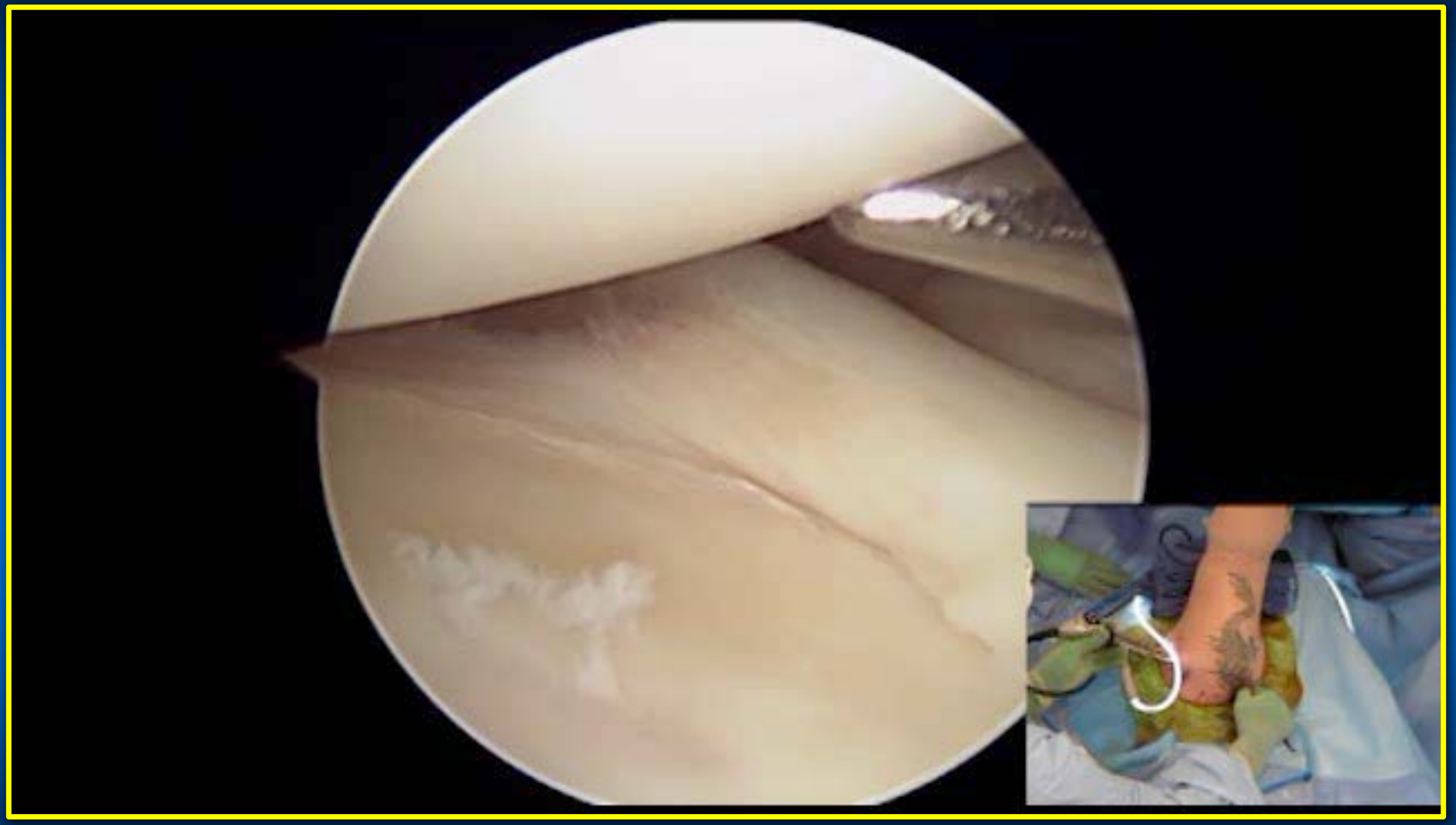


Shoulder Arthroscopy: Basic Principles of Positioning, Anesthesia, and Portal Anatomy, Paxton, Scott E. MD; Backus, Jonathan MD; Keener, Jay MD; Brophy, Robert H. MD., *JAAOS* June 2013 - Volume 21 - Issue 6 - p 332–342

Outside In Needle Localization. Angle and Portal Location Based on What You Have to Fix



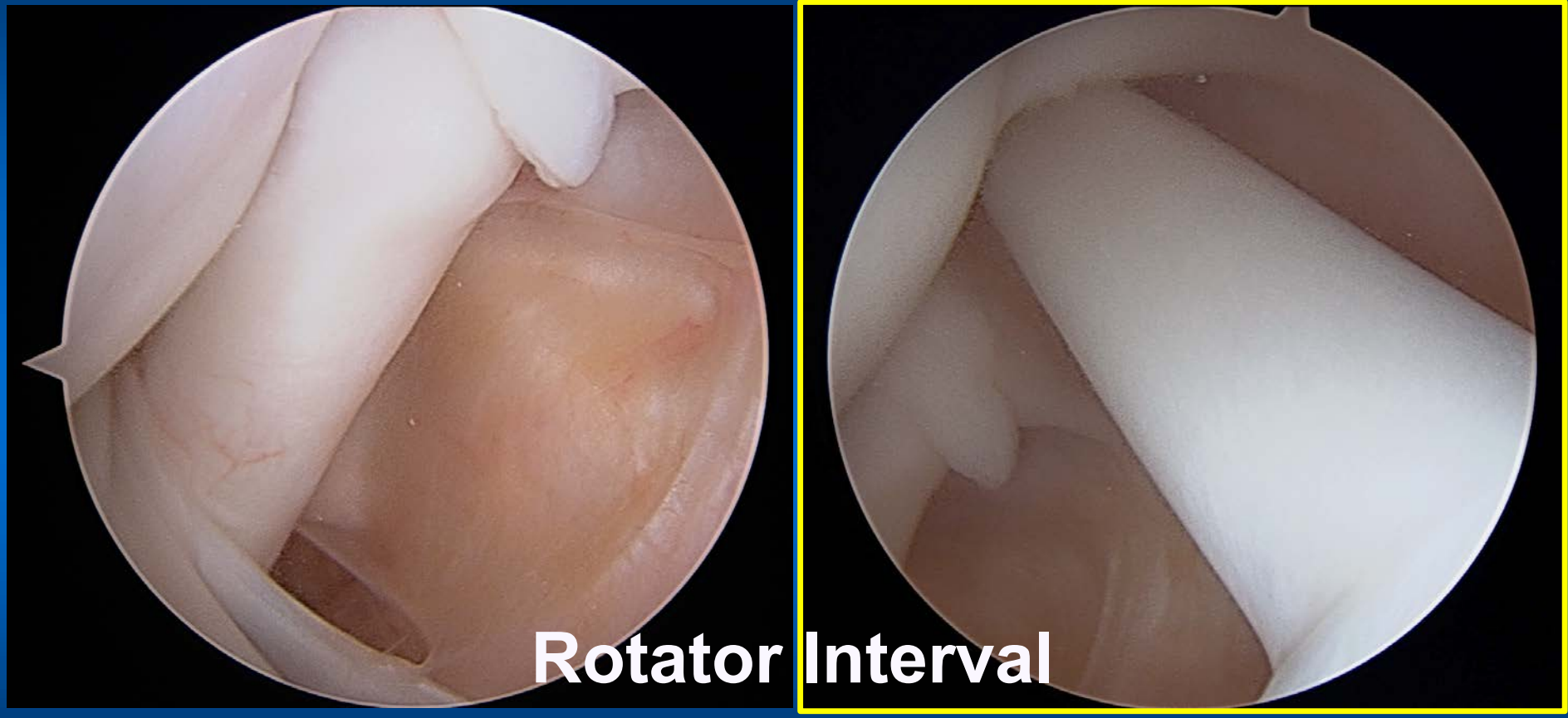

Left Shoulder





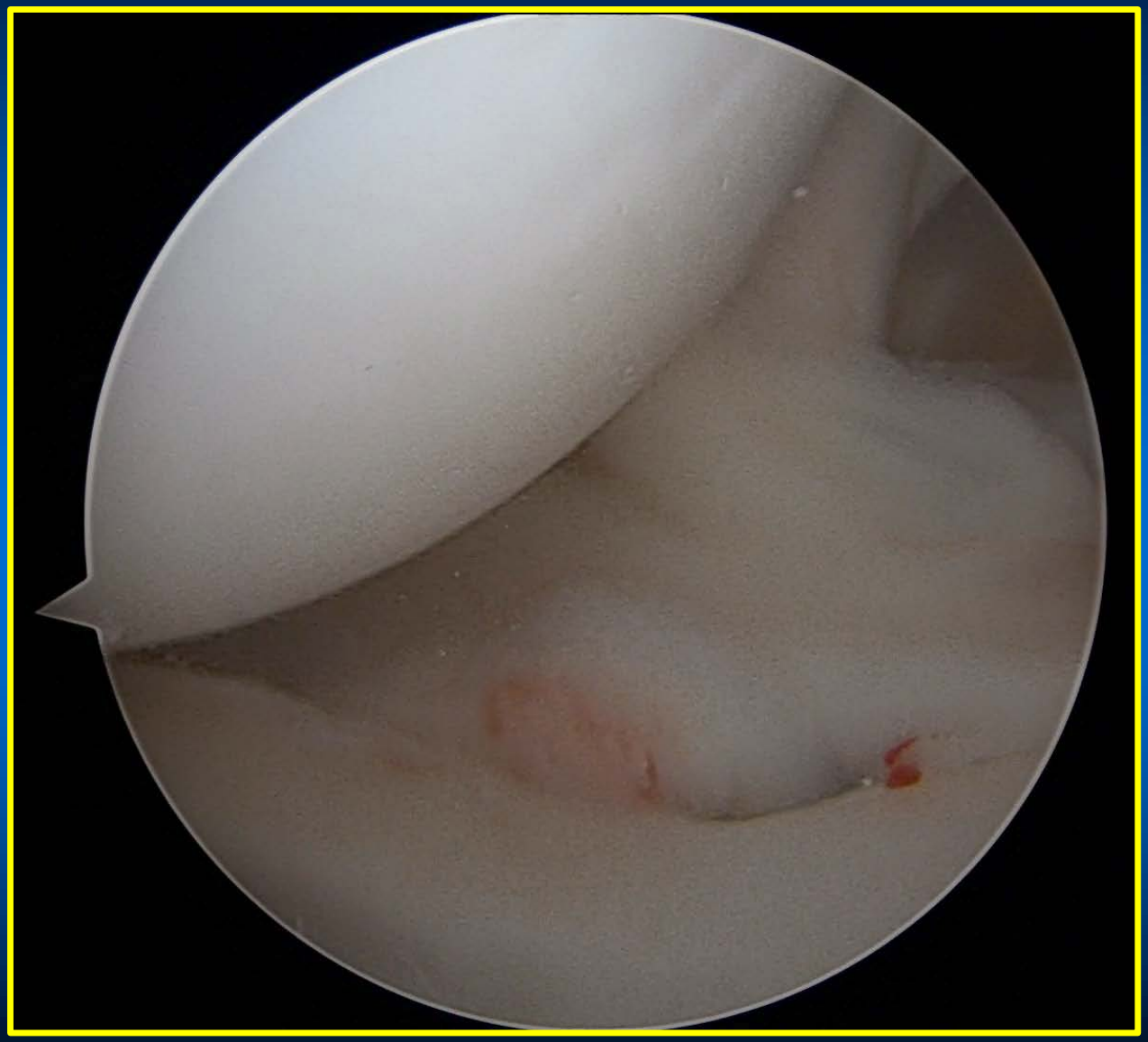

Subscapularis

Biceps

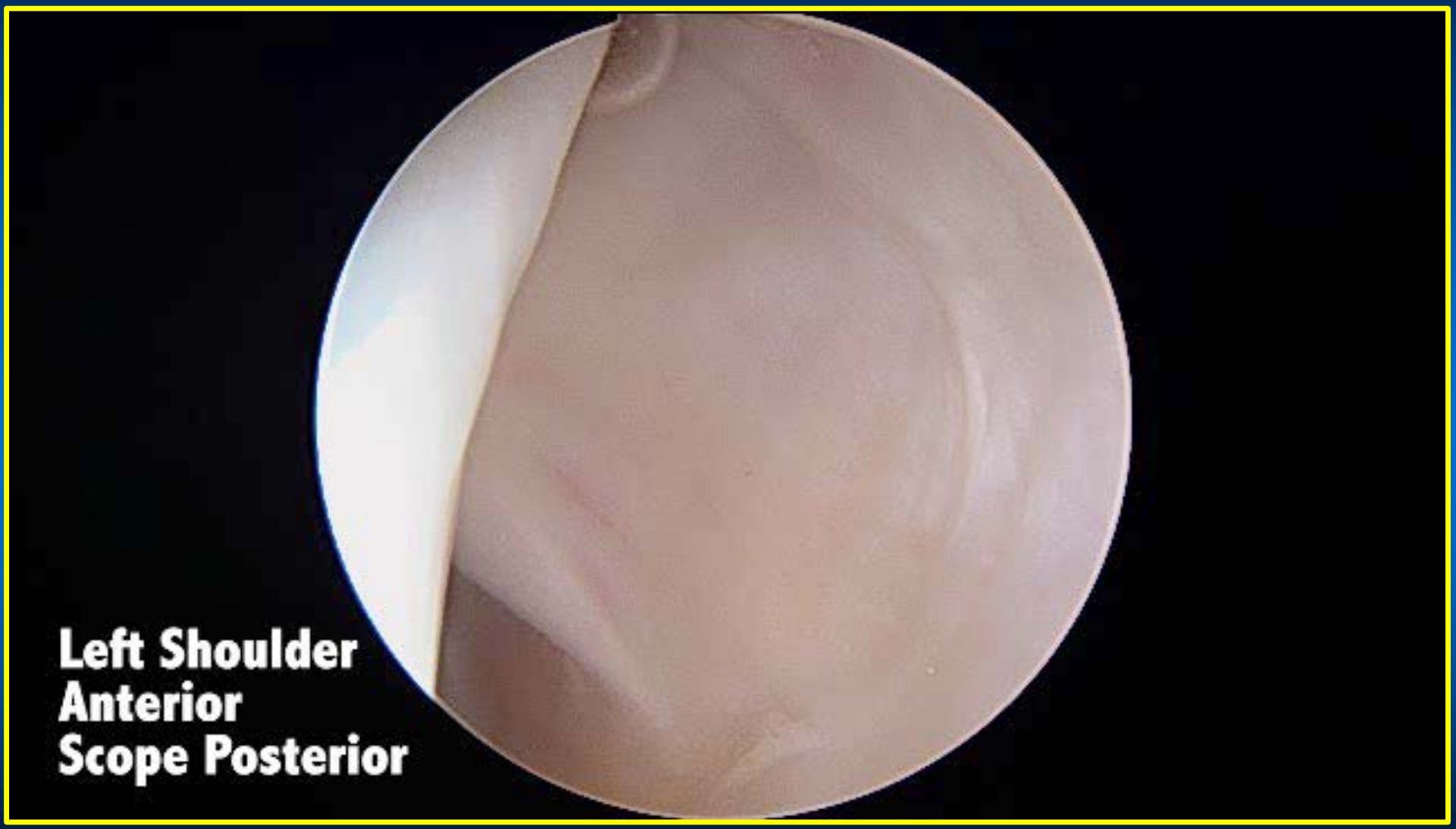


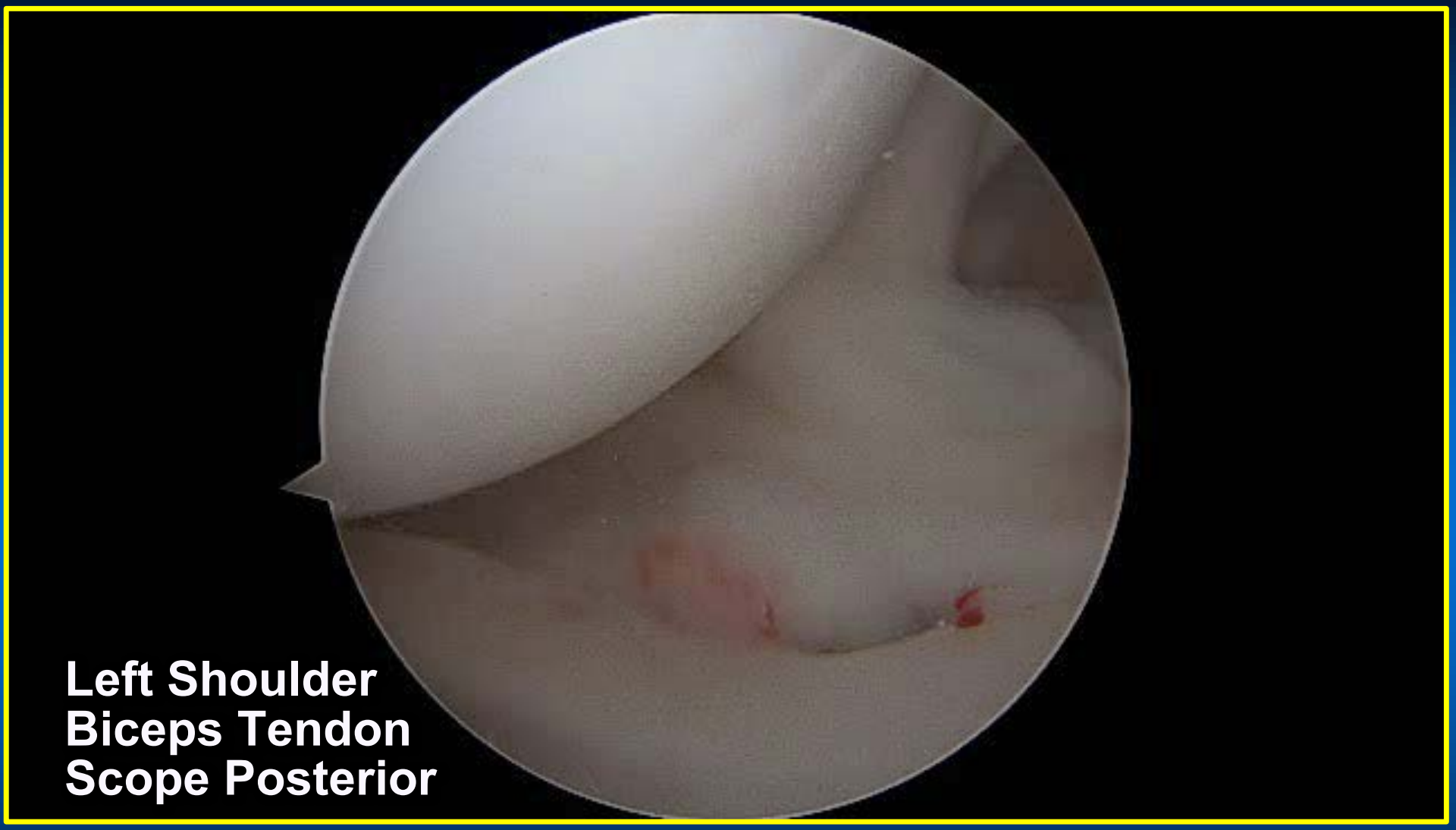
Anterior Ligaments Subscapularis

Biceps Tendon Left Shoulder



Normal Anatomy Tendons and Ligaments




Left Shoulder
Biceps Tendon
Scope Posterior

Do Arthrogram or Not?

Does Position of Arm Assist in DX of Labrum Tear?

What Position of the Arm?

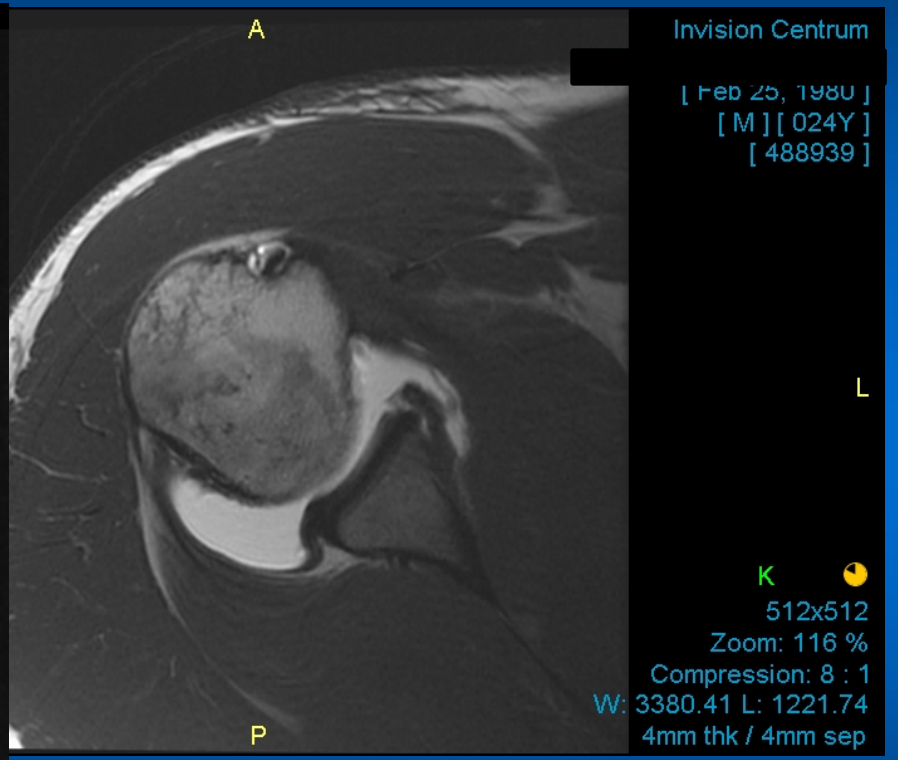
ABER

- Abducted External Rotation
- SLAP

FADIR

- Flexion Adduction Internal Rotation
- Posterior Labrum

Anterior labral tears

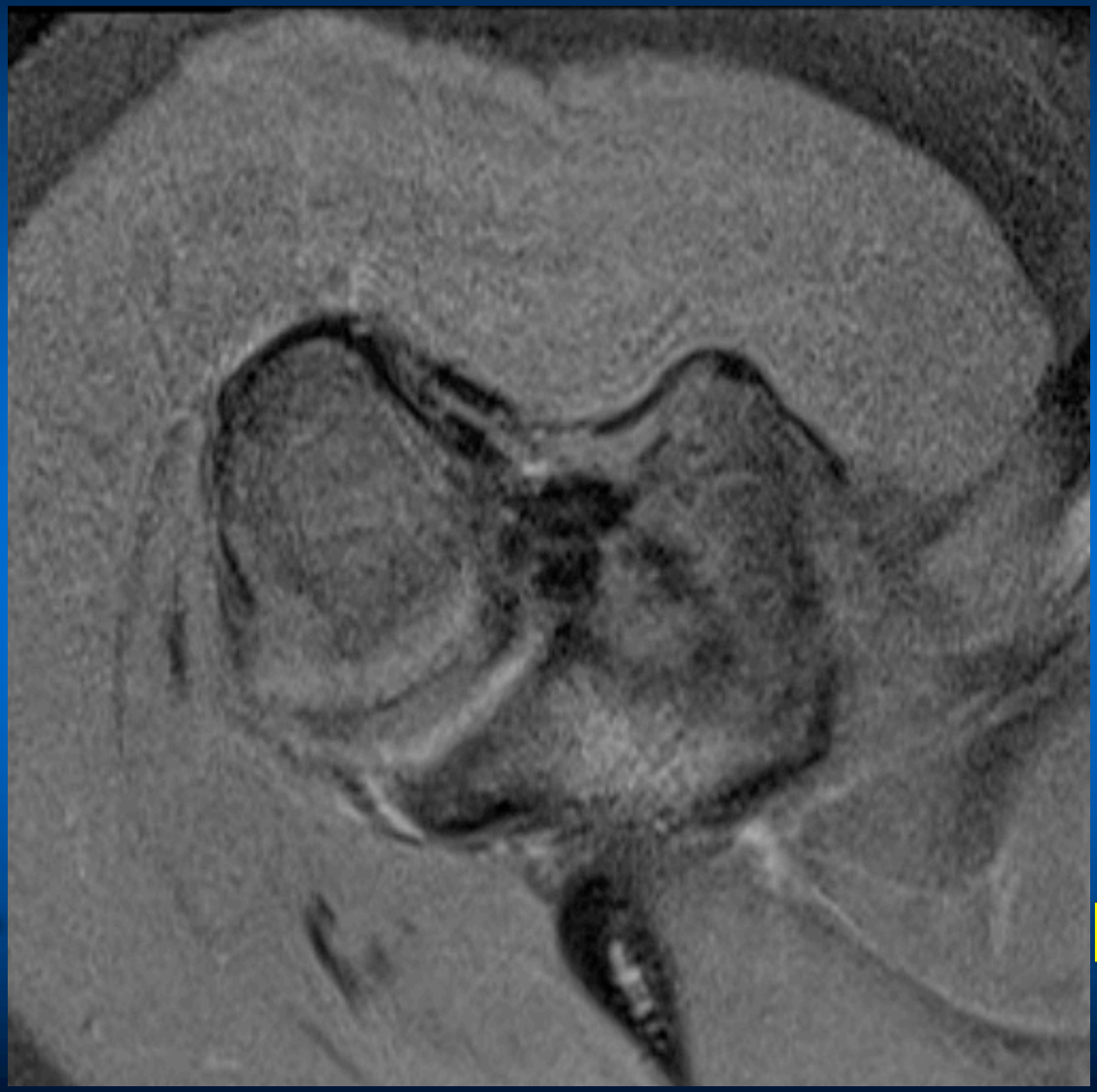


ABER T1FS – anterior labral tear

Anterior

Posterior

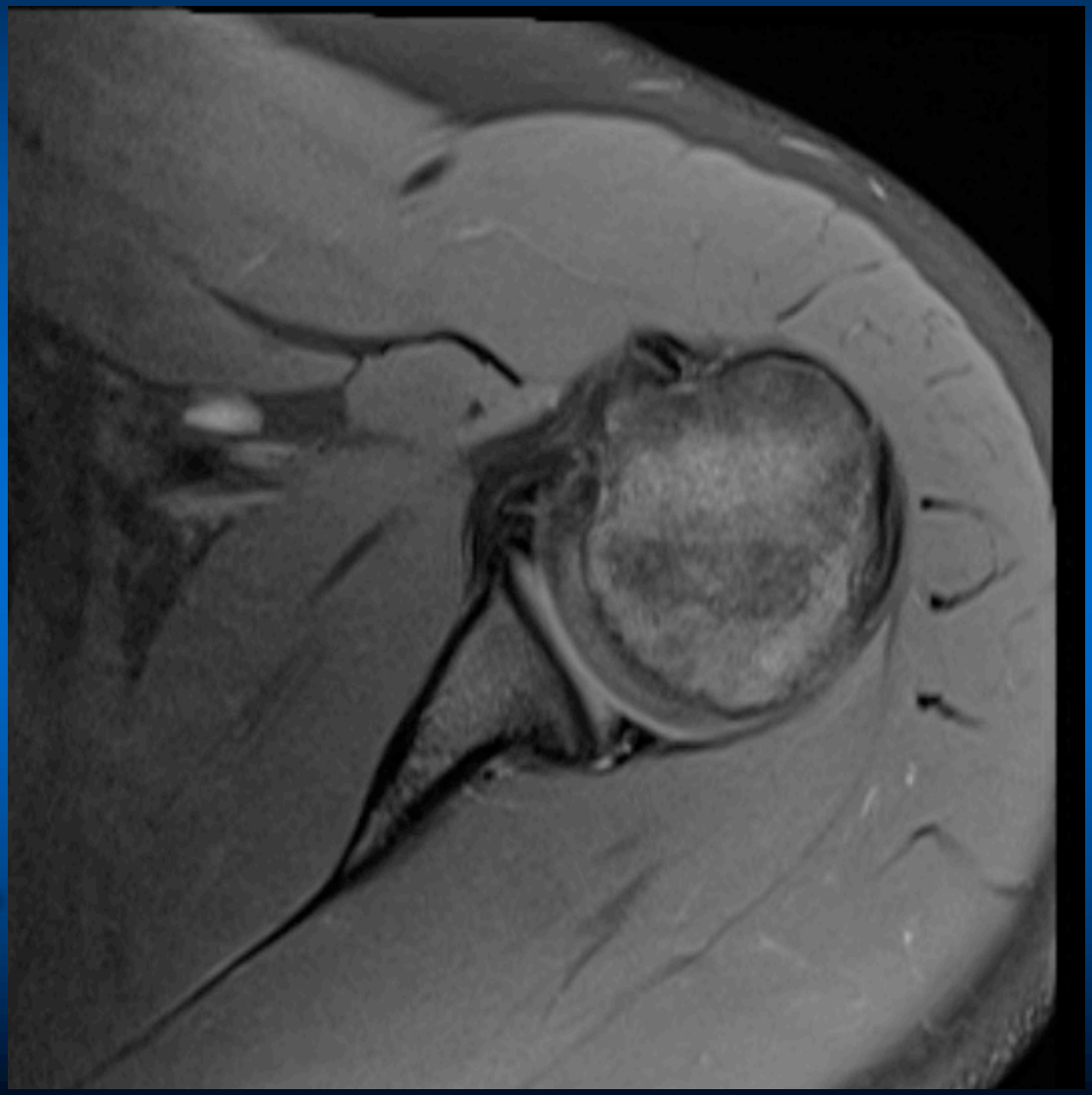
FADIR T2 FS – posterior labral tear



Anterior

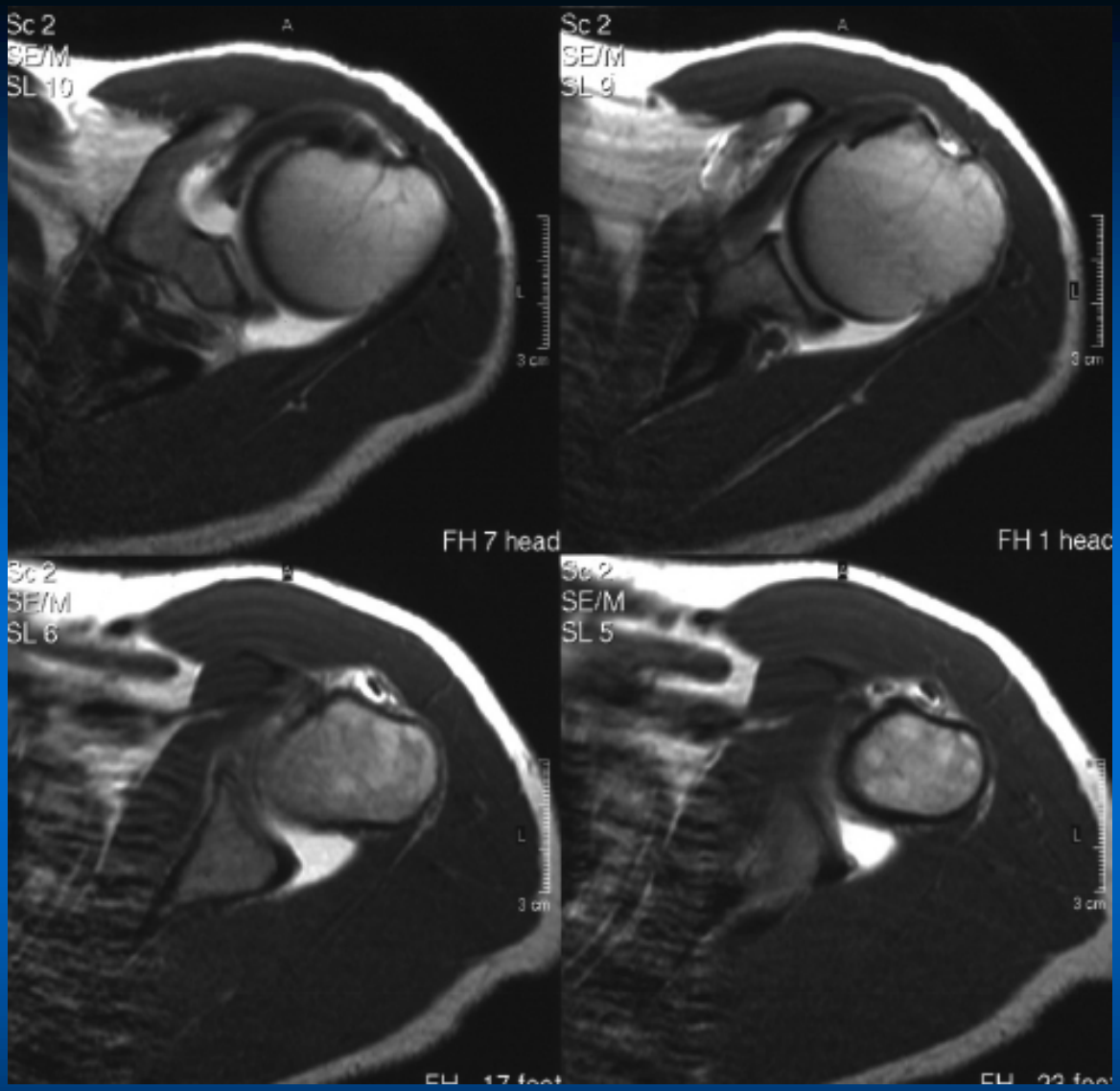
Posterior

Axial PD FS - labral tears

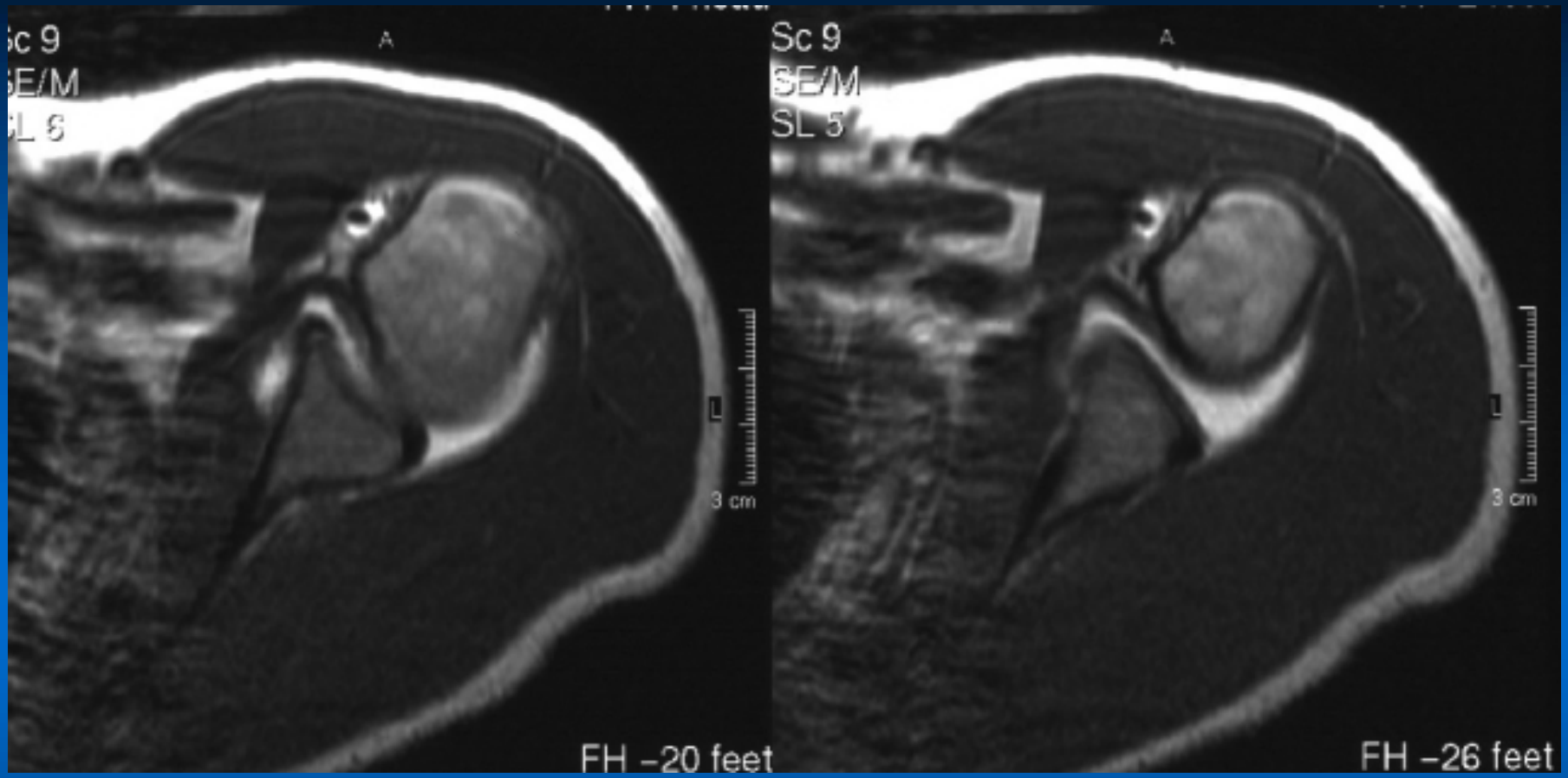


Anterior

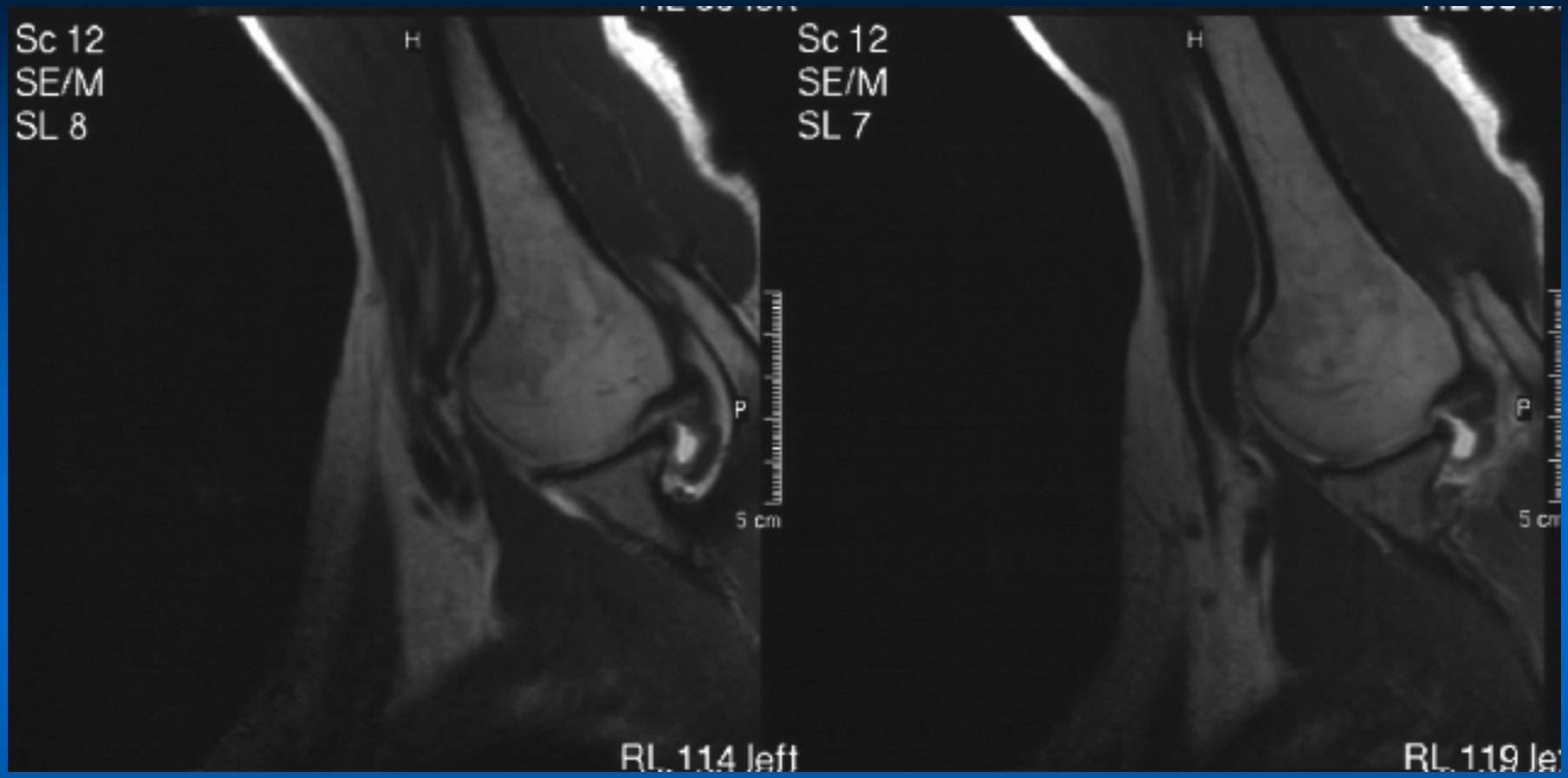
Posterior



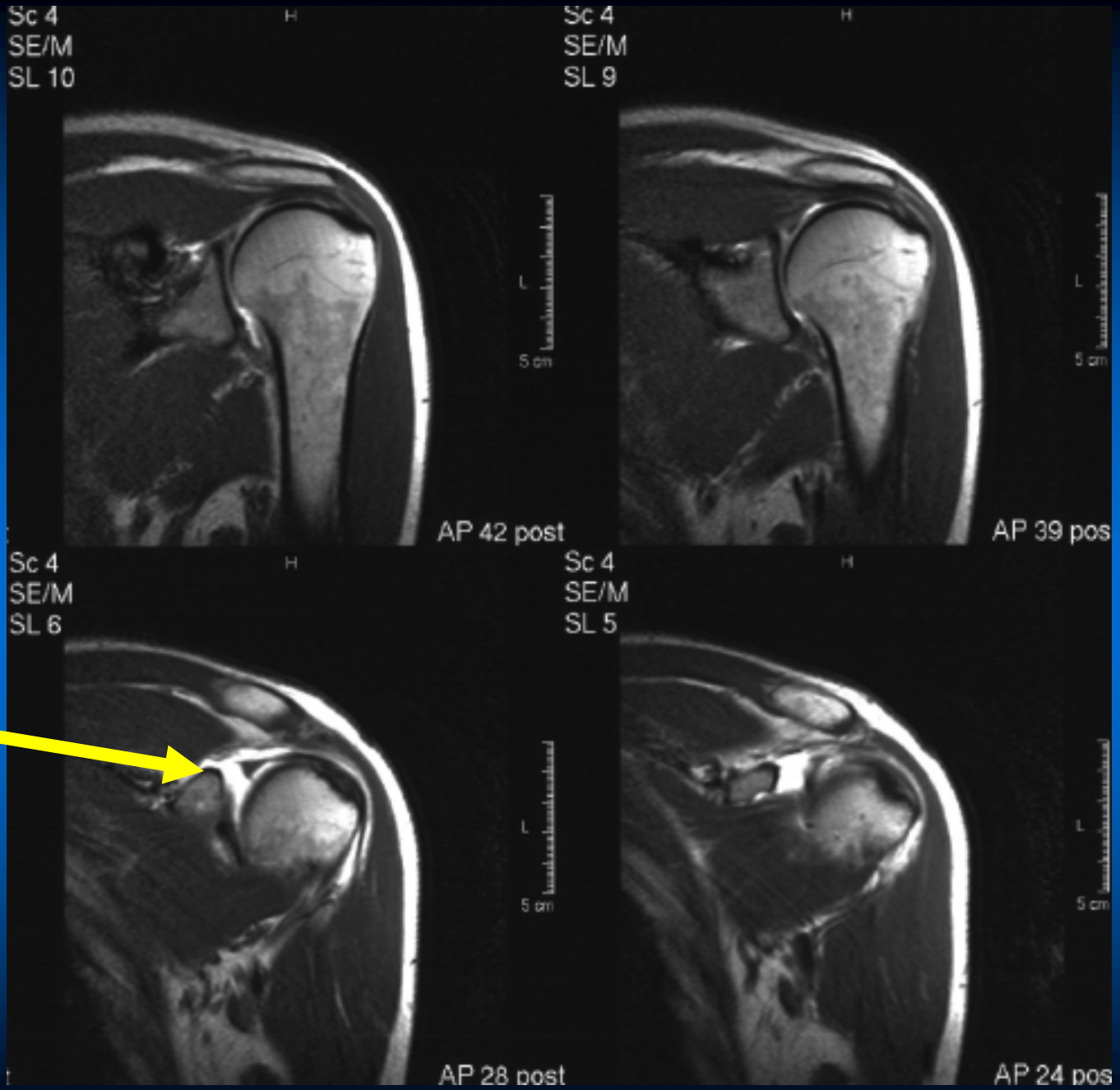
Arm position, ER



Arm position, IR



Arm position hyper-abduction, IR


Sc 4
SE/M
SL 10
AP 42 post
Sc 4
SE/M
SL 9
AP 39 pos
Sc 4
SE/M
SL 6
AP 28 post
Sc 4
SE/M
SL 5
AP 24 pos

Biceps Glenoid Labrum Complex

- Pre-1985
  - Tenodesis
  - Many procedures
  - Originally described 1948: Hitchcock HH and Bechtol CP, “Painful shoulder: observation on a role of the tendon of the long head of the biceps brachii in its causation,” JBJS 30-A: 263 (1948).

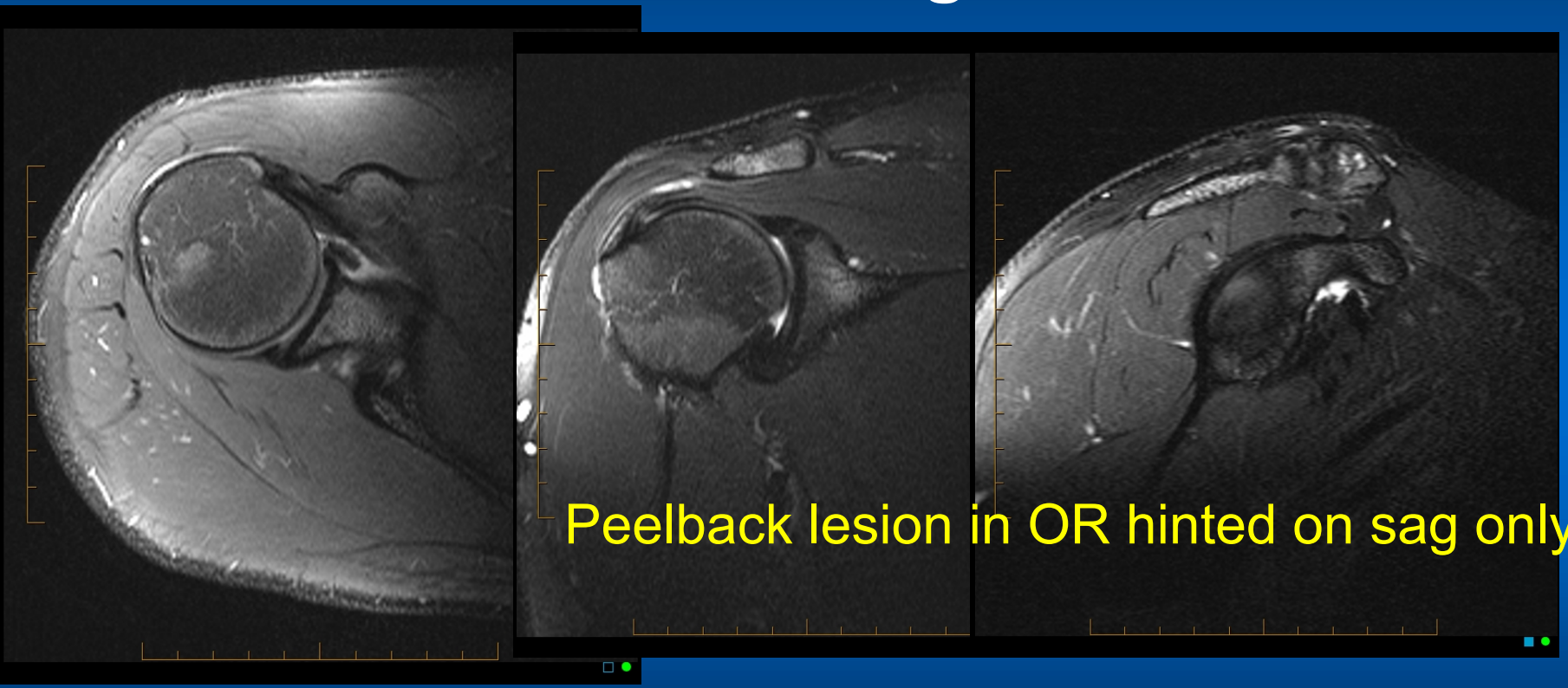
Now 62 years later:

- Biceps is still a pain generator

Shoulder Pain in a Thrower
Biceps Tendon / Labrum

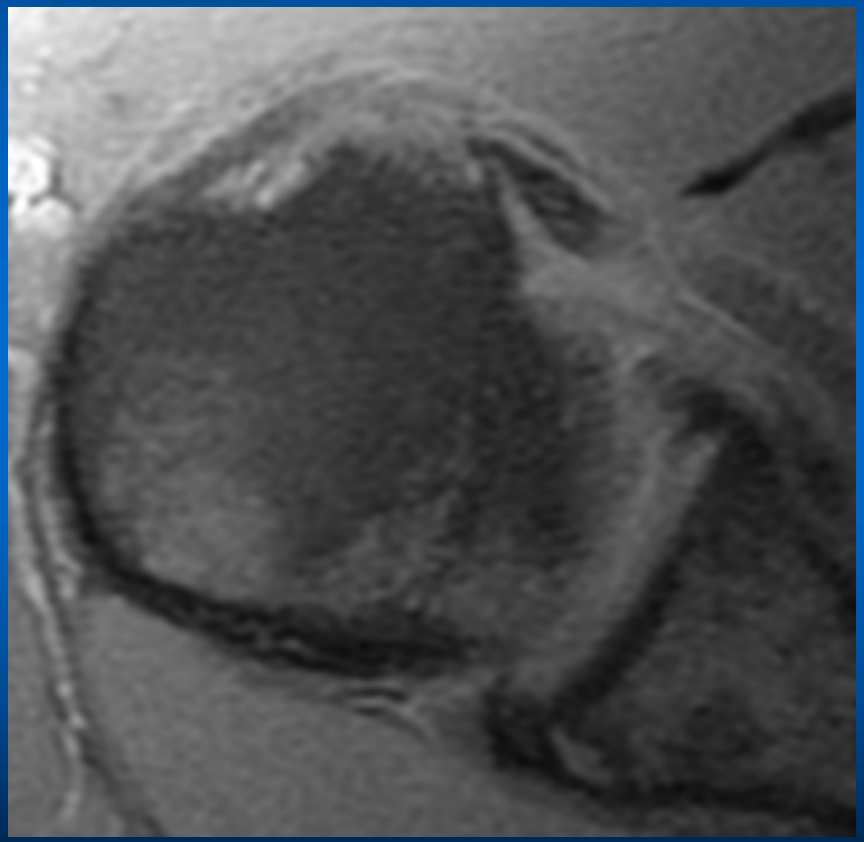
- Prior to 1980s: No MRI Scan, Diagnosis was biceps tendinitis
- Mid 1980's Arthroscopy Defined SLAP and Injuries in Throwing Athletes
- 1990s: SLAP lesion
  - Repair most
- 2005: more tenodeses
- 2017 Repair Younger Athletes, Move Early, Throw Later
  - Do Not Repair after age 35
- If not repairing, only tenodesis or tenotomy– Cannot Fix then Why do MRI scan and Why Operate??

False negative labrum

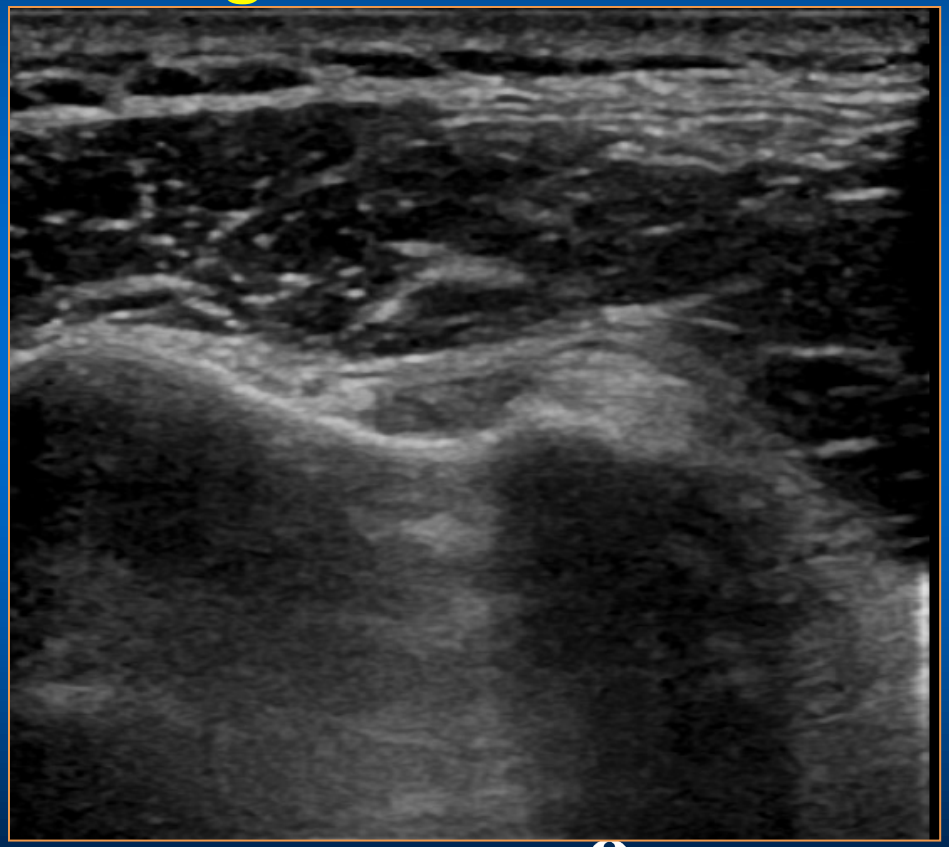


Shoulder

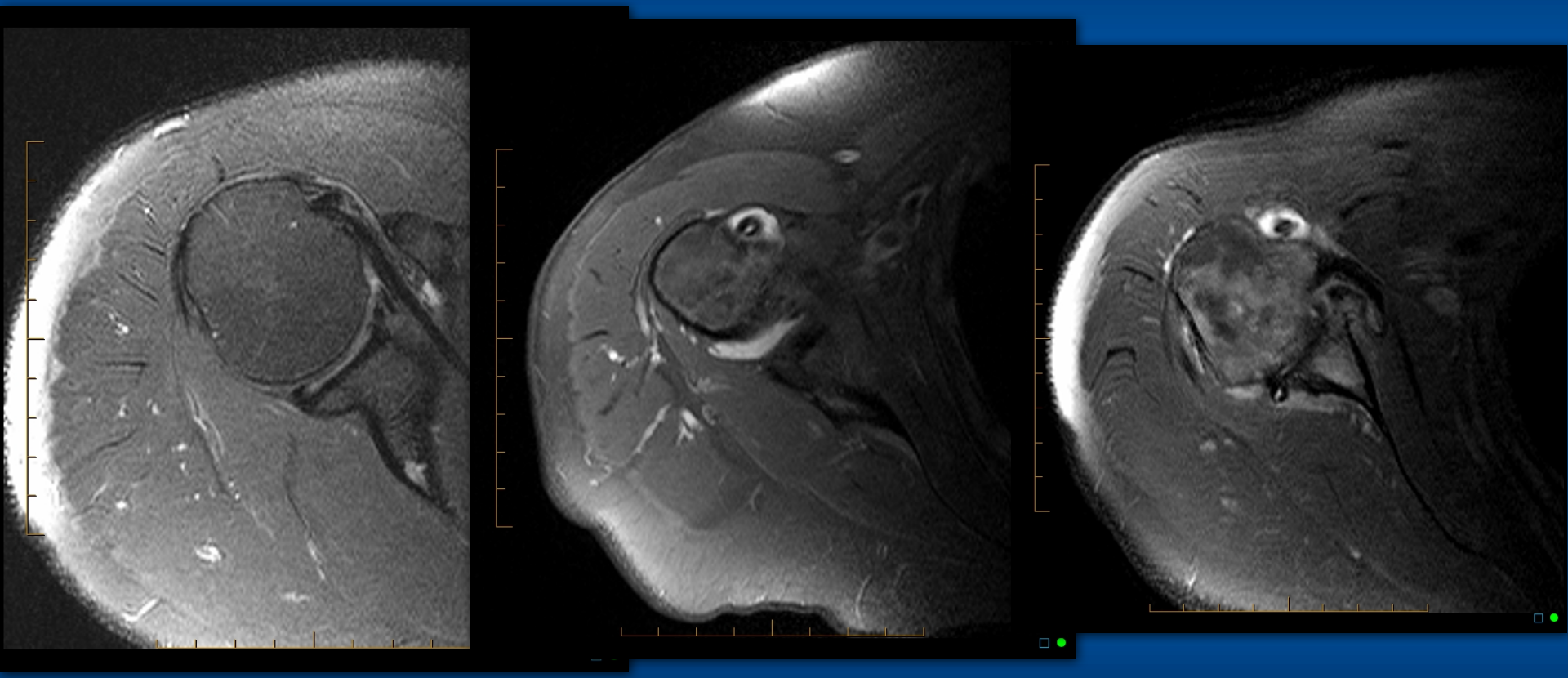
Long Head Biceps Tendon



Sonogram



Examples – False positive biceps



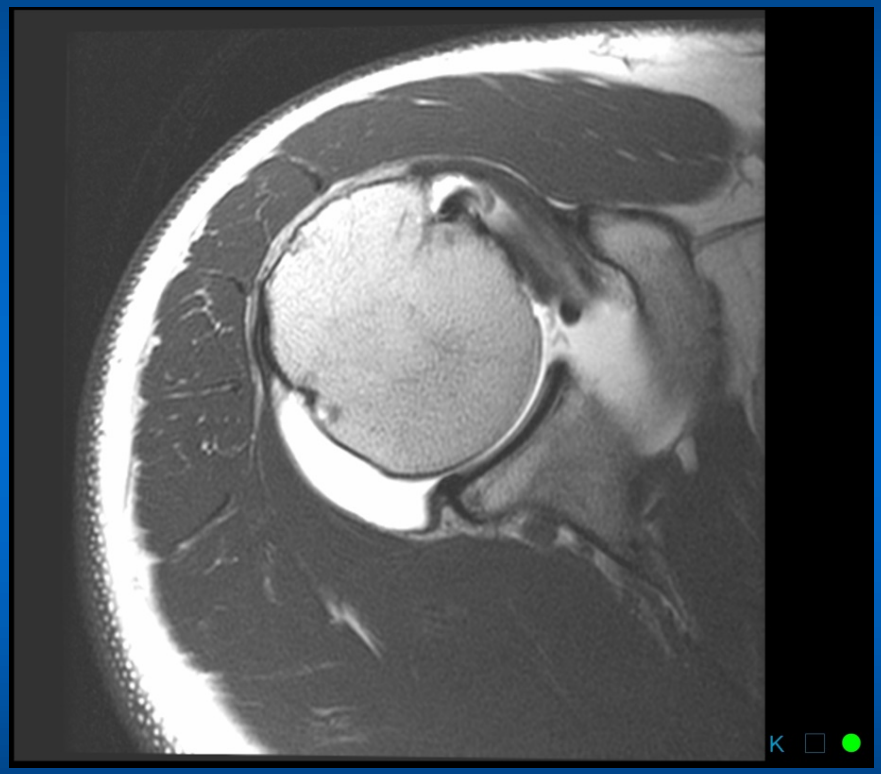
Buford Complex

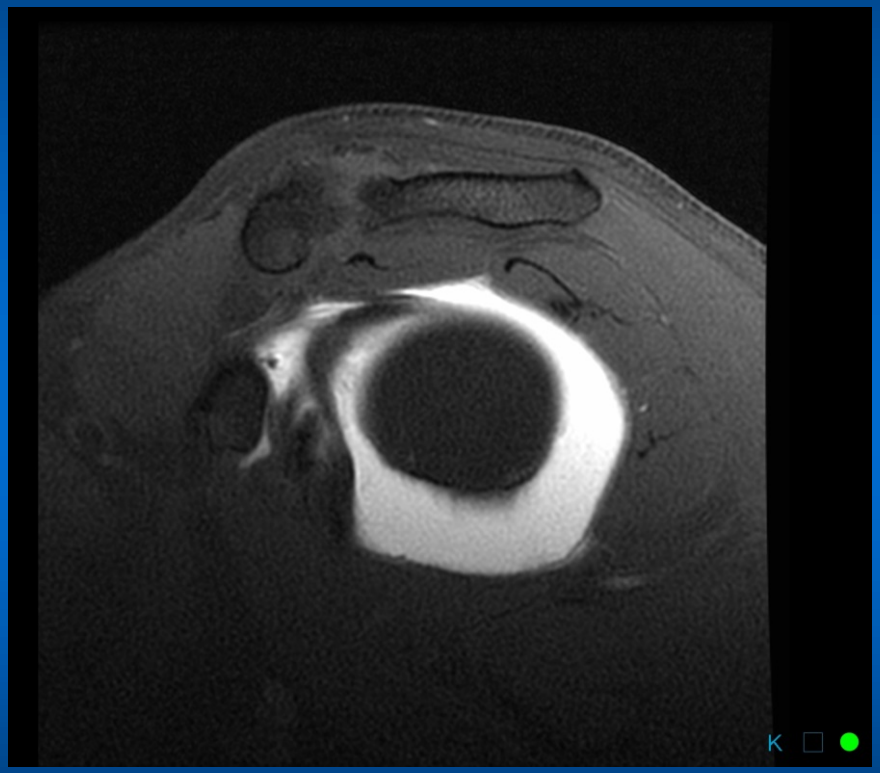
- Cord-like middle glenohumeral ligament contiguous with anterior superior labrum, attaching at biceps base

Williams MM, Snyder SJ and Buford D Jr.
The Buford complex – the "cord-like" middle glenohumeral ligament and absent anterosuperior labrum complex: a normal anatomic capsulolabral variant.

Arthroscopy 10:241, 1994.

Buford Complex

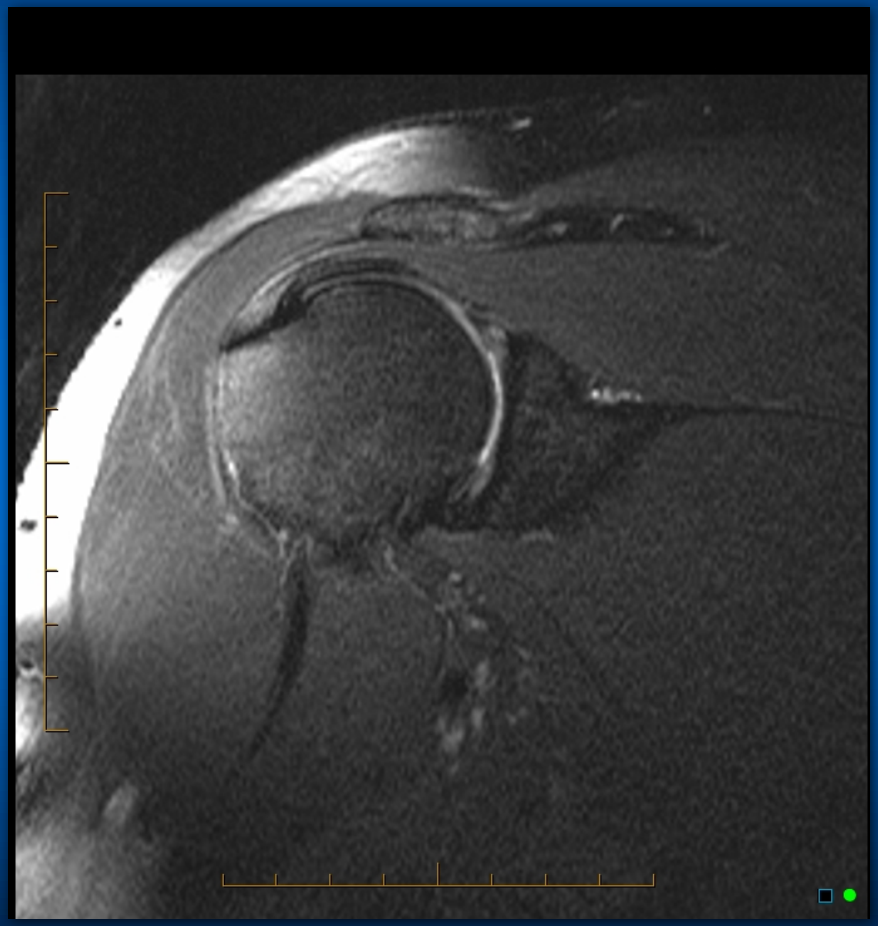


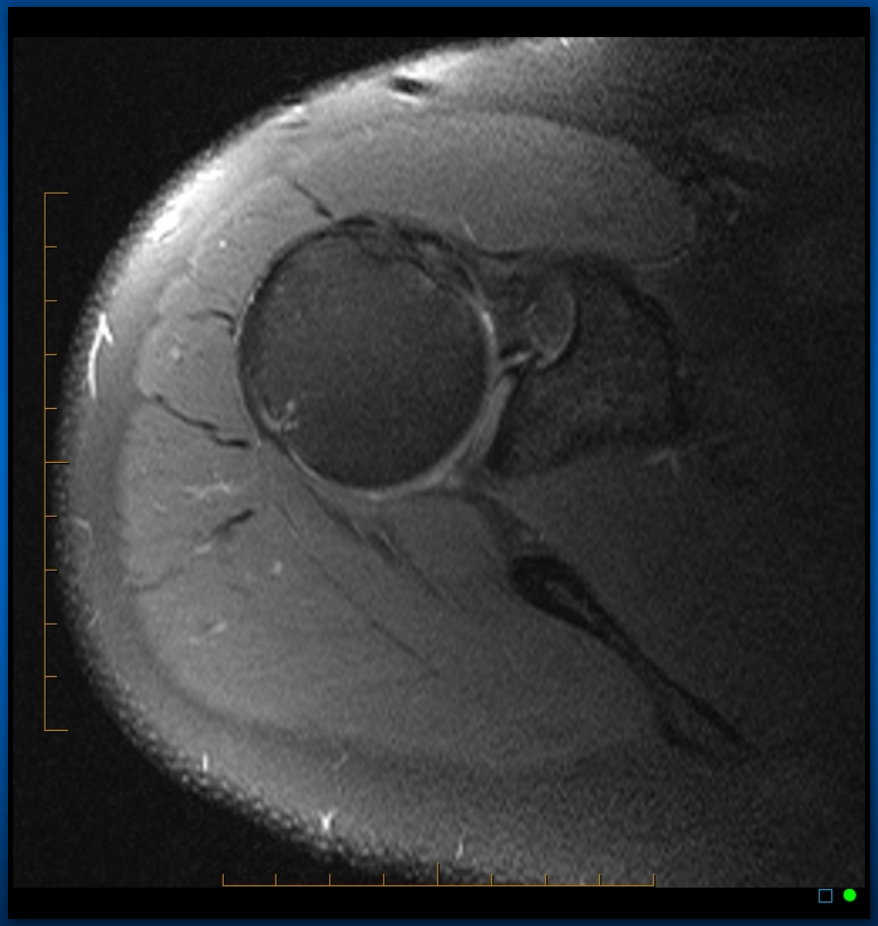


SLAP Tear
Buford Complex

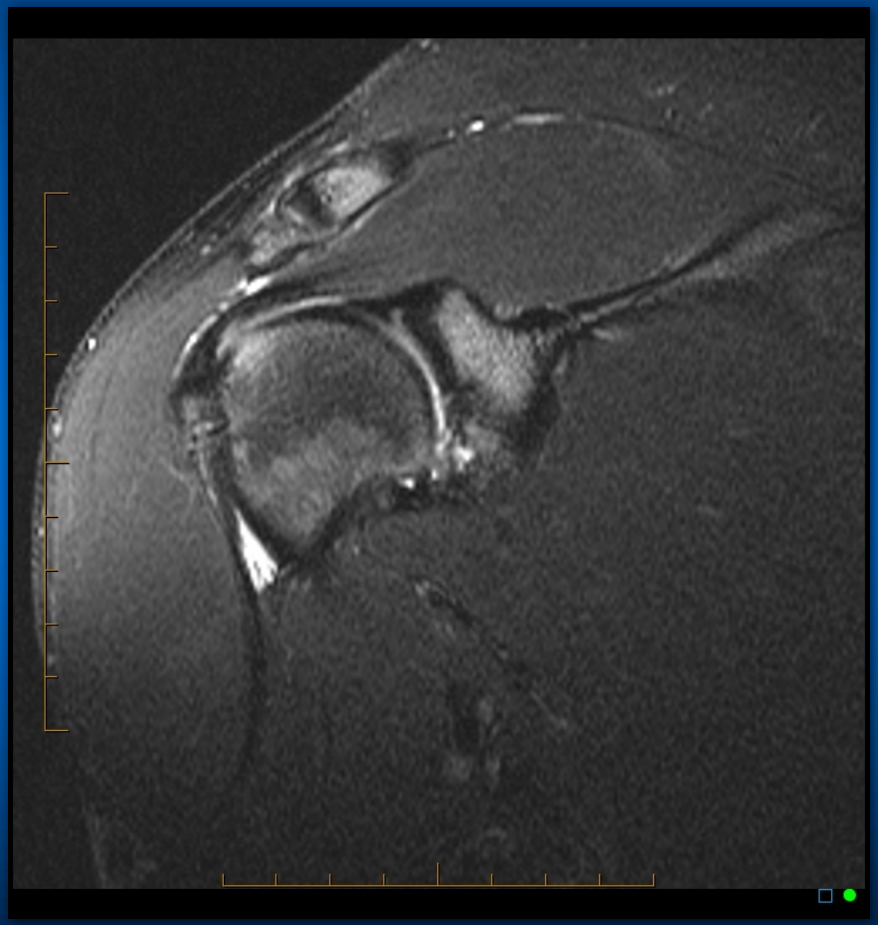
Right Shoulder
Scope Posterior

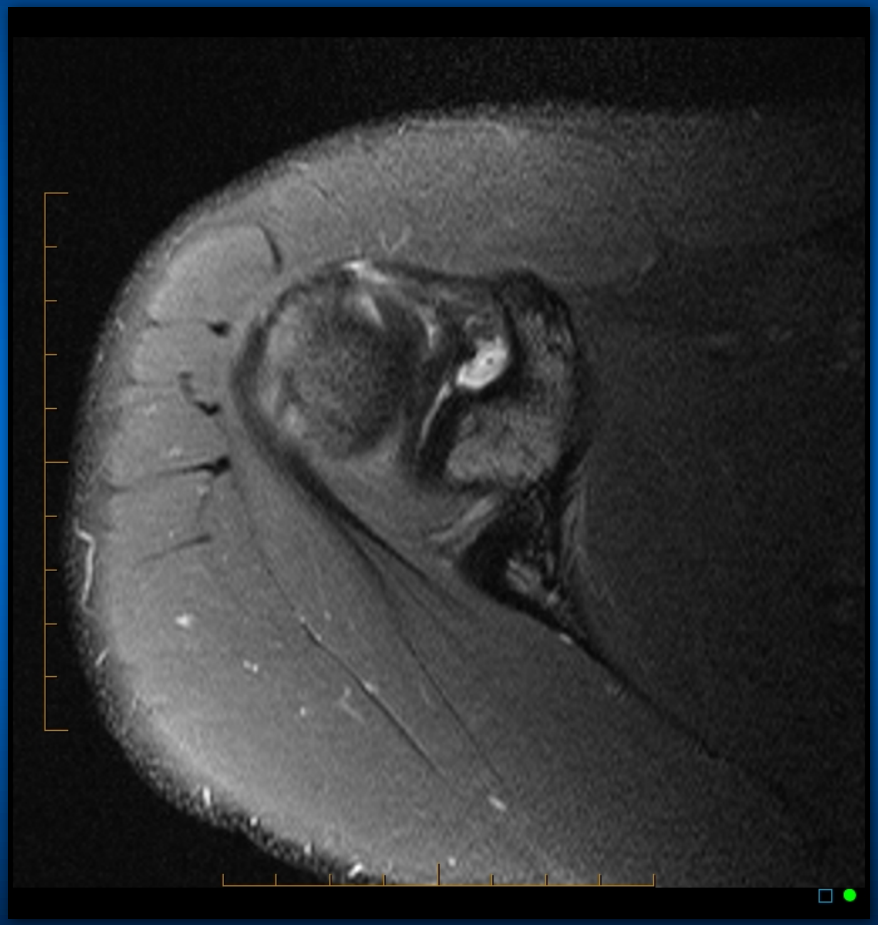
Examples – False Negative SLAP tears



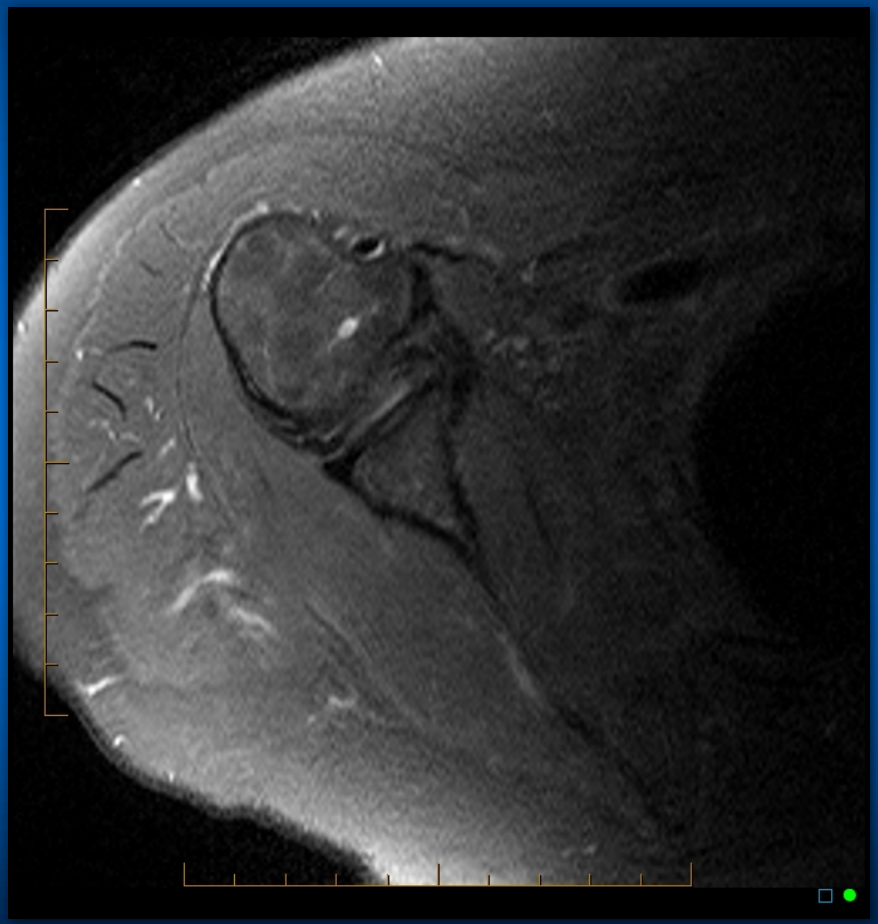


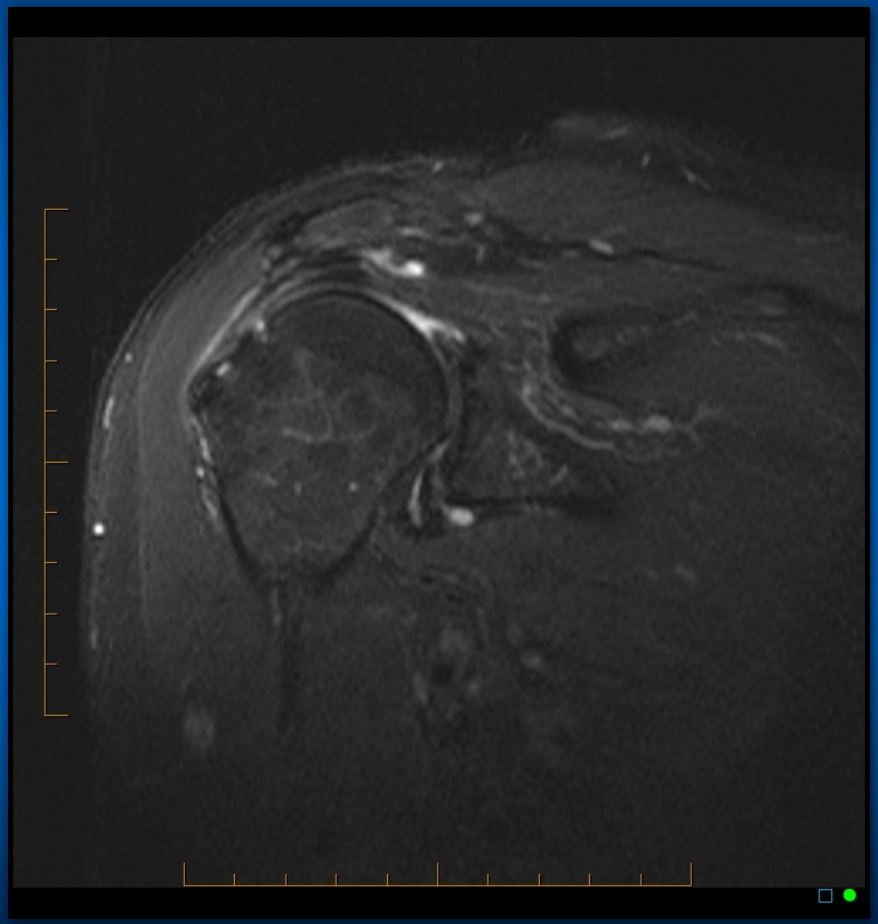
Examples – False Negative SLAP tears



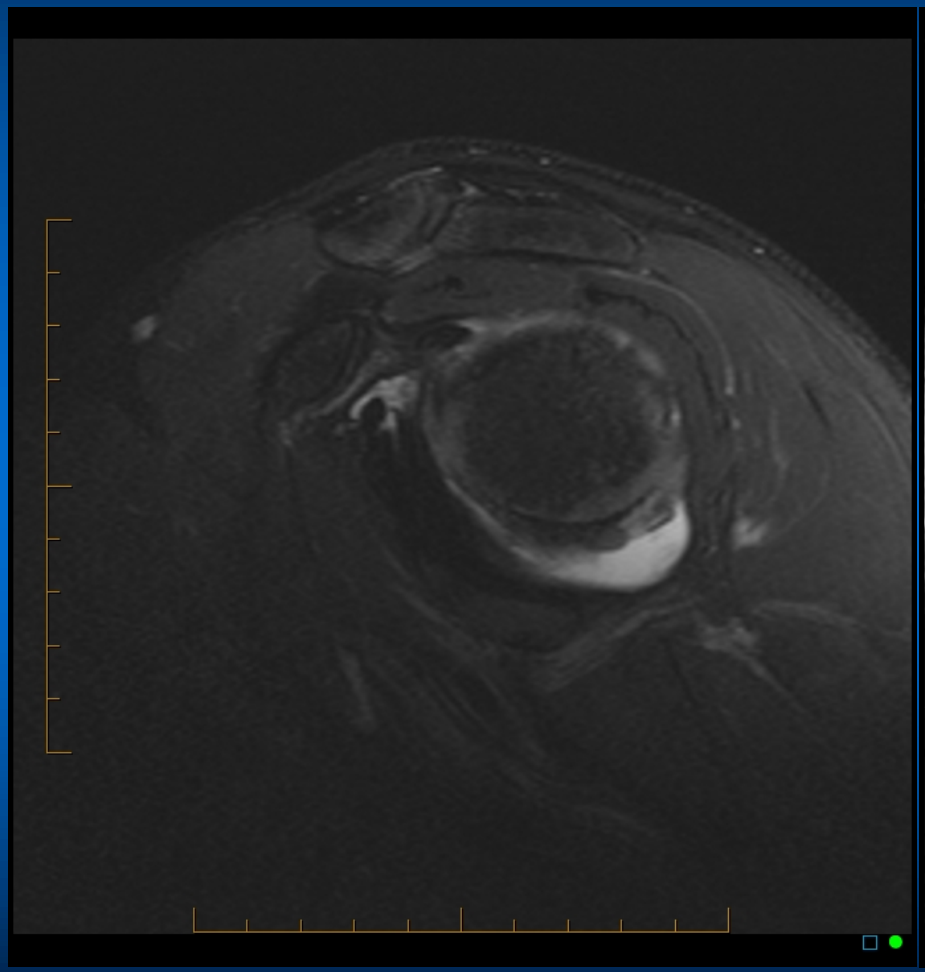


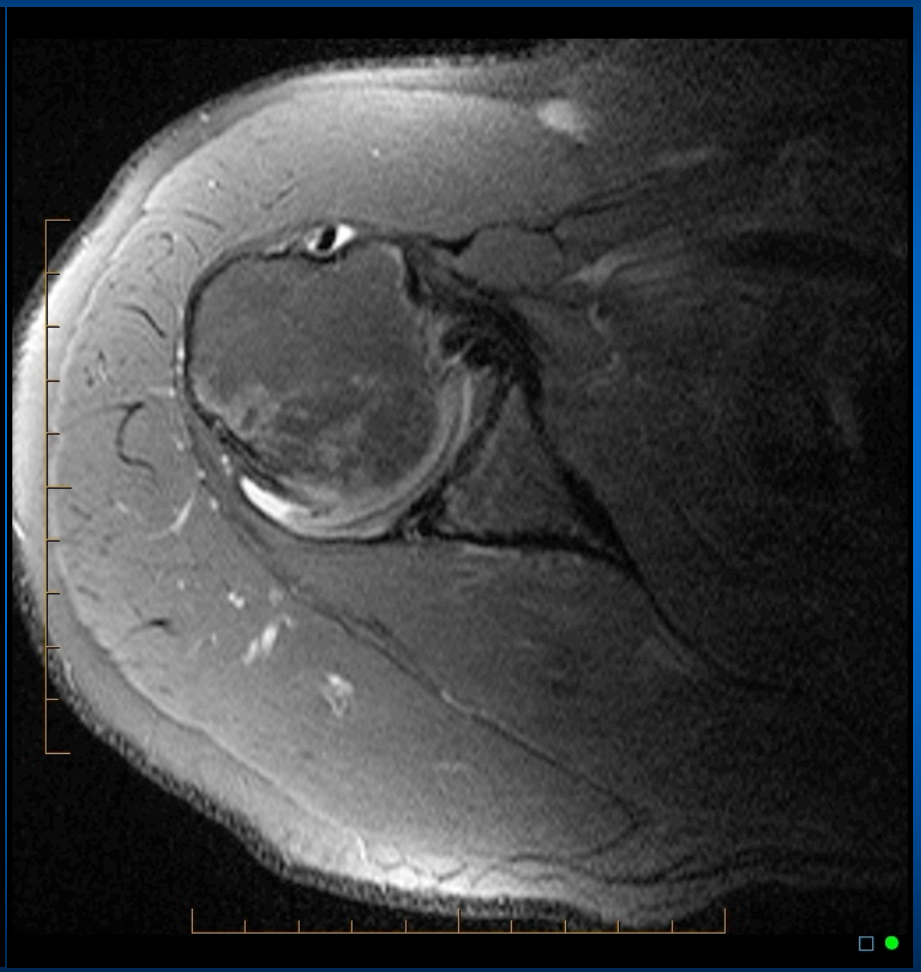
False Positives - Labrum



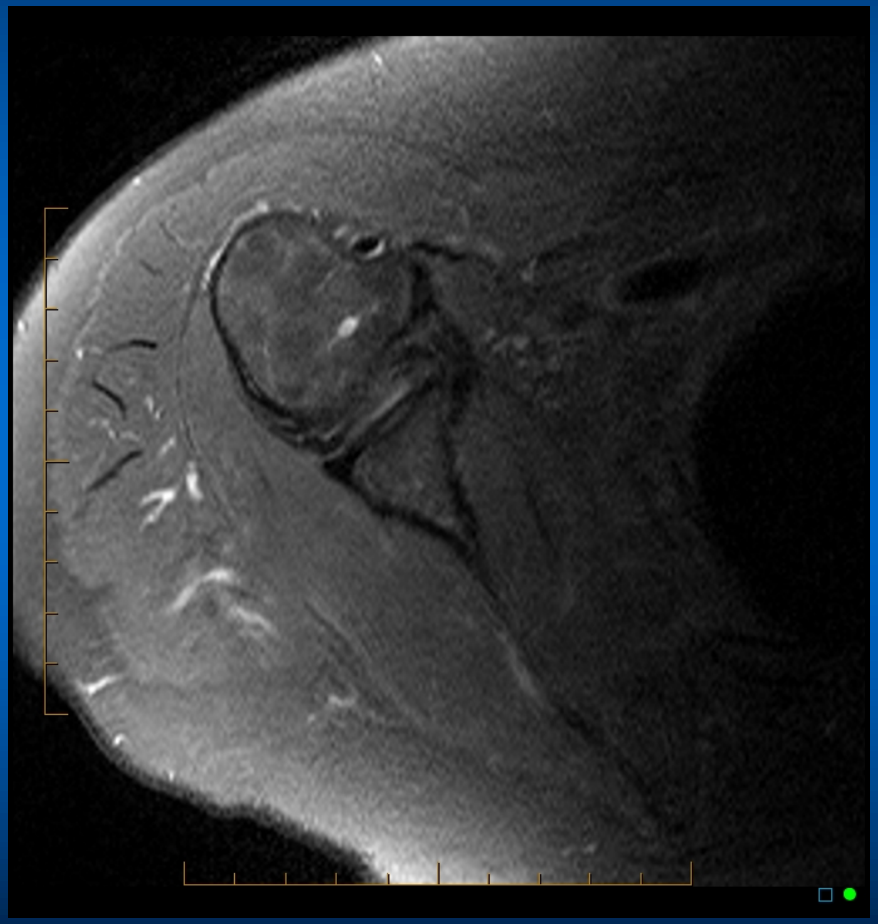


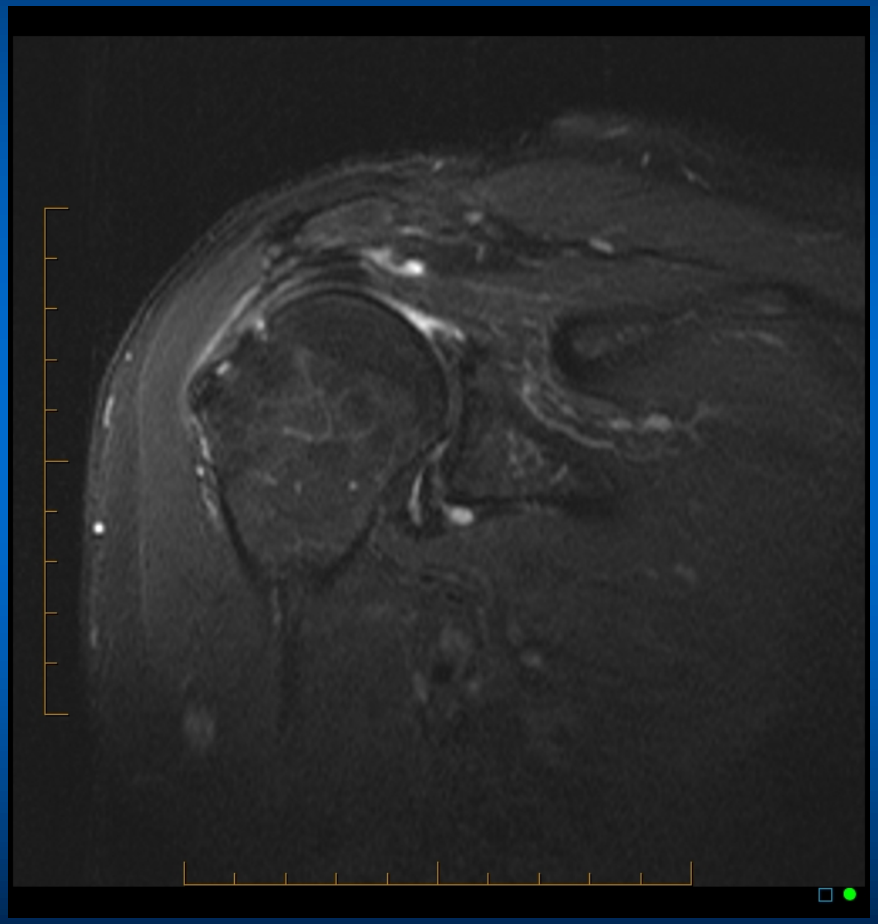
Example: False negative labral tear





False Positives - Labrum



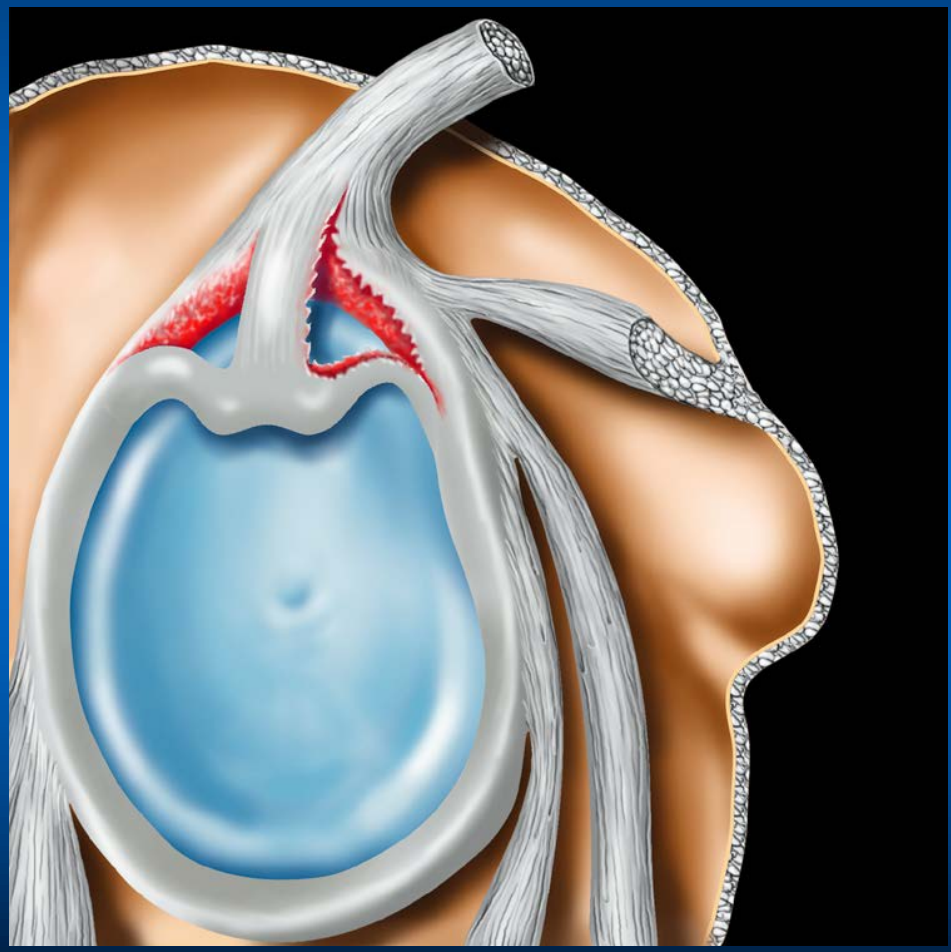


Examples – False negatives labrum

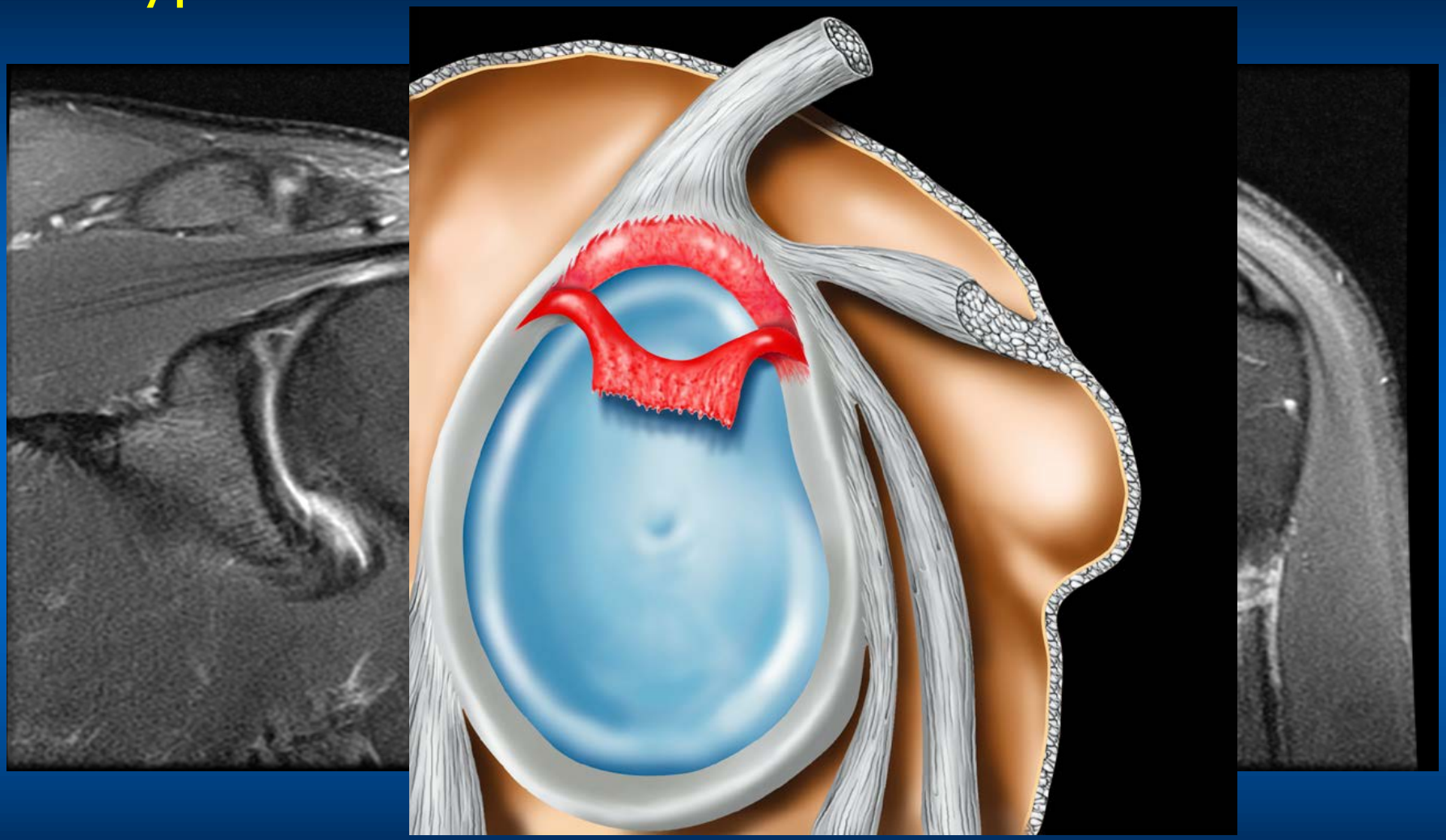
Two examples of labral degenerative tears undercalled but described as labral degeneration.

Slap Lesions: 4 Types Originally Described

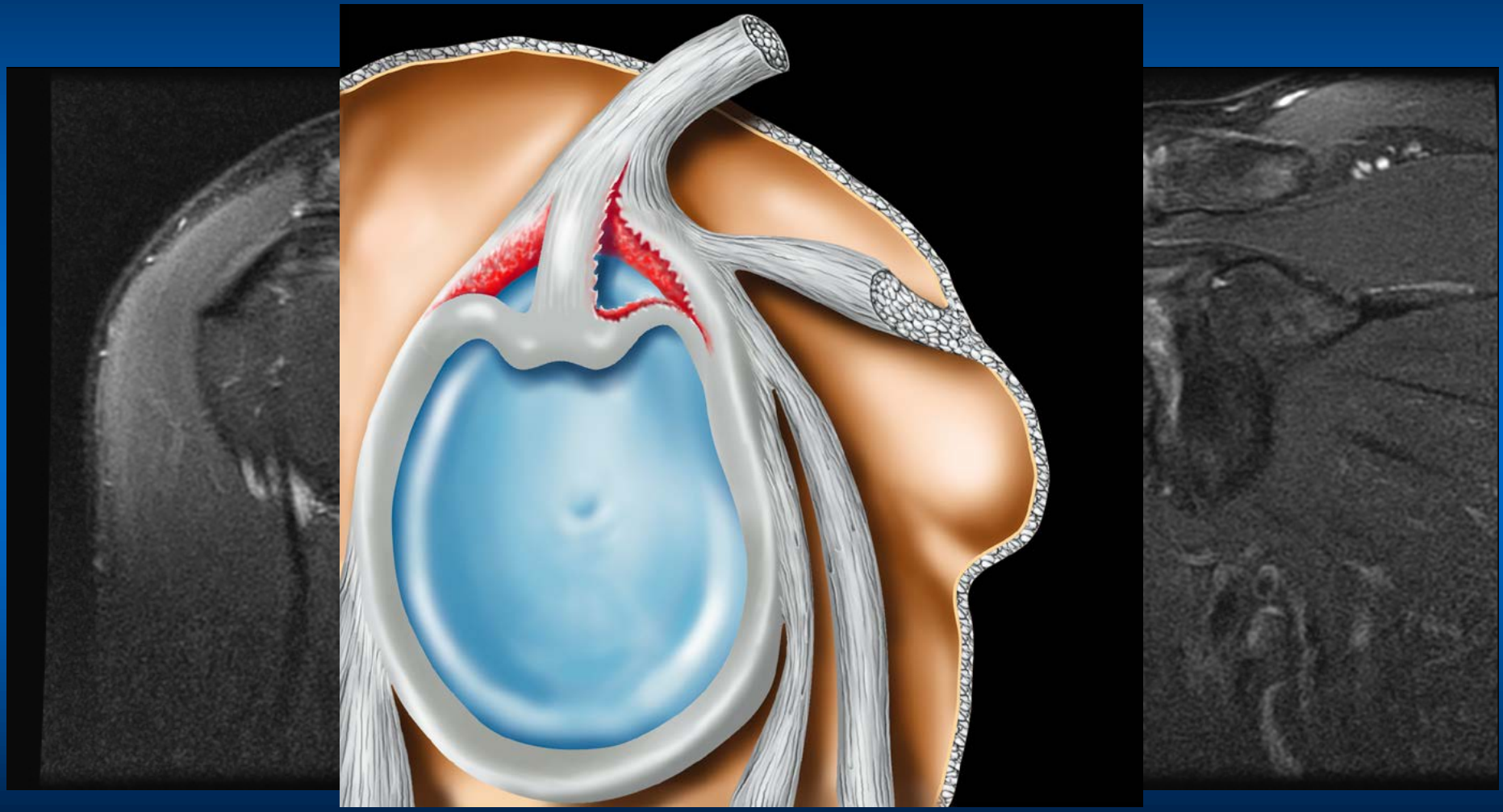
- I degenerative fraying
- II unstable
- III buckethandle
- IV involves biceps tendon



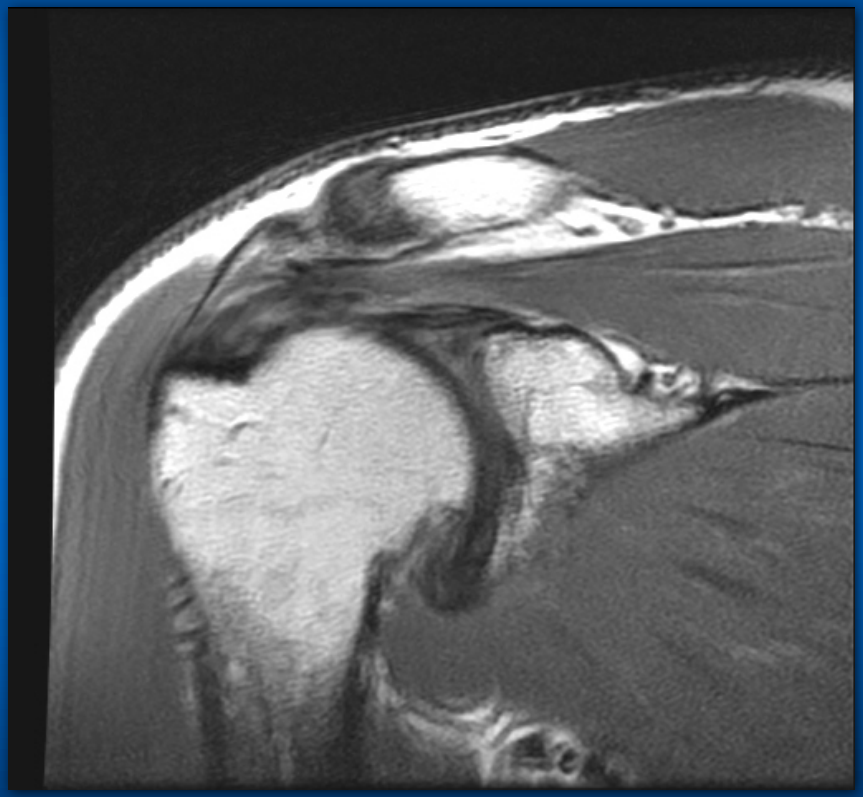
Type III

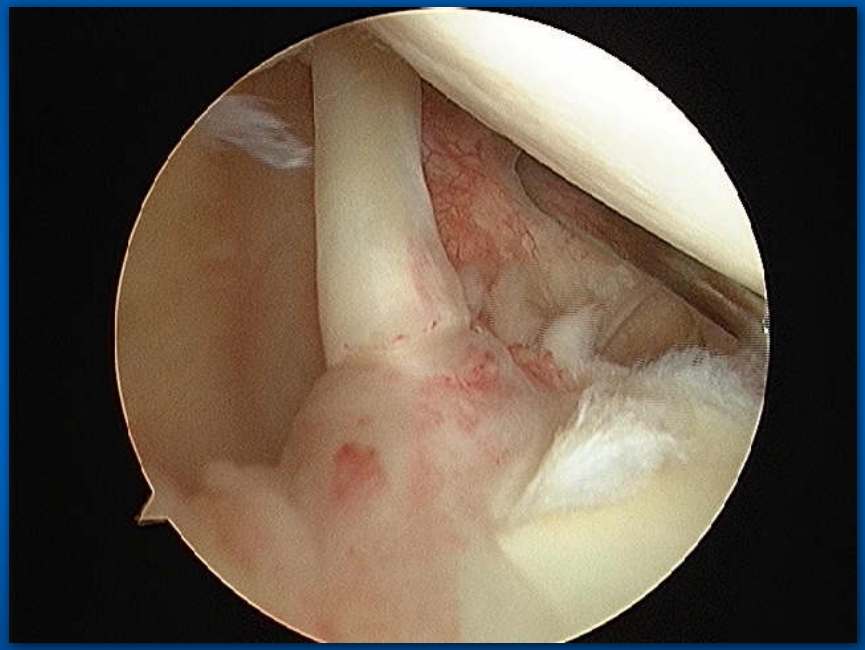


Slap Lesion: Type IV



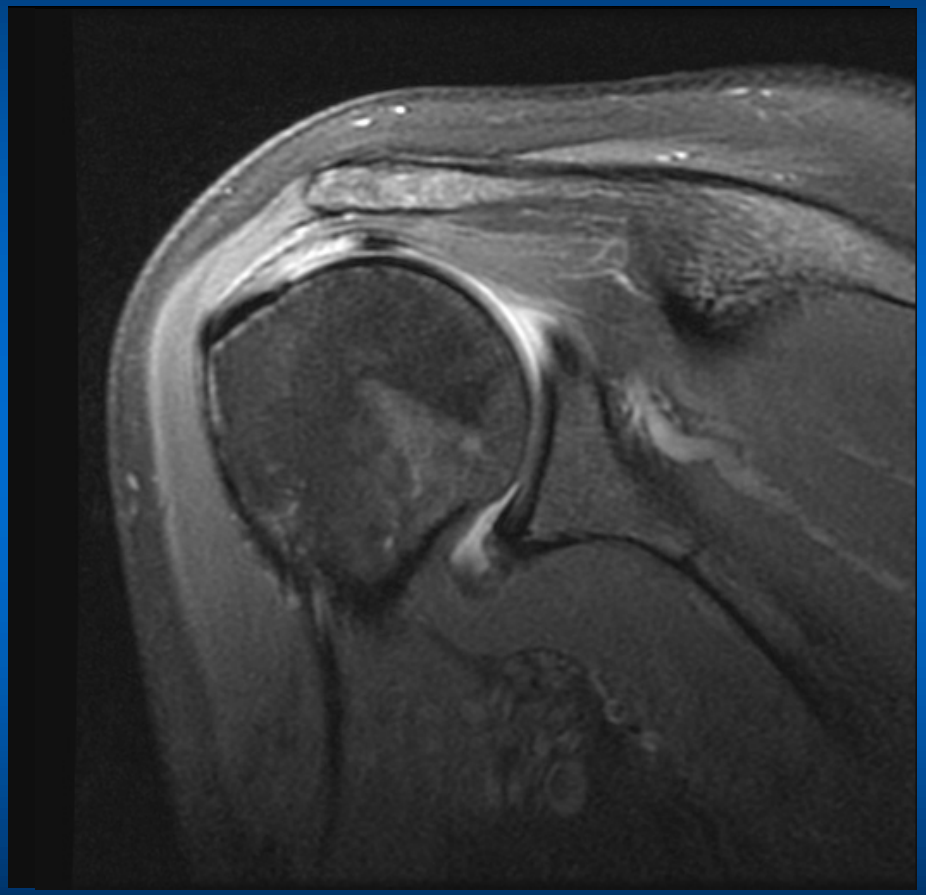
SLAP Type I
Degenerative



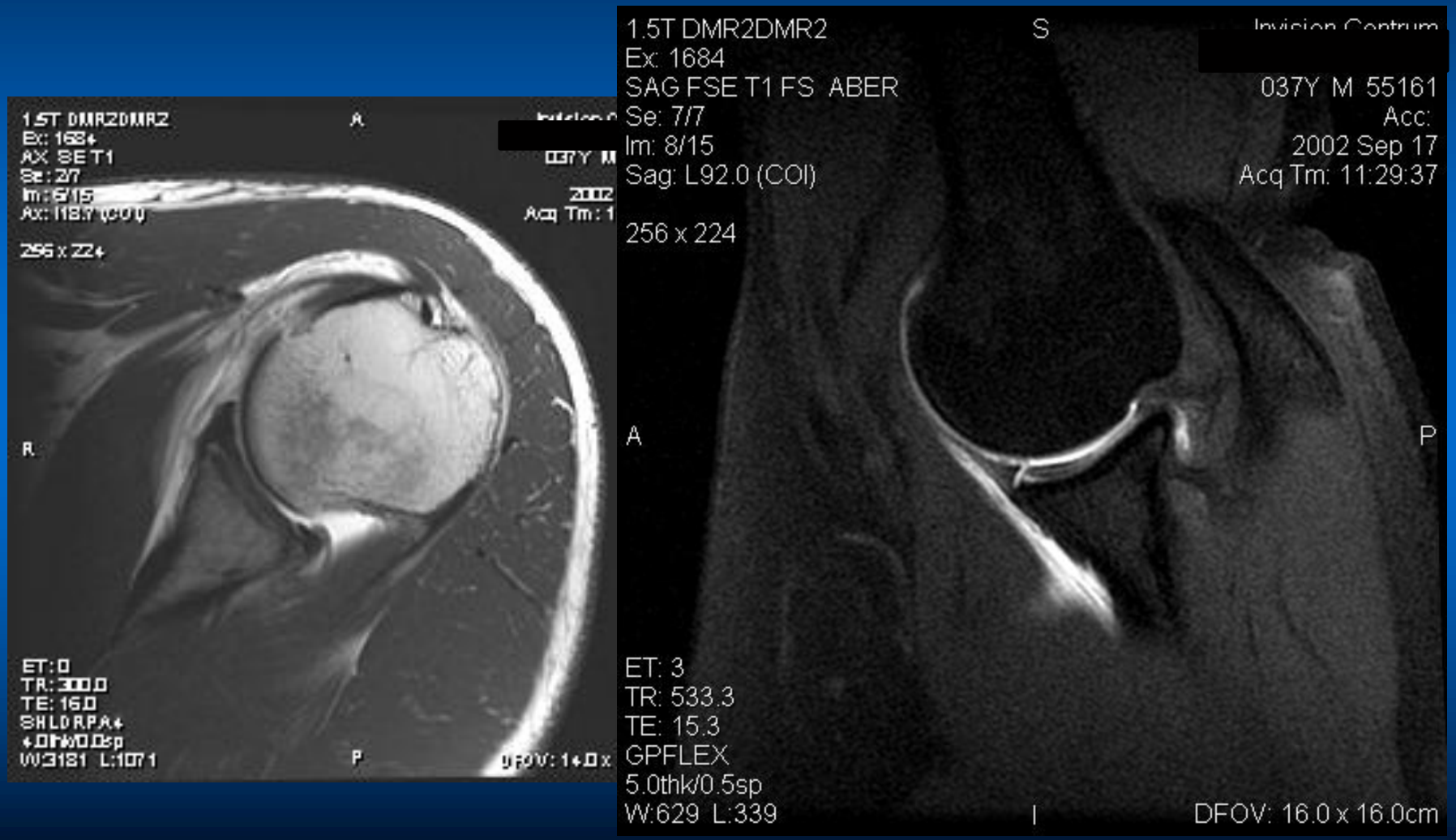


SLAP Lesions: Type II

- Classic
  - Anterior to posterior
- Anterior
  - SLAC
- Posterior
  - Posterior peel back



ABER showing tear not seen on routine imaging



ABER

Chronic SLAP & Anterior Instability

- 24 YO Right hand dominant high school pitcher, boxer
- History of 30 times shoulder slipping out of place in overhead positions
- PE: anterior apprehension, labral click, pain and weakness in maximum rotation, arm 90 deg. abducted

Bucket handle tear, labrum

Scope posterior

Anterior-inferior glenoid preparation, labral debridement

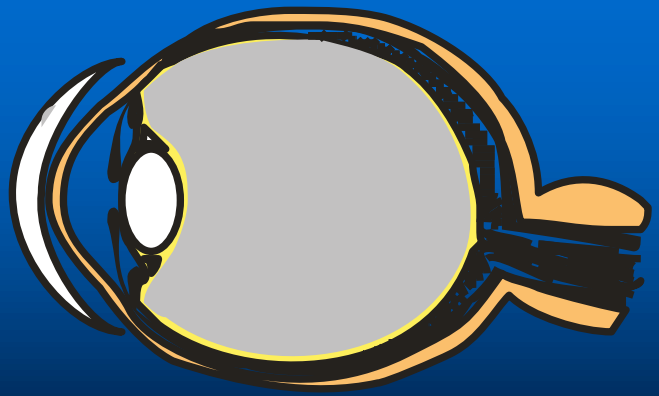
Removal unstable SLAP tissue

Mobilization of anterior-inferior capsuloligamentous complex, labral debridement

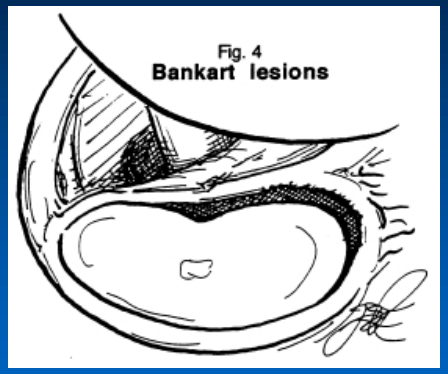
Post-repair, arthroscope posterior

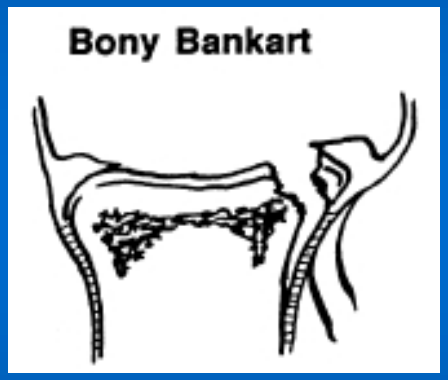
Glenoid : Labrum

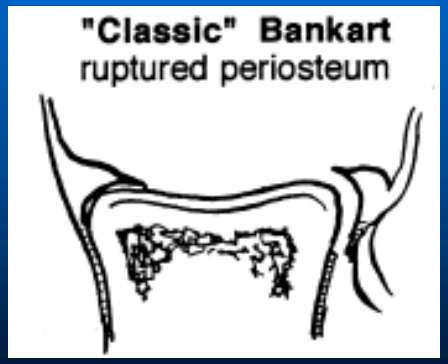
Tee : Golf Ball
Seal : Ball
Contact Lens : Eyeball

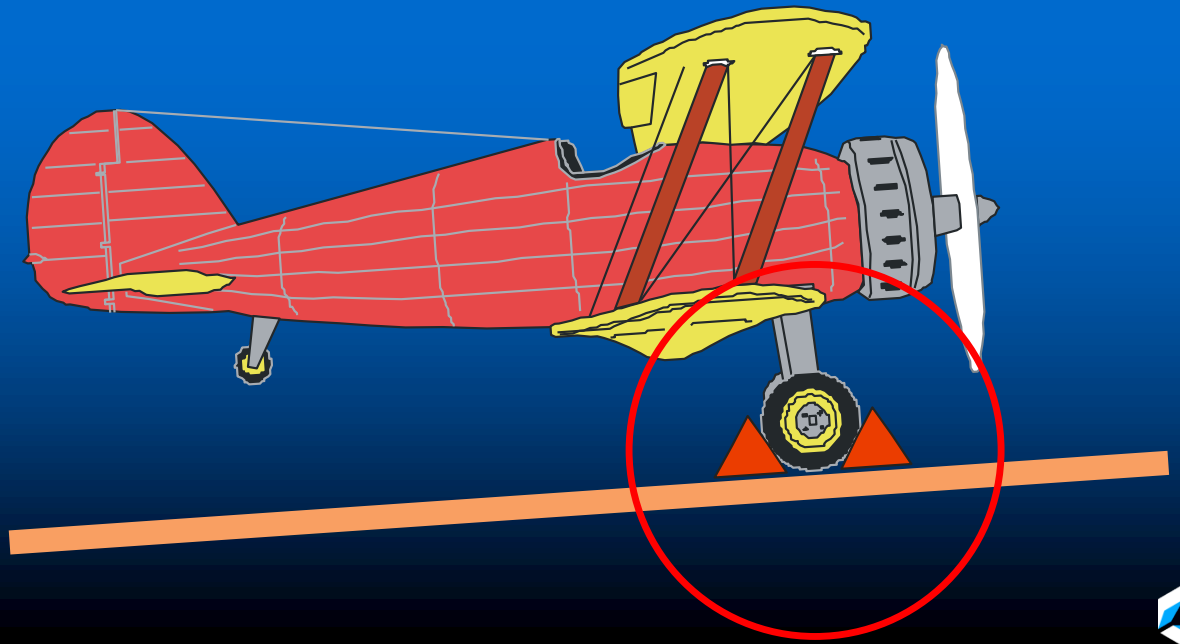


Surgical Stabilization



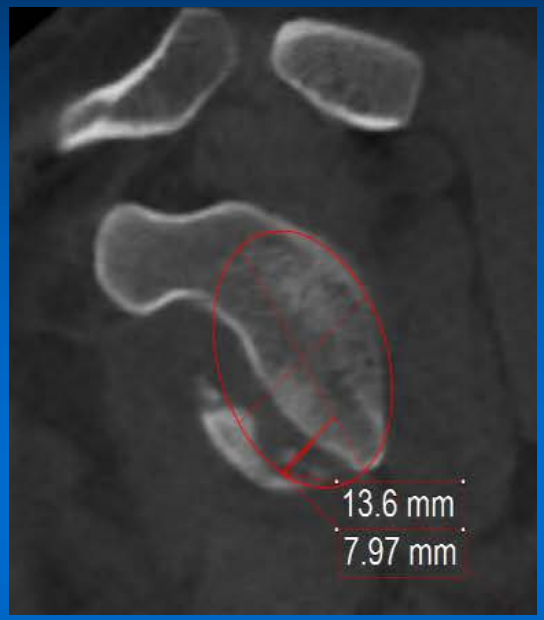






Concept of Glenoid Track

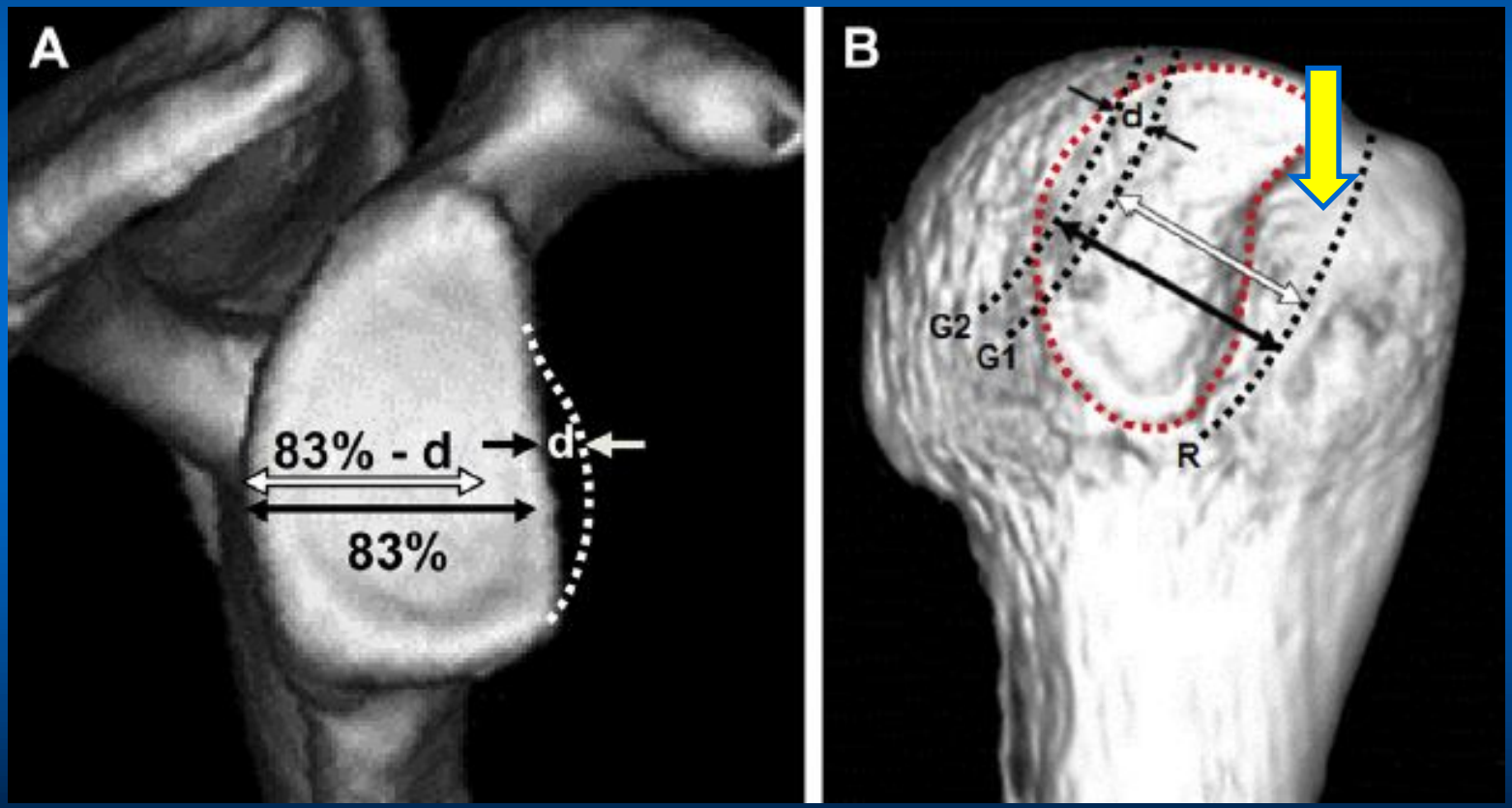
- The Glenoid track is the zone of contact between the rim of the glenoid and the humeral head in the end-range of motion (abduction and external rotation) of the arm.
- It measures 83% of the width of the Glenoid.
- It ensures bony stability of the joint.



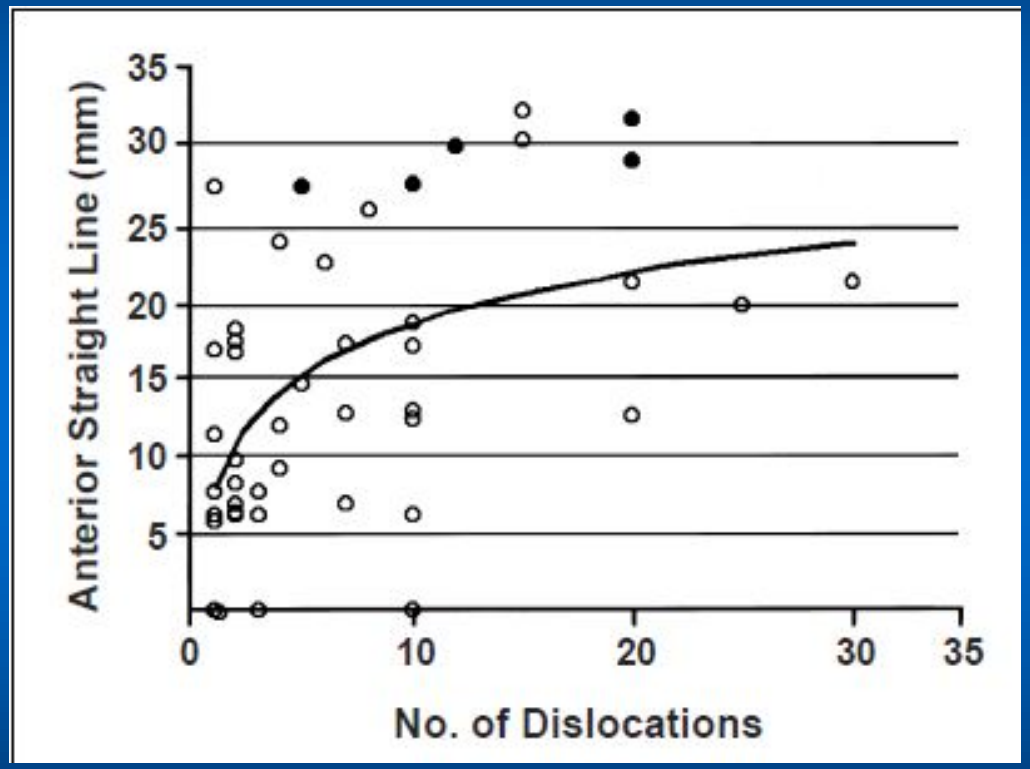
83% of glenoid track = 83% of 27.2=22.5mm

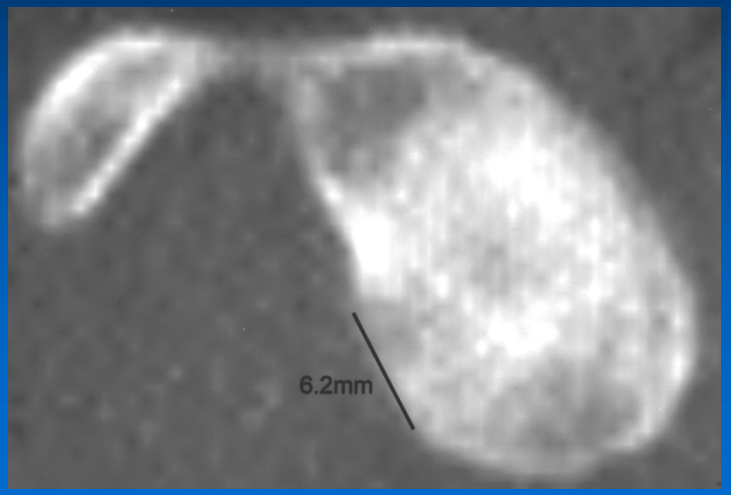
Hill-Sachs Interval (HSI) = HS width + bone bridge

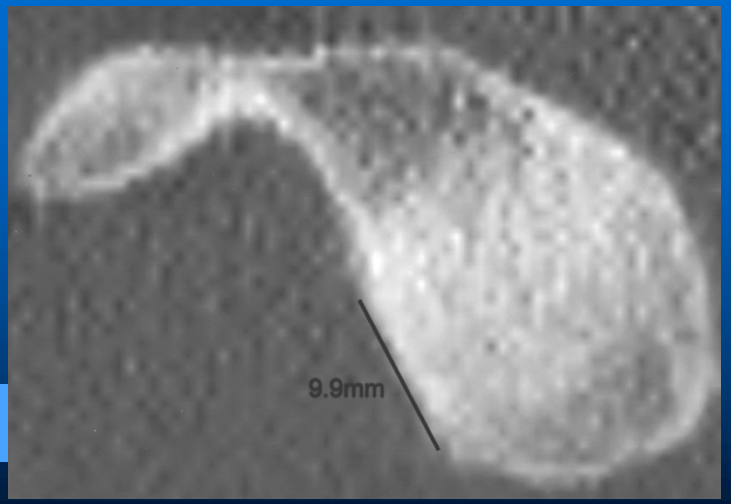
Bone bridge between cuff insertion and lateral margin of H-S



Use of CT to assess glenoid bone loss

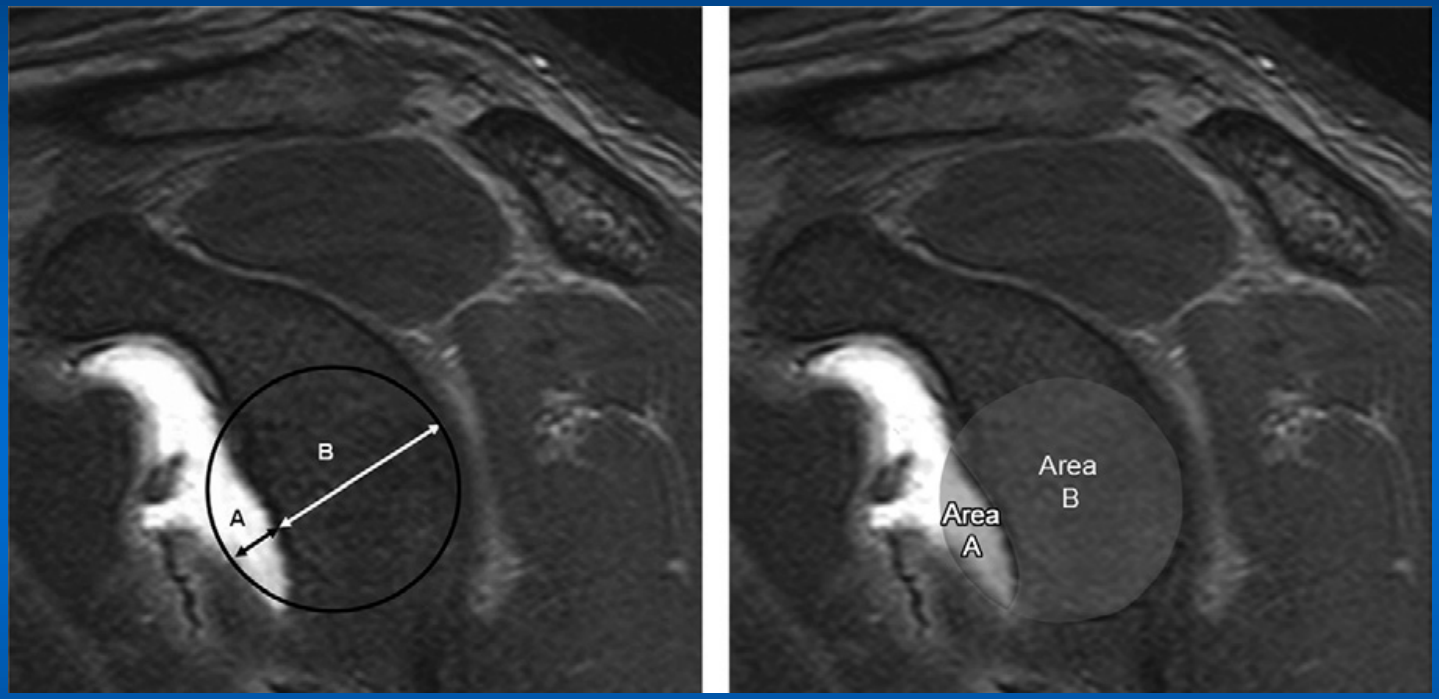






From Griffiths J et al. AJR 2003; 180:1423-1430

Use of MR to assess glenoid bone loss



From Lee RK, et al. Radiology 2013; 267:496-502

Treatment Paradigm*

*according to Burkhart

Table 2. Anterior Instability Categories

Group	Glenoid Defect	Hill-Sachs Lesion
1	<25%	On track
2	<25%	Off track
3	≥25%	On track
4	≥25%	Off track

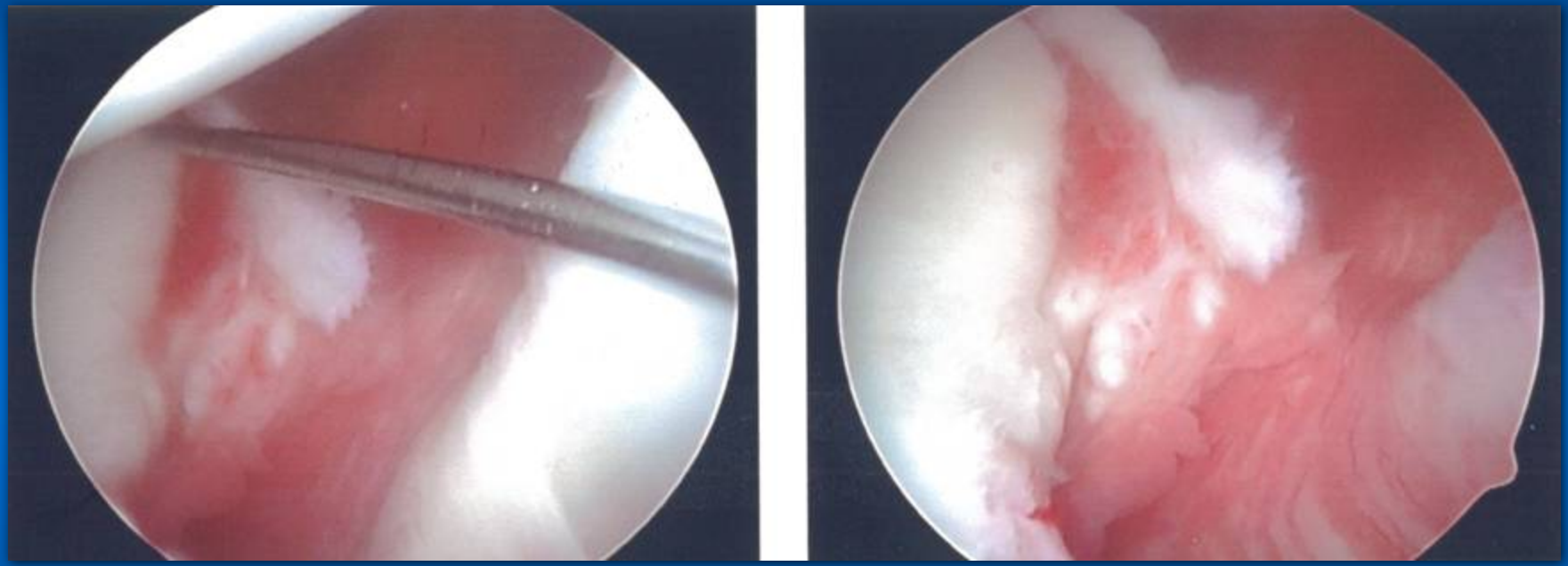
Table 3. Treatment Paradigm

Group	Recommended Treatment
1	Arthroscopic Bankart repair
2	Arthroscopic Bankart repair plus remplissage
3	Latarjet procedure
4	Latarjet procedure with or without humeral-sided procedure (humeral bone graft or remplissage), depending on engagement of Hill-Sachs lesion after Latarjet procedure

Assessing Hill-Sachs Deformities ("On-Track" vs. "Off-Track")

- Conclusion: > 25% glenoid bone loss MUST be treated with graft
- Almost all lesions will be "on-track" after grafting
- "In cases with <25% glenoid bone loss, Hill-Sachs lesion is usually small or nonexistent."
- Consider remplissage of H-S in addition to Bankart repair if no glenoid bone loss.

15 YO Football Player Linbacker Multiple Shoulder Dislocations Reduced by Coach




FFE/M
SL 8
FH -30 feet
FFE/M
SL 7
FH -35 fe
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#7 28-Nov-2006 09:25
T1 SE COR
Series: 3
OPEN MRI OF MONTICELLO
AIRIS II AIRIS2-2
HFS
256 x 256 x 16
LEFT SHOULDER
R
L
120 mm
Coil: QD Shoulder!
NEX: 2.00
%FOV 160.00
Flip: 90.00
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Filter:None Fact:0
SE 2D
Echo: 1
TR: 550.00
TE: 20.0
Slice: 4.00 Loc: 6.60
Lossy: 6:1
!Teach_Lname , !Teach_Fname A
#13 28-Nov-2006 09:16
T2 3D SG TRS
Series: 2
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AIRIS II AIRIS2-2
HFS
512 x 512 x 16
LEFT SHOULDER
R
L
150 mm
Coil: QD Shoulder!
NEX: 1.00
%FOV 104.00
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W:8268 L:4134
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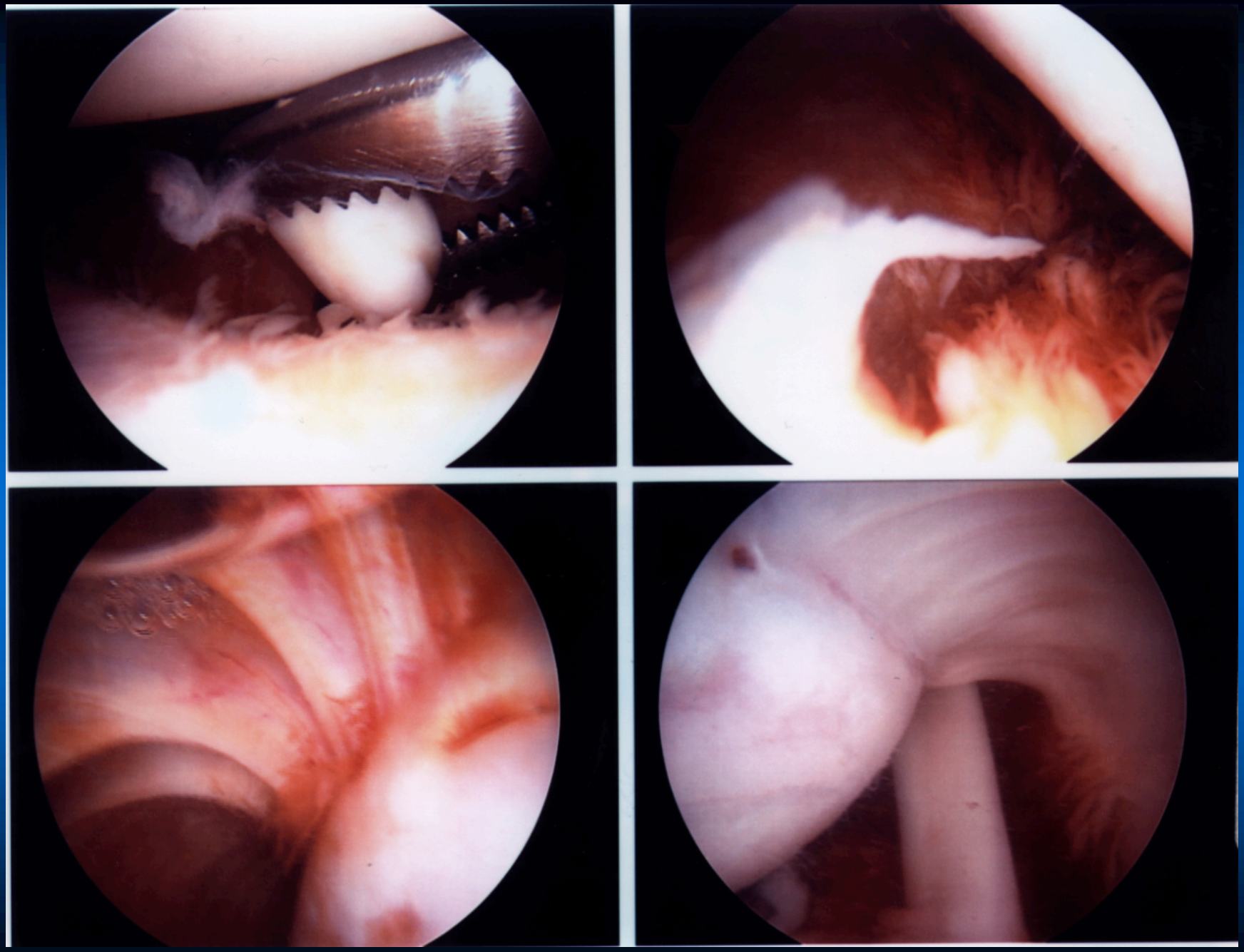
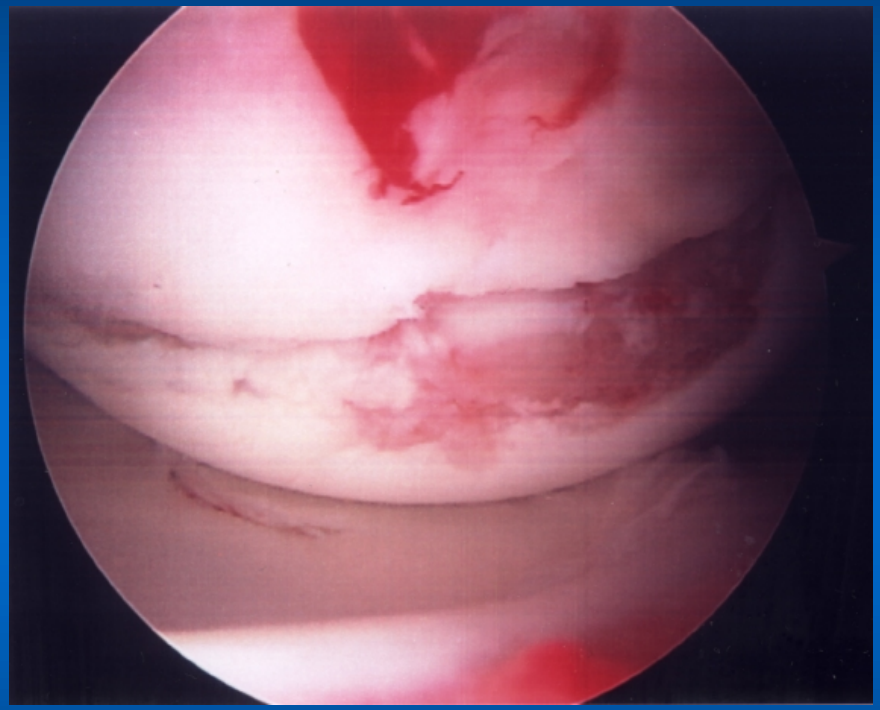
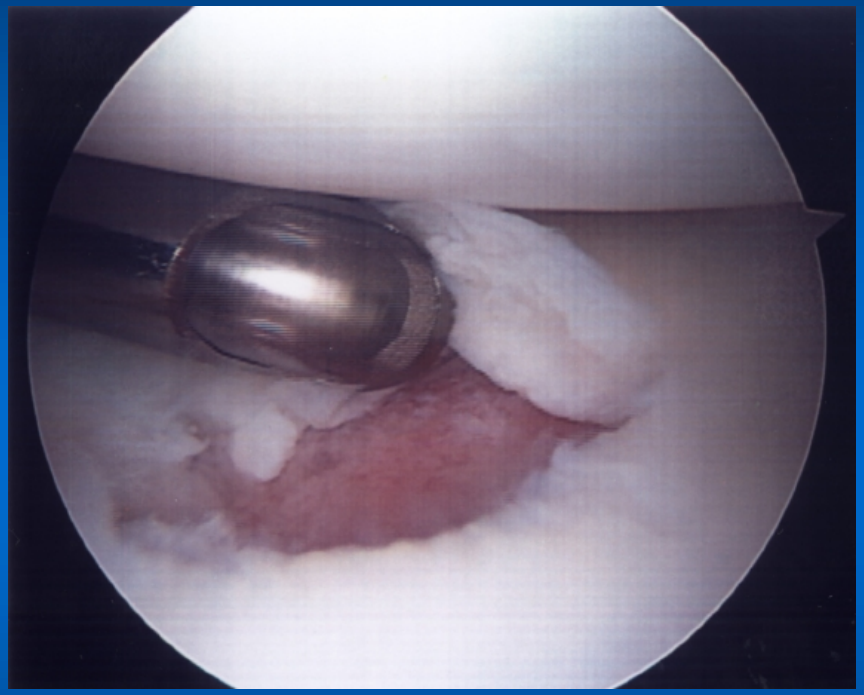
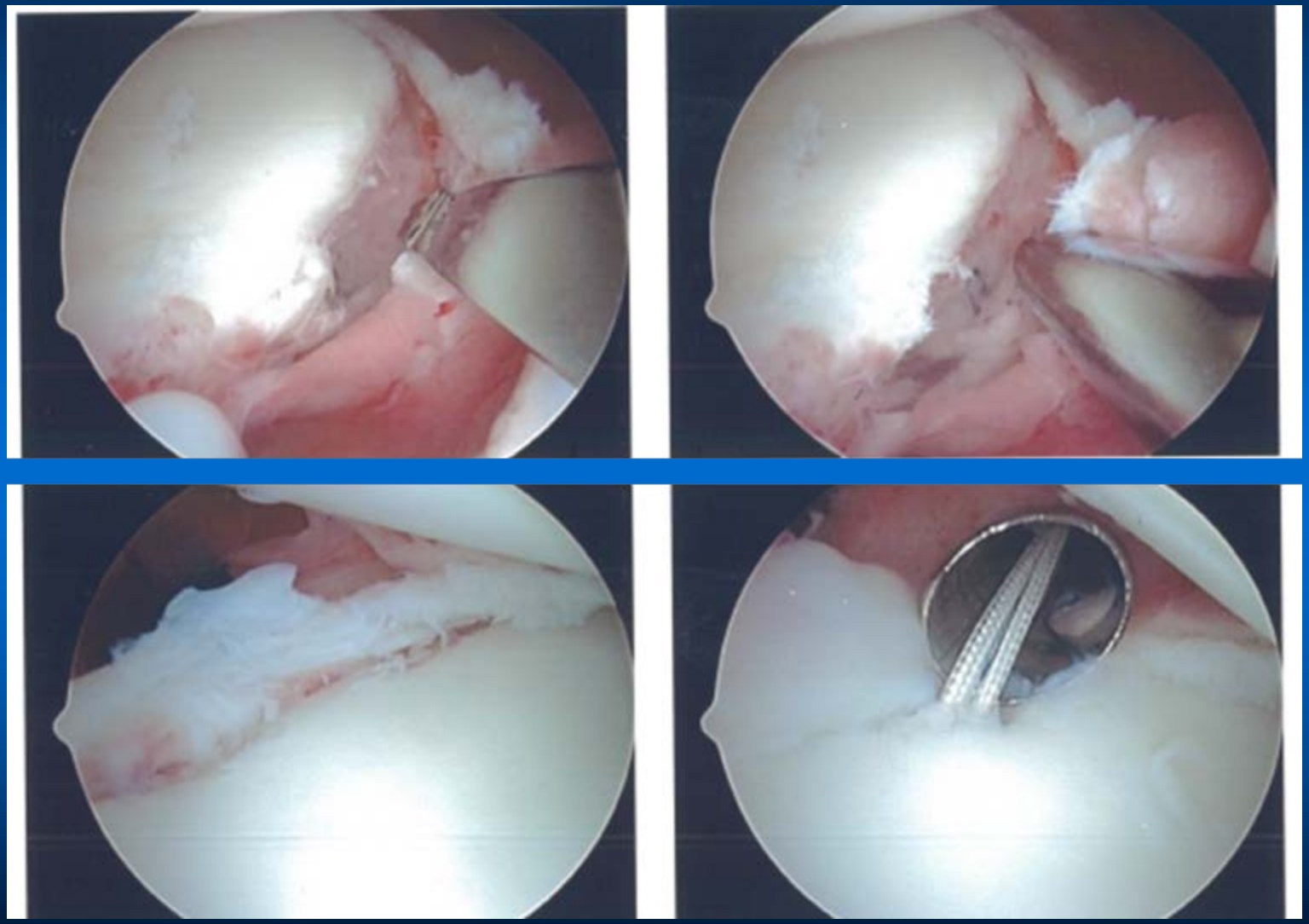
GE 3D
Echo: 1
TR: 67.00
TE: 30.0
Slice: 3.00 Loc: 17.30
Lossy: 6:1
P



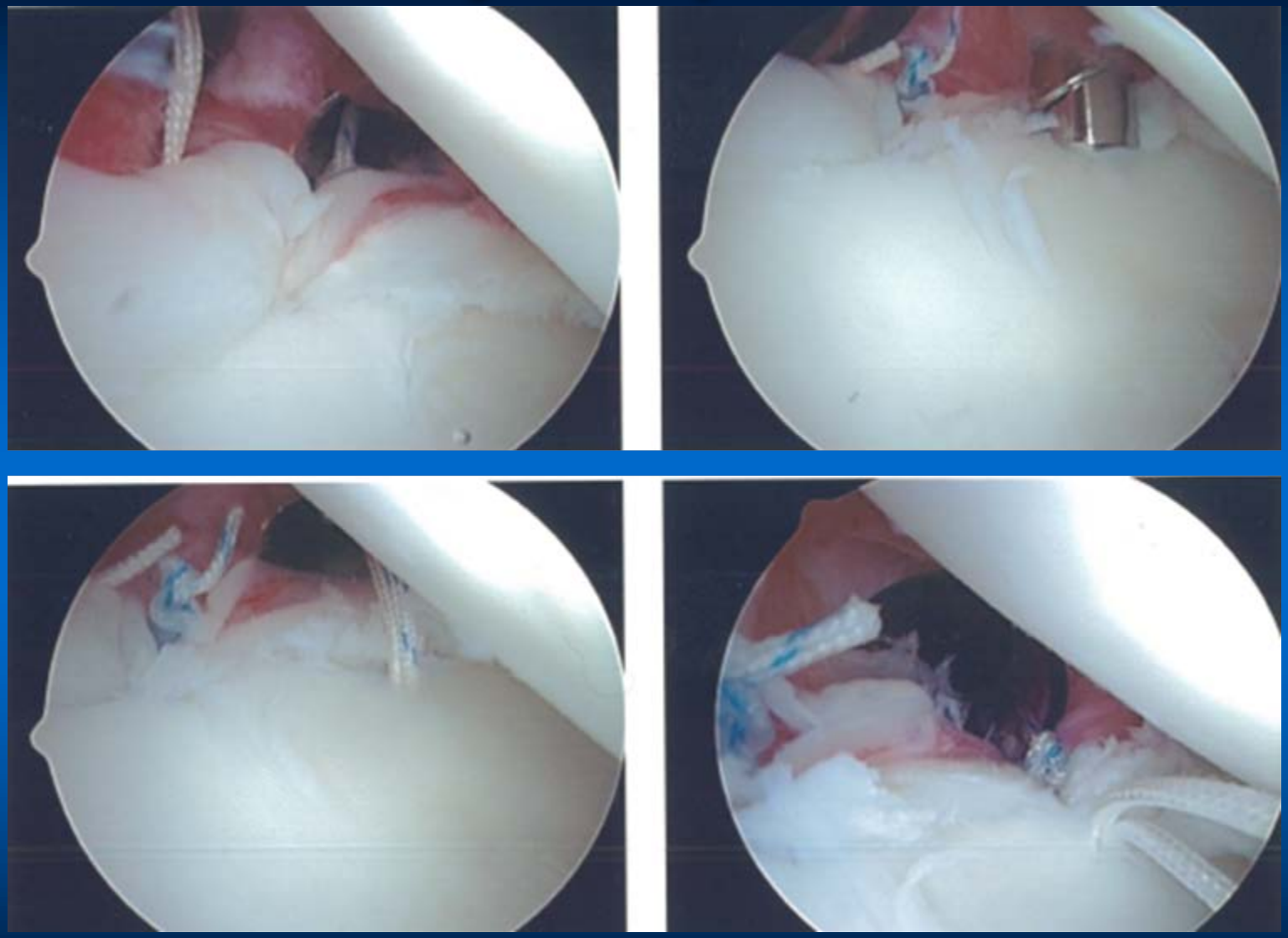




15 YO Football Player Hill Sachs Anterior Inferio Labrum

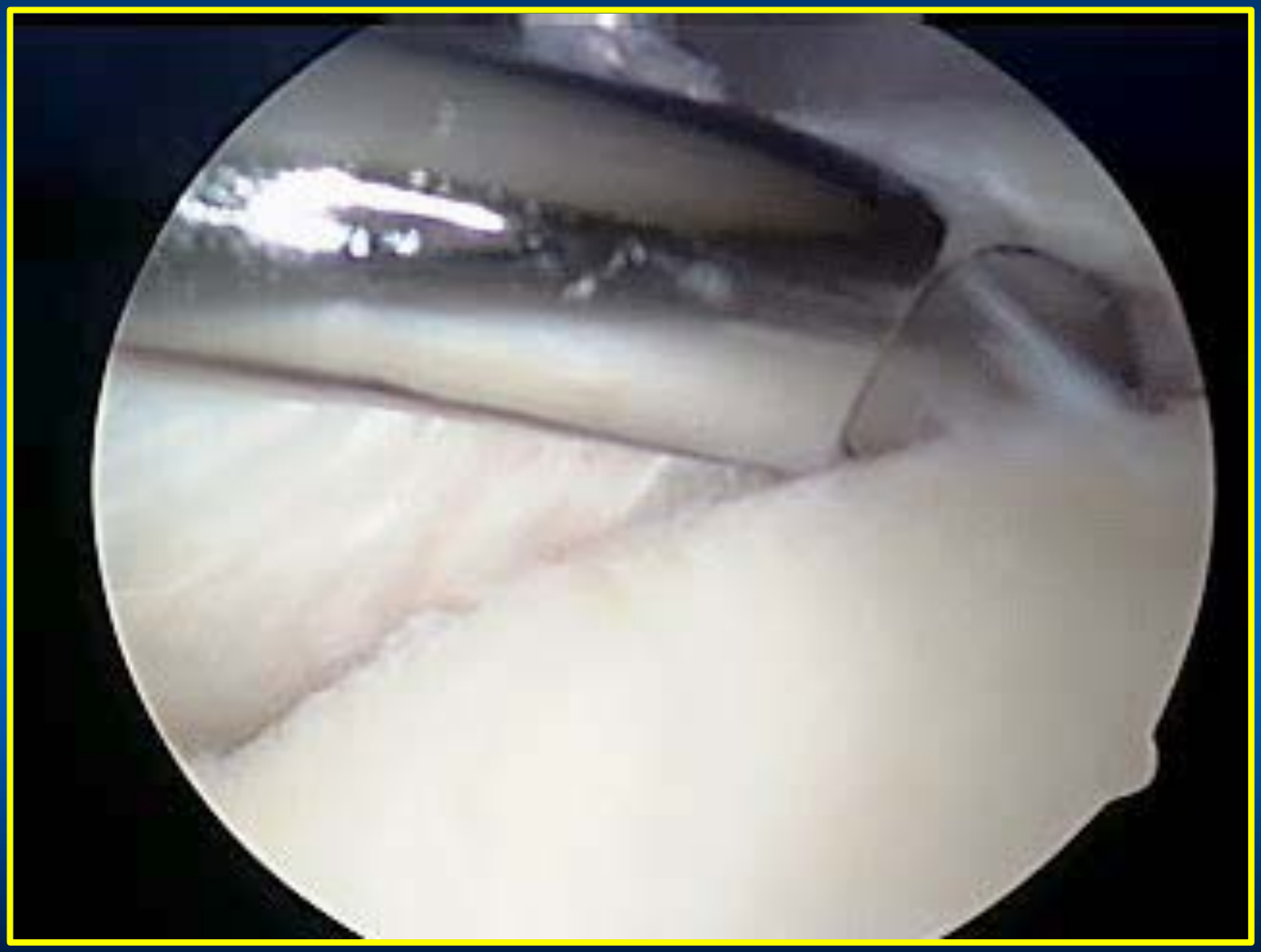


15 YO Football Player Scope Series

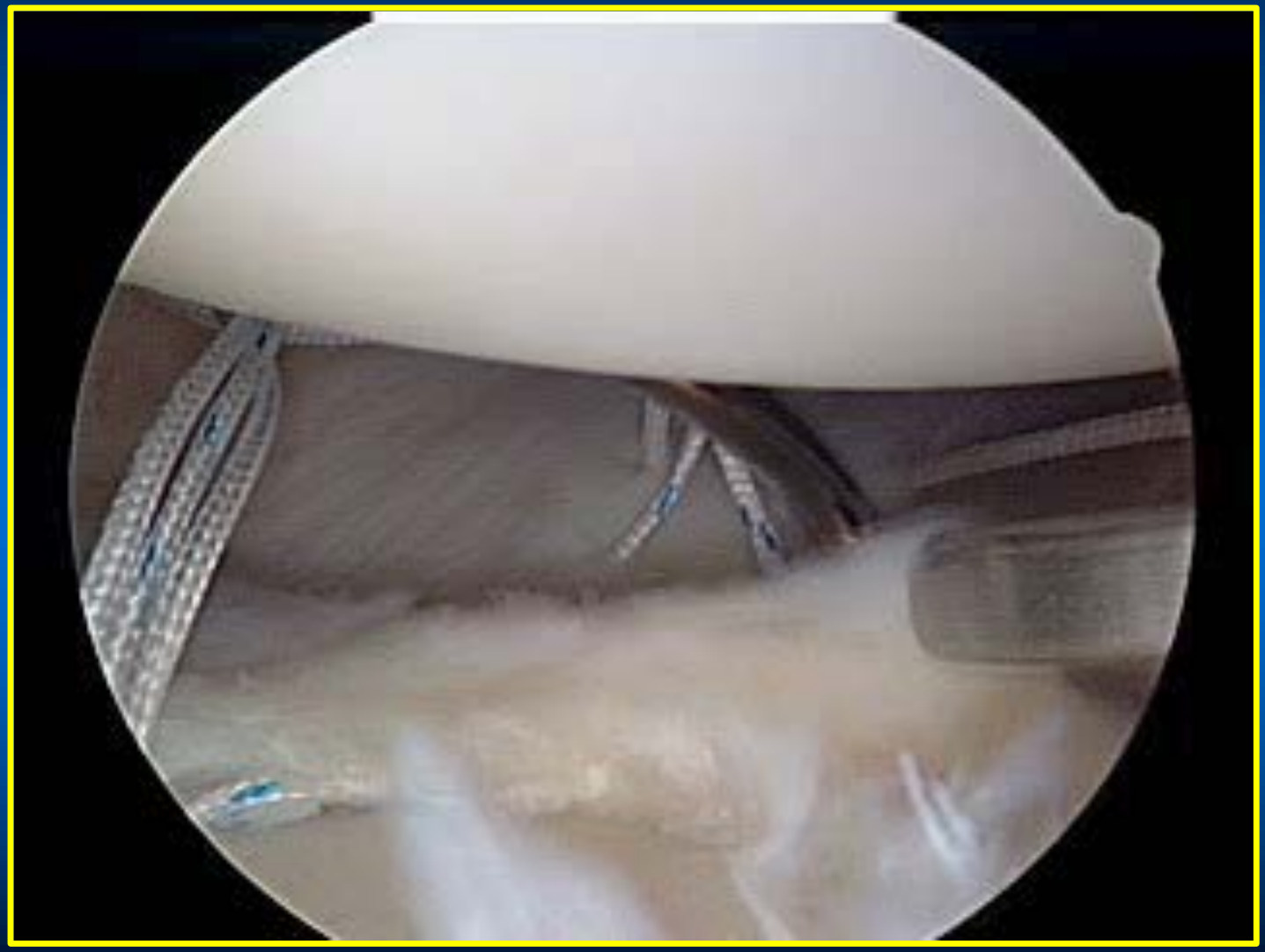


Bankart lesion and capsular insufficiency

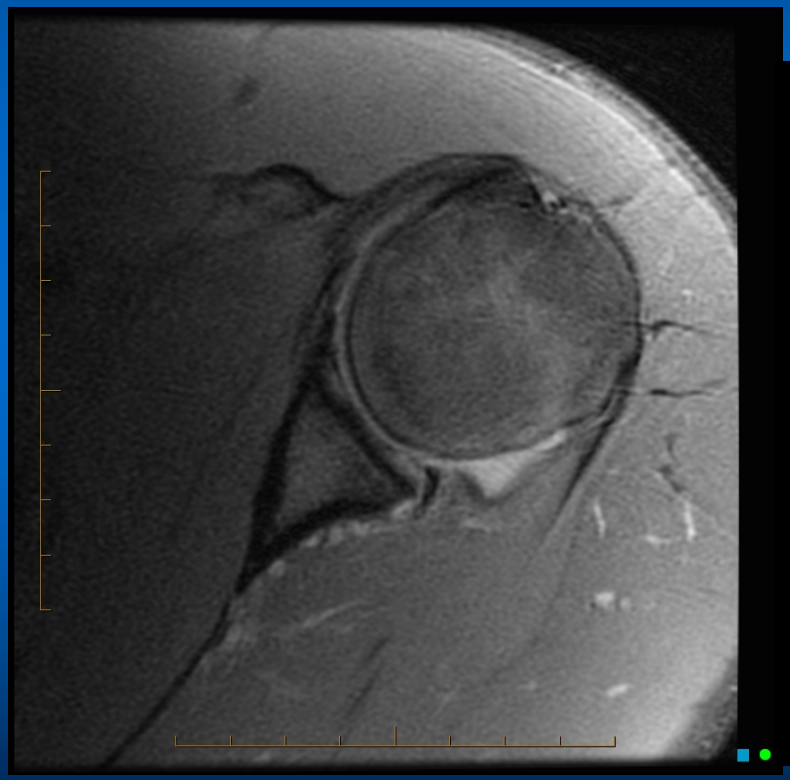
Preparation of the glenoid, mobilization of capsuloligamentous labral tissue from scapular neck

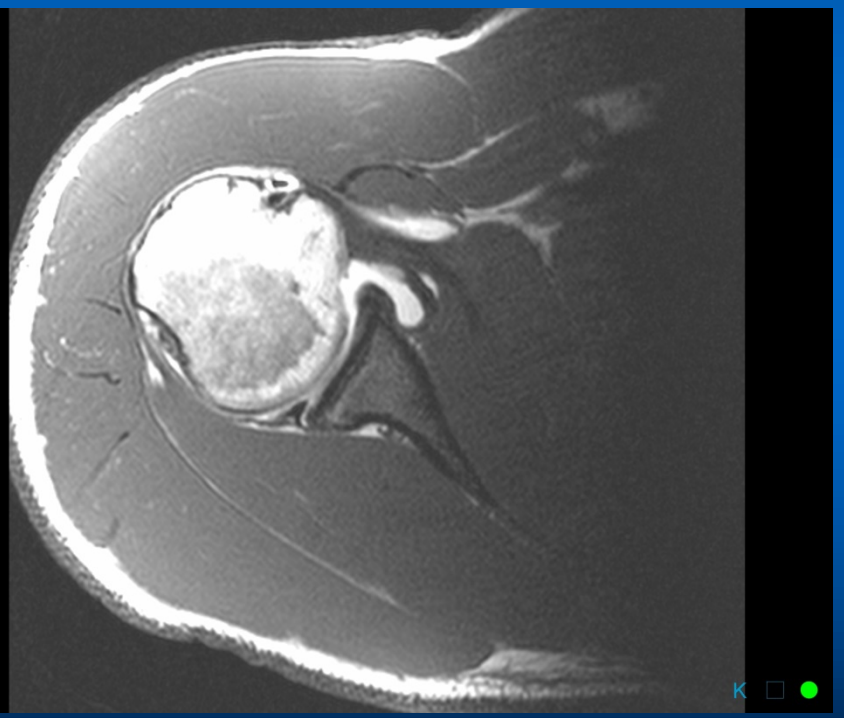


Suture management, 2 anchors with 4 sutures and capsulorraphy sutures inferior and rotator interval



Posterior labral tears






Left Shoulder
Anterior
Scope Posterior

Complete RC tear surgery

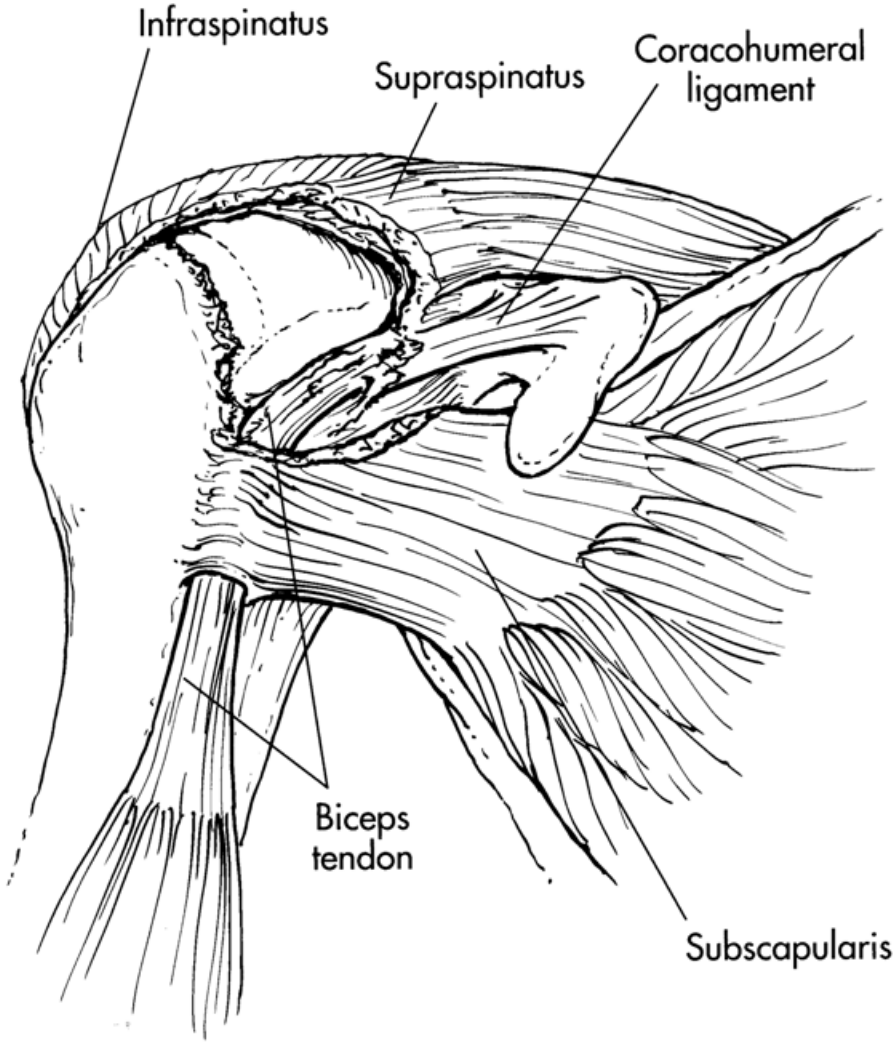
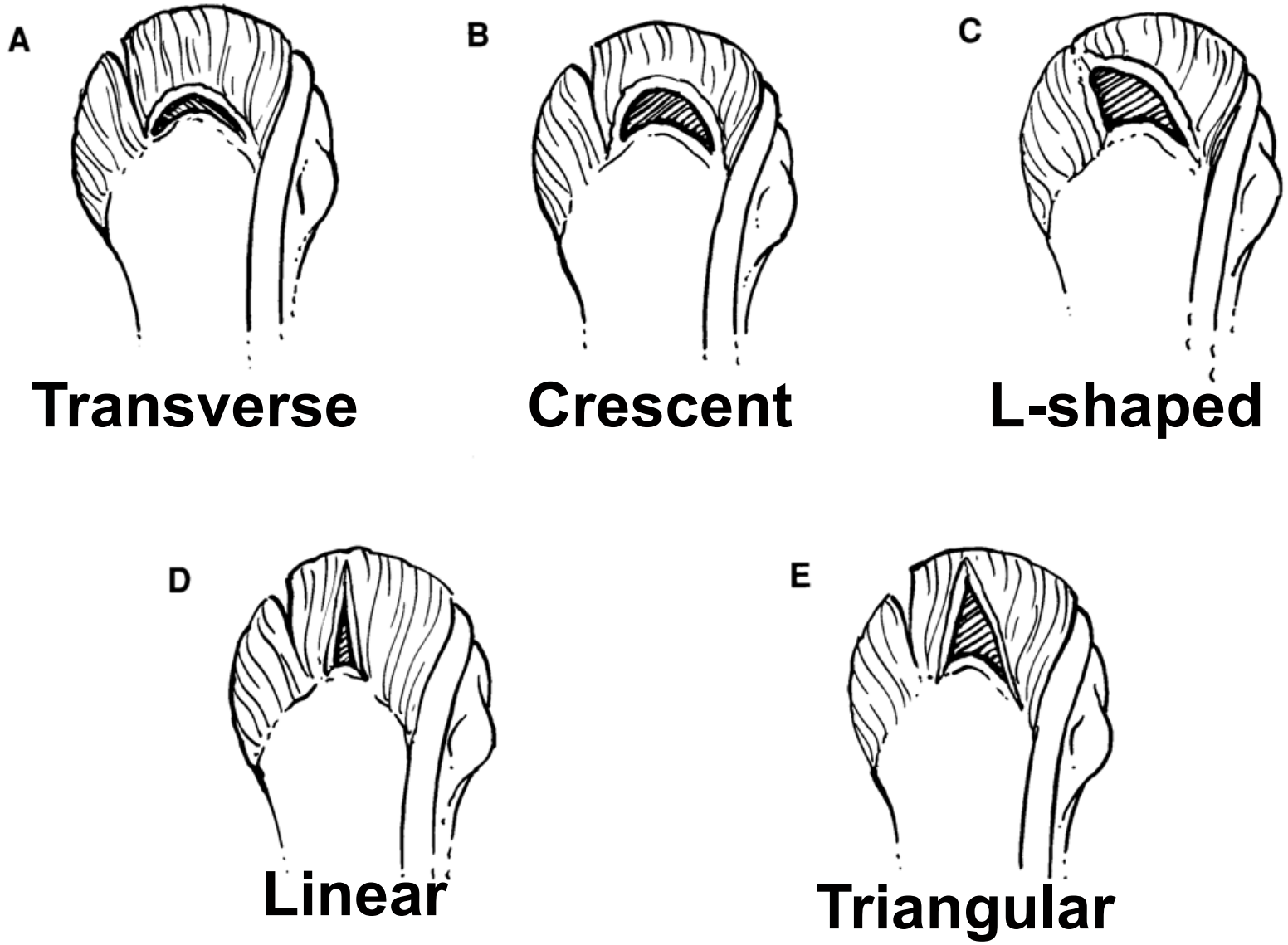
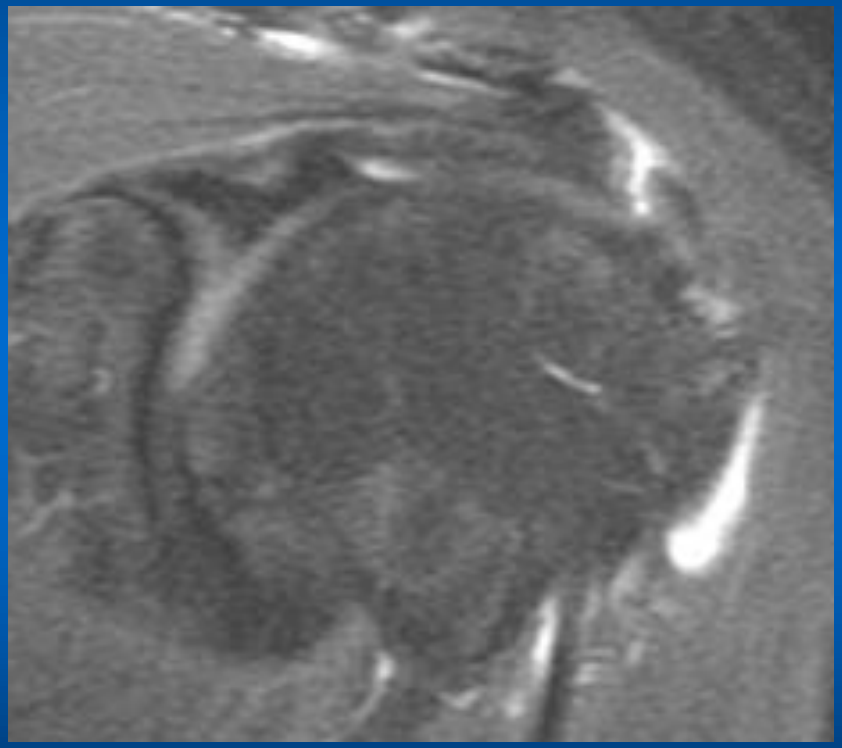


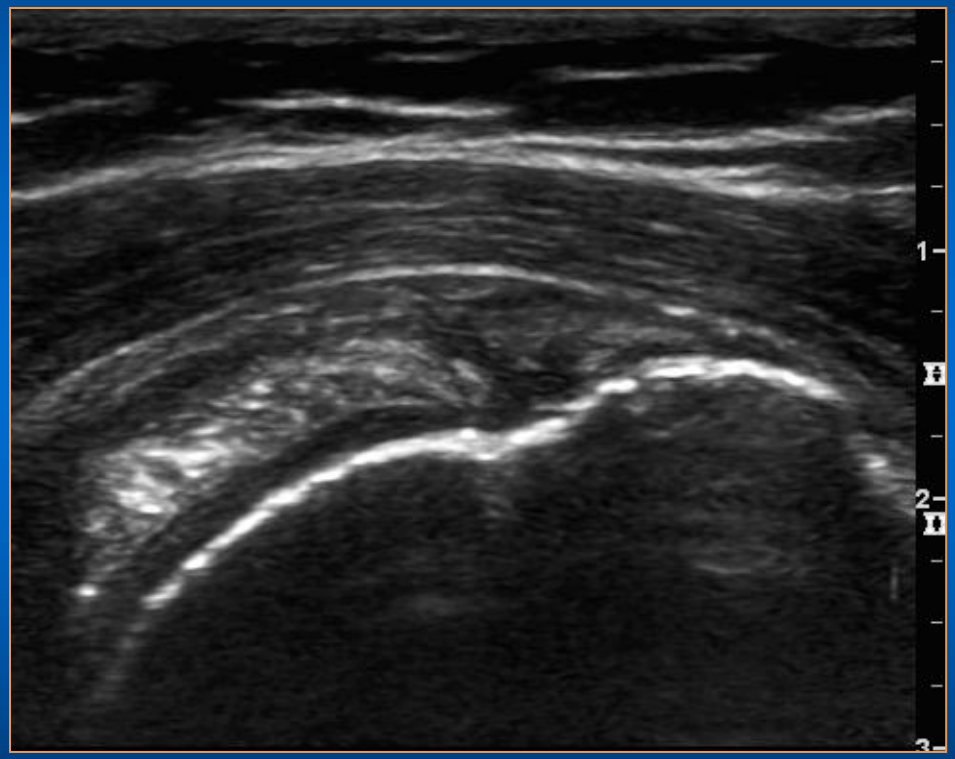
FIGURE 7-64 A massive rotator cuff tear involving the subscapularis, supraspinatus, and infraspinatus muscle tendons. There is retraction of the supraspinatus tendon, subluxation of the biceps tendon, and contraction of the coracohumeral ligament.



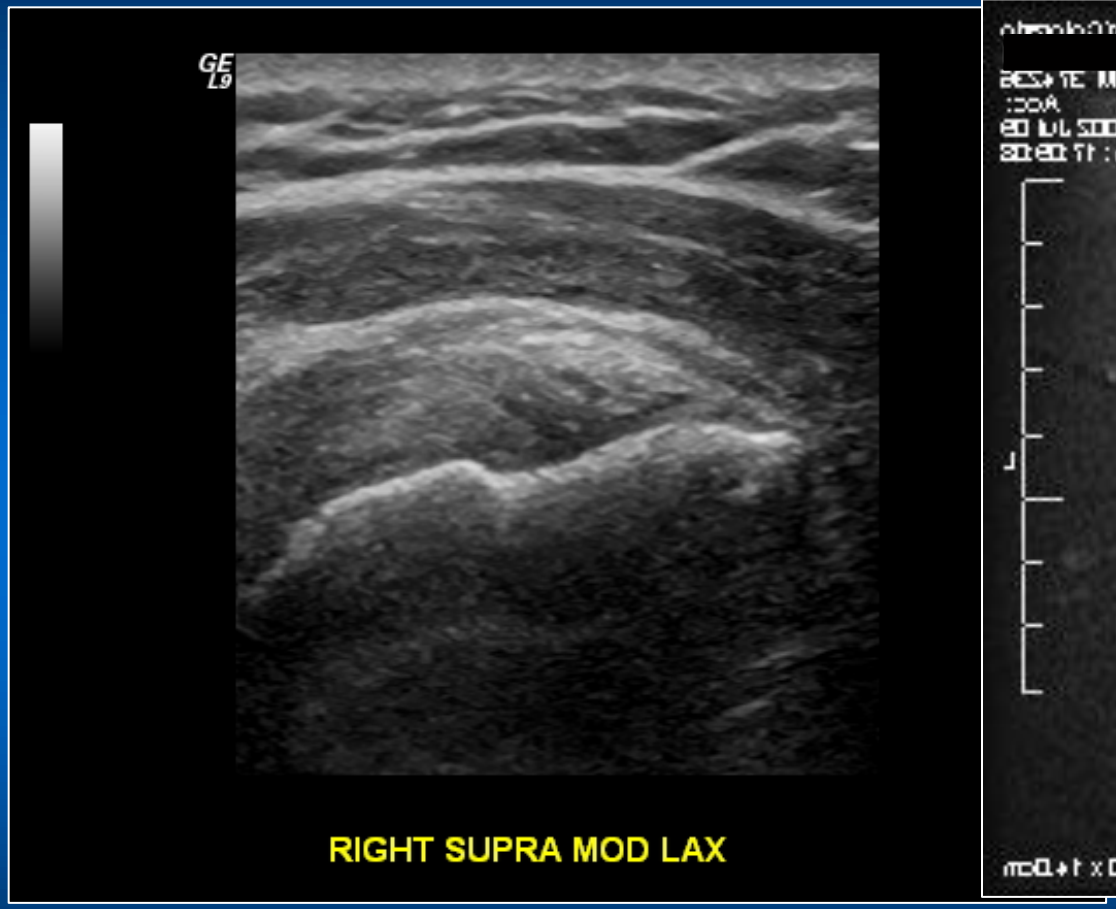
Jobe FW. Operative techniques in upper extremity sports Injuries. Mosby, 1996, p.225. Fig. 7-59.

Shoulder – Supraspinatus Tear



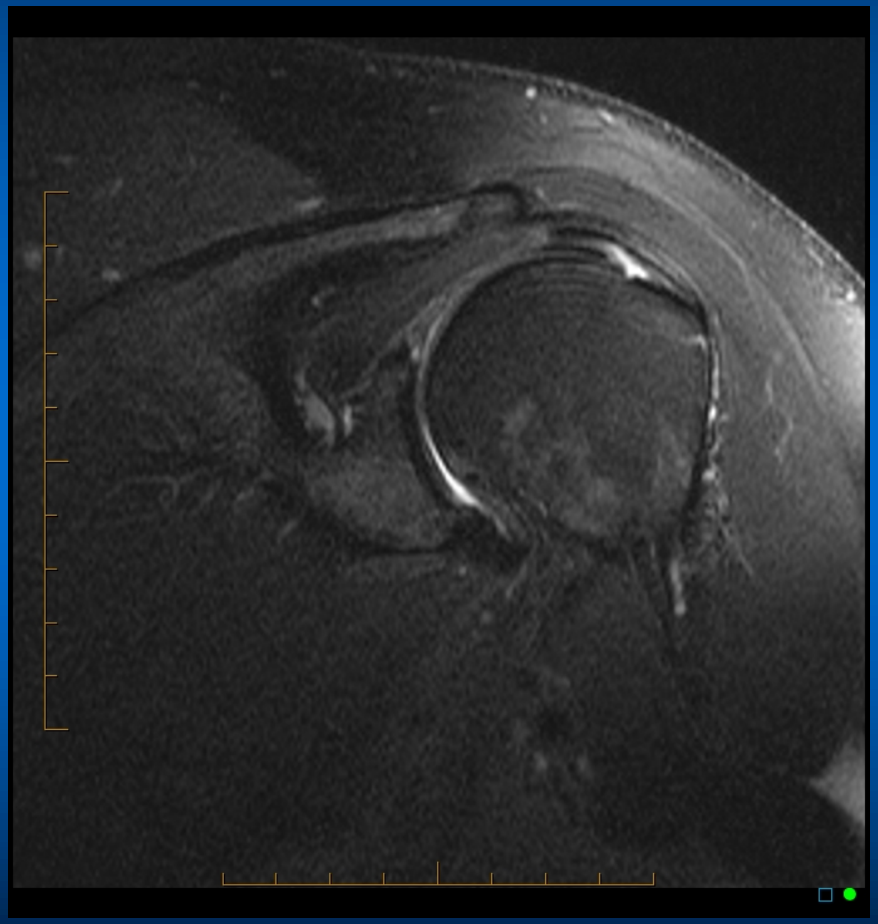


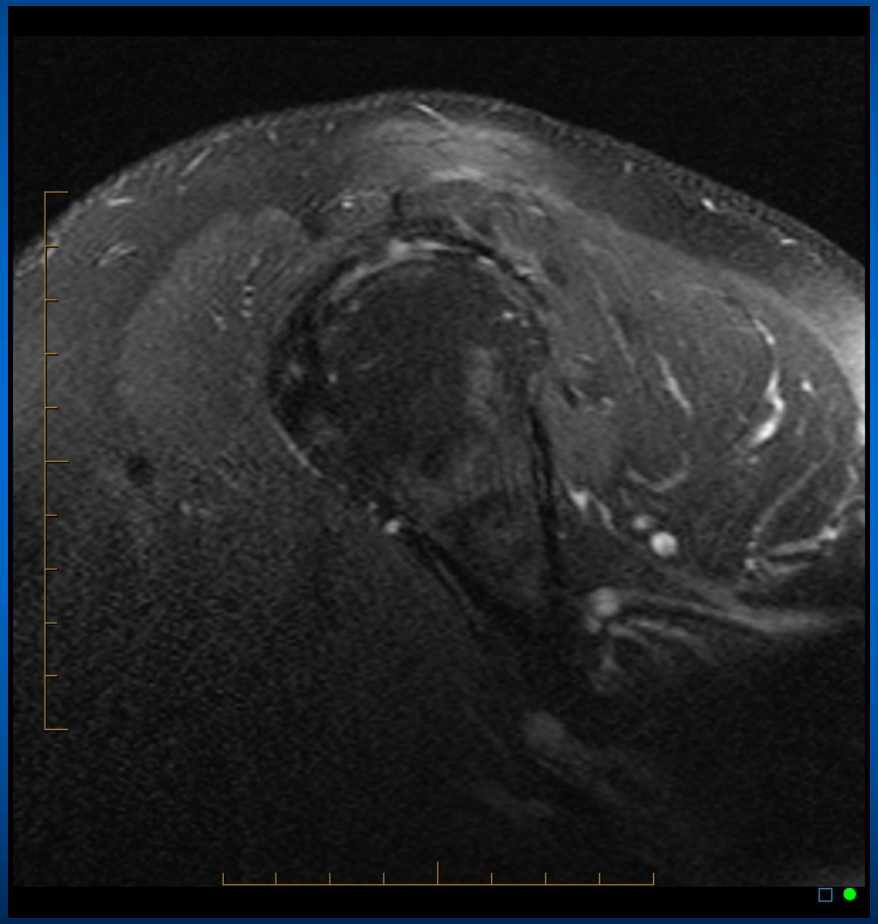
Shoulder- Subacromial impingement



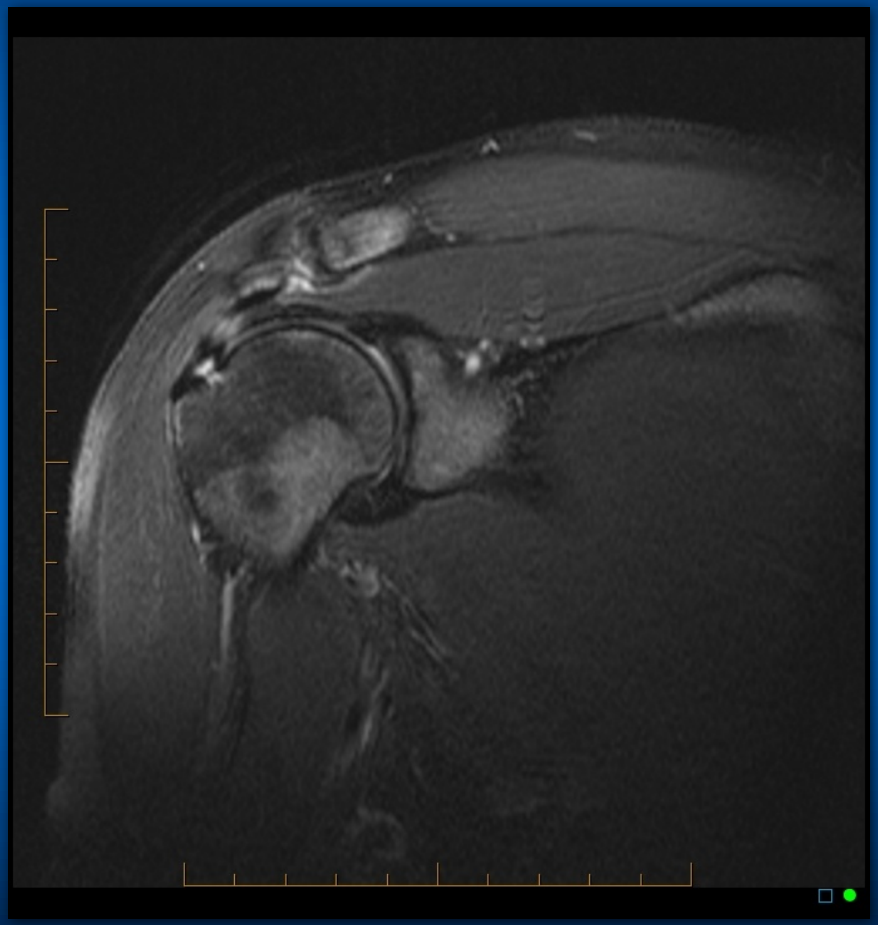
Calcific Tendinosis - Supraspinatus

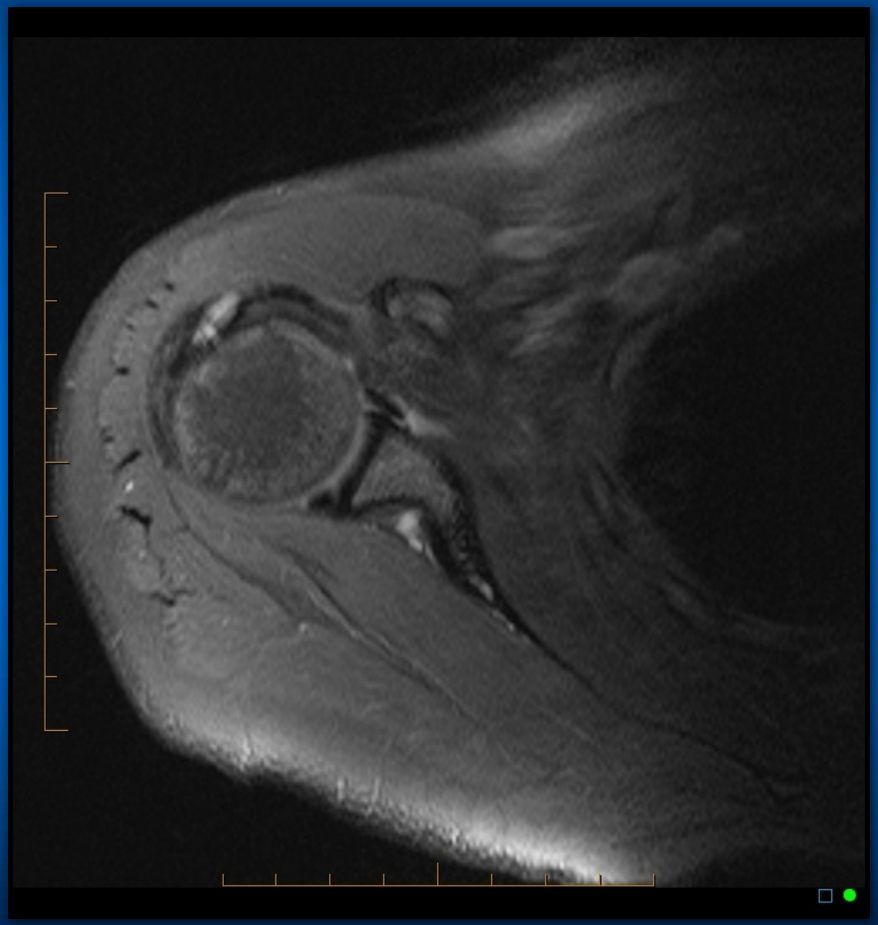
False positive supraspinatus



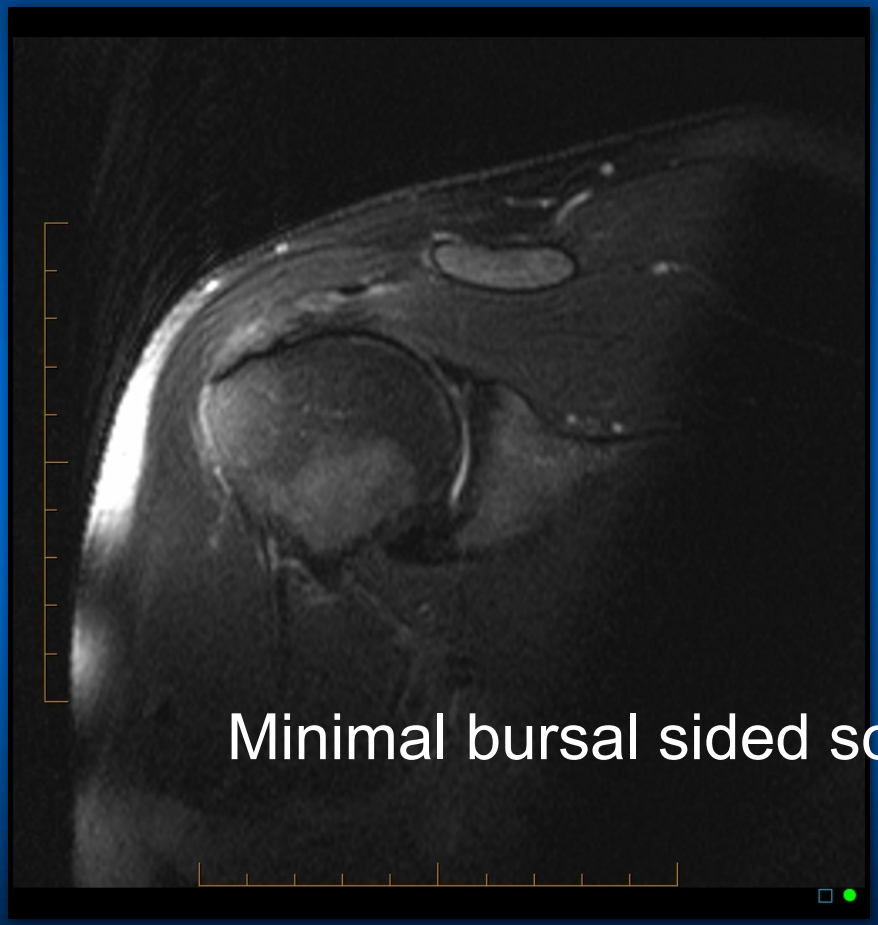


False Positives - cuff



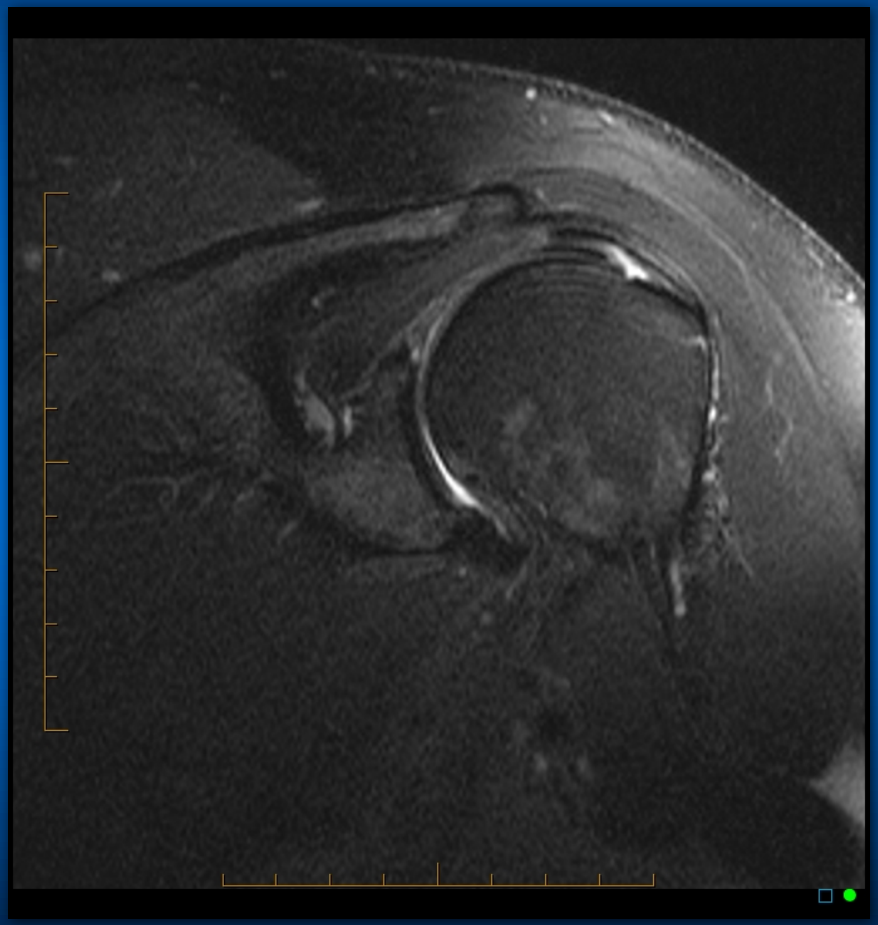


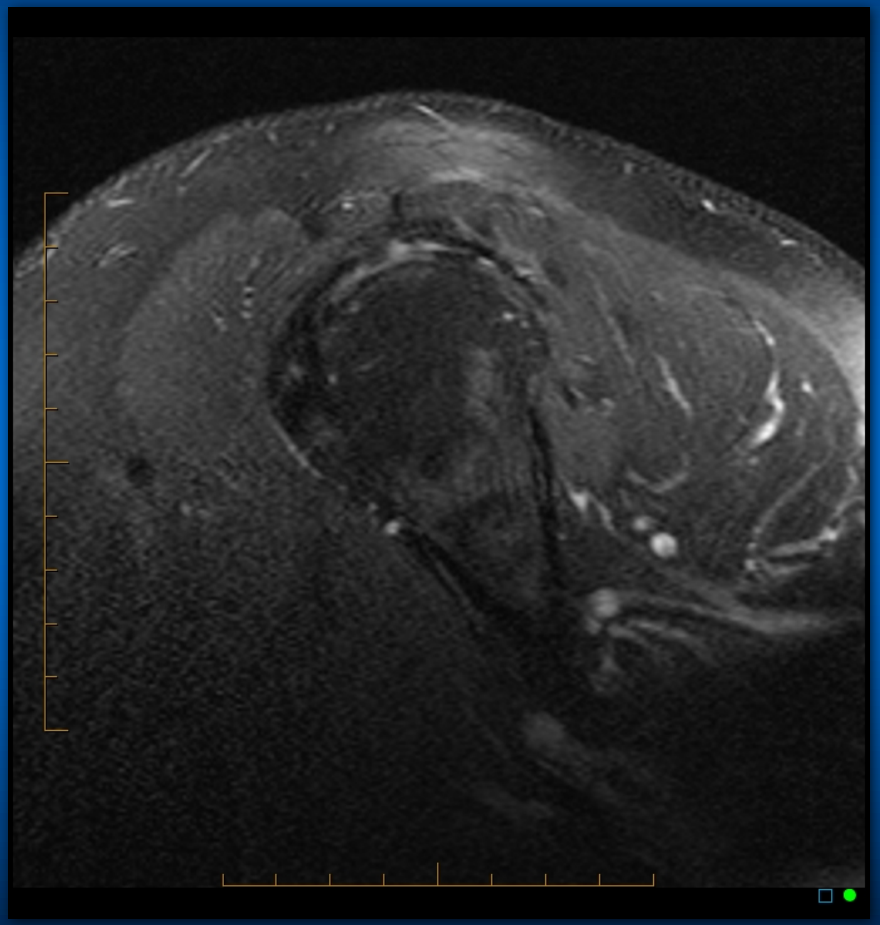
False Positives - cuff



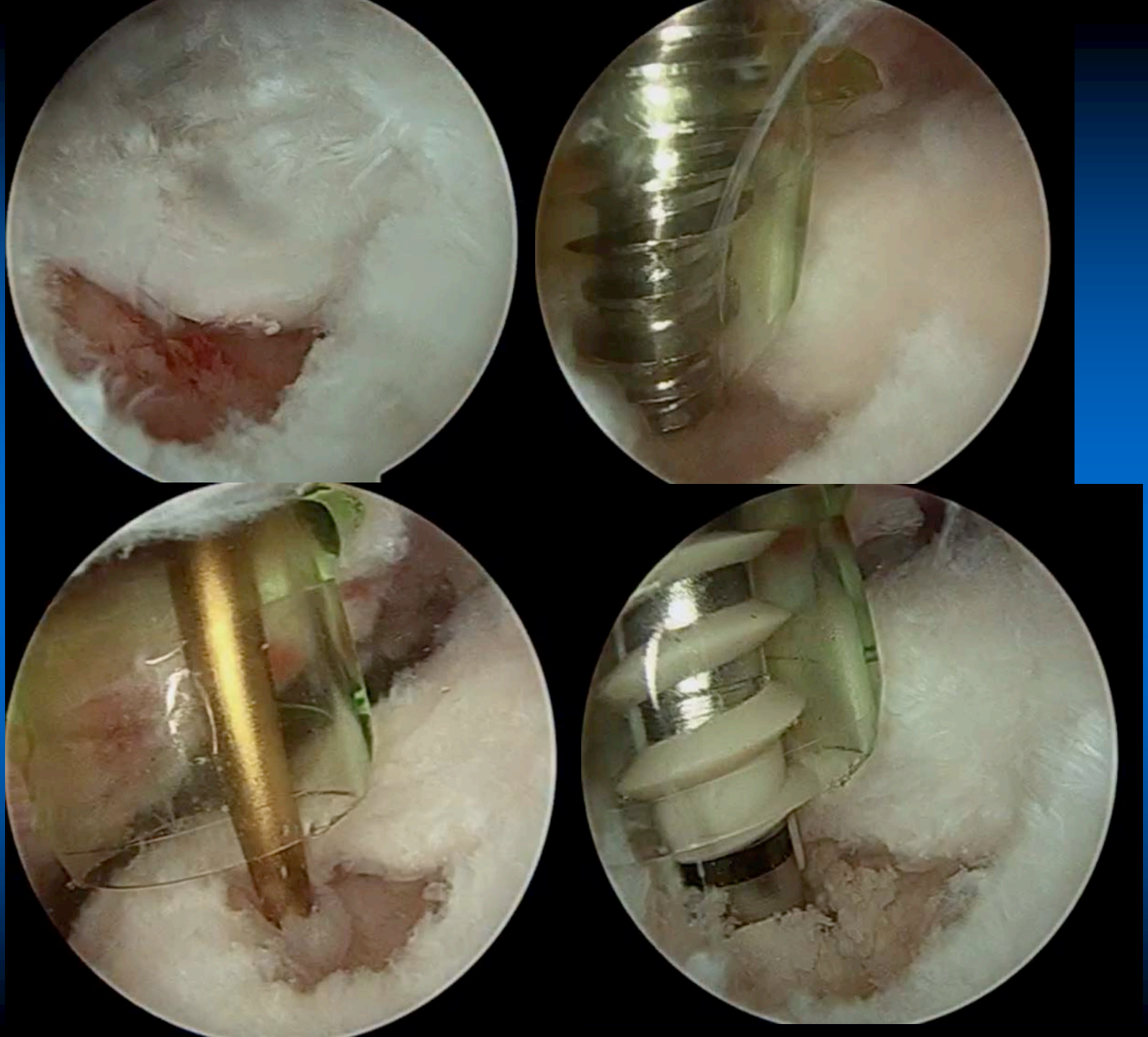
Minimal bursal sided scuffing called by MRI

False Positives - cuff



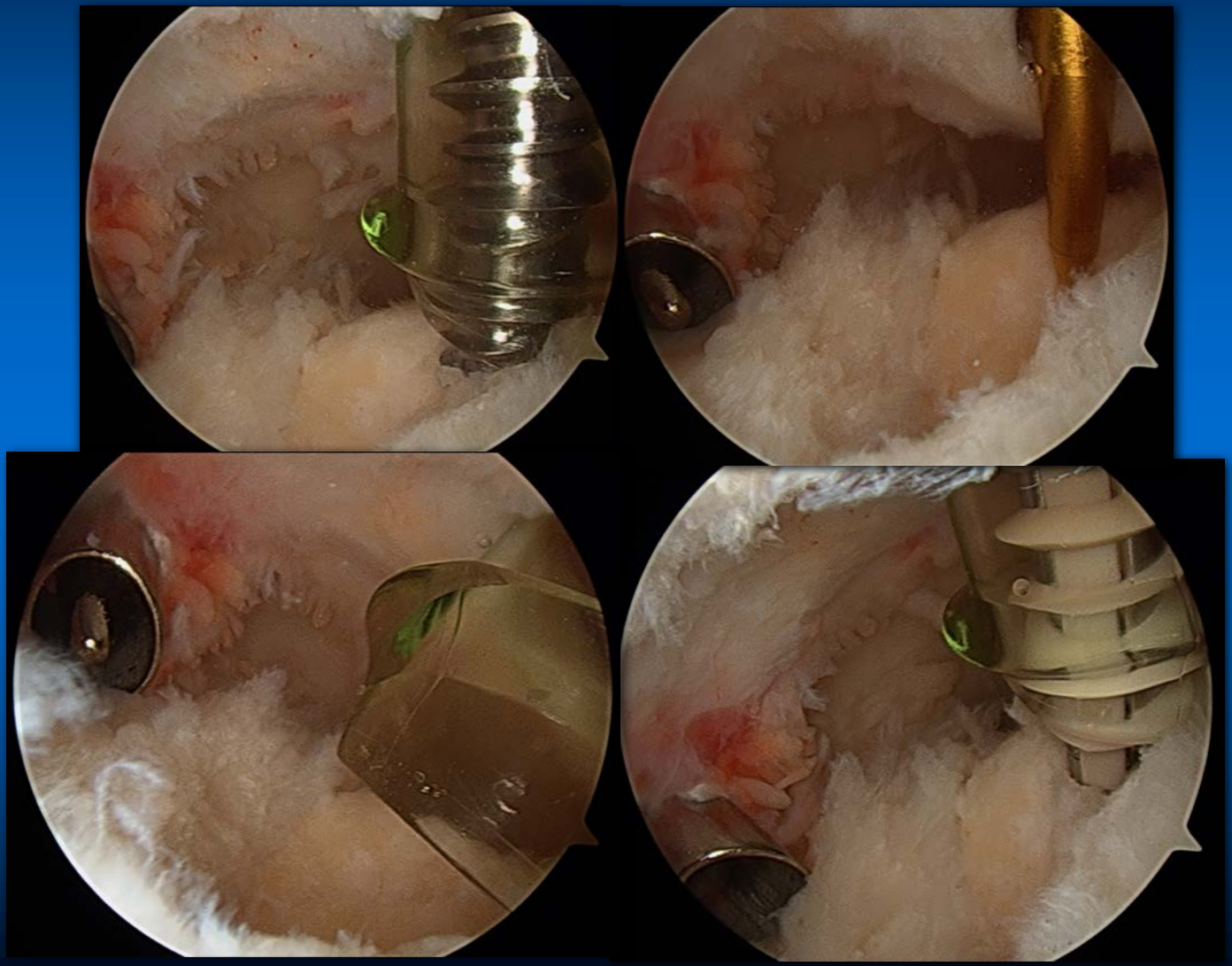


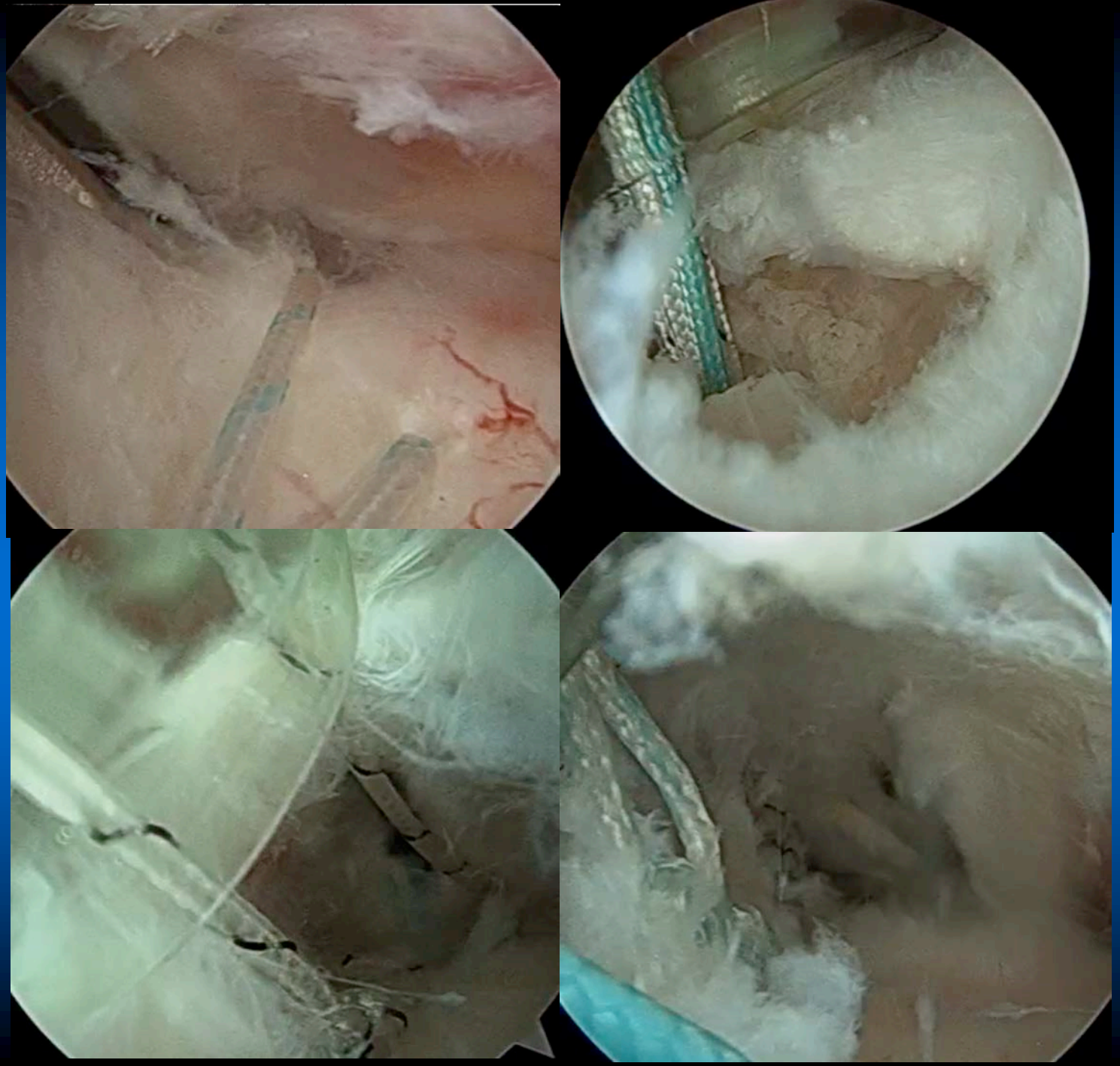
Biceps Normal Rotator Cuff Tear



Lateral Deltoid Portal - Scope Posterior

- Think Perpendicular Orientation
- Dead Man's Angle for Anchor Insertion

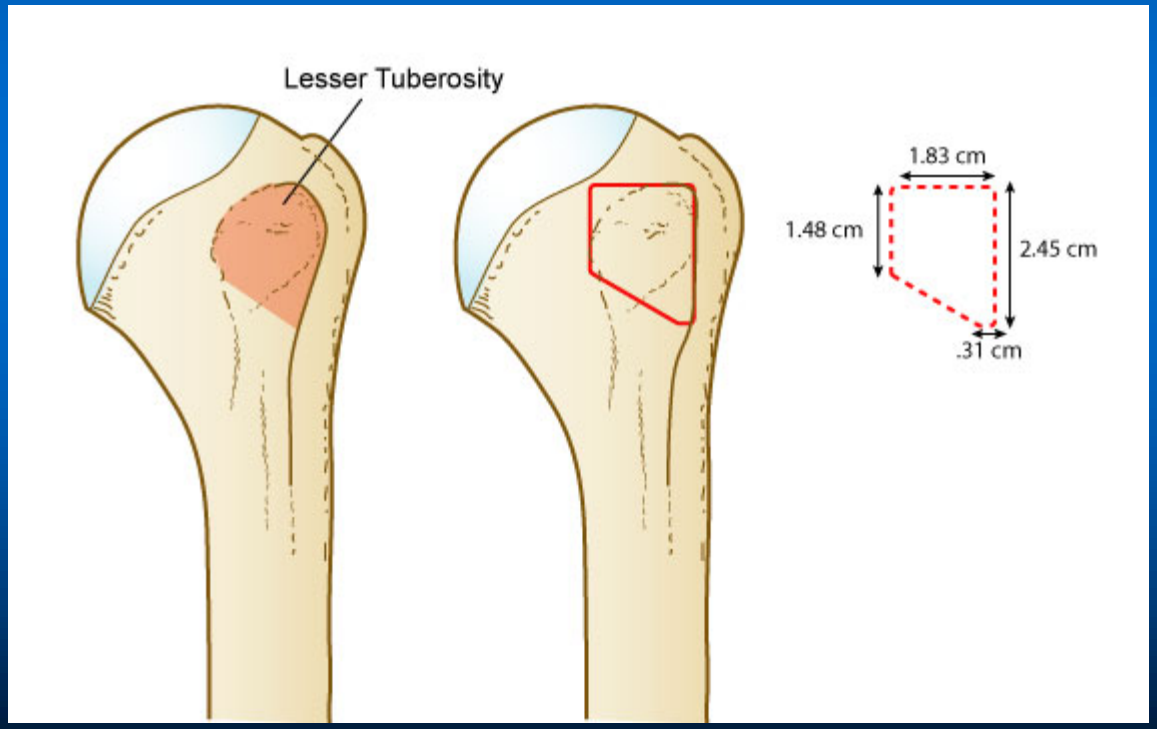


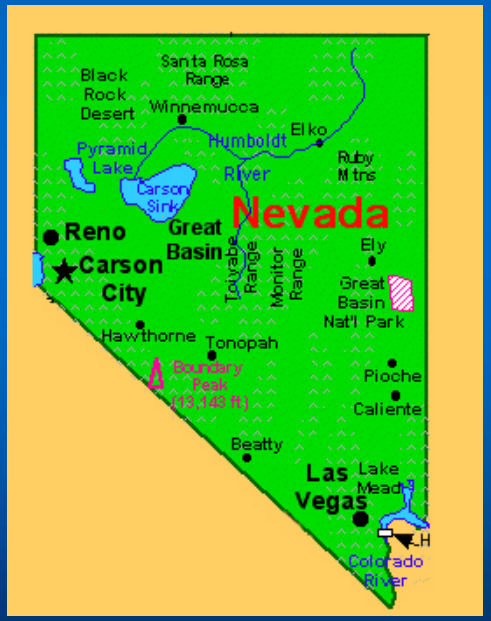


Subscapularis Muscle

Subscapularis Footprint

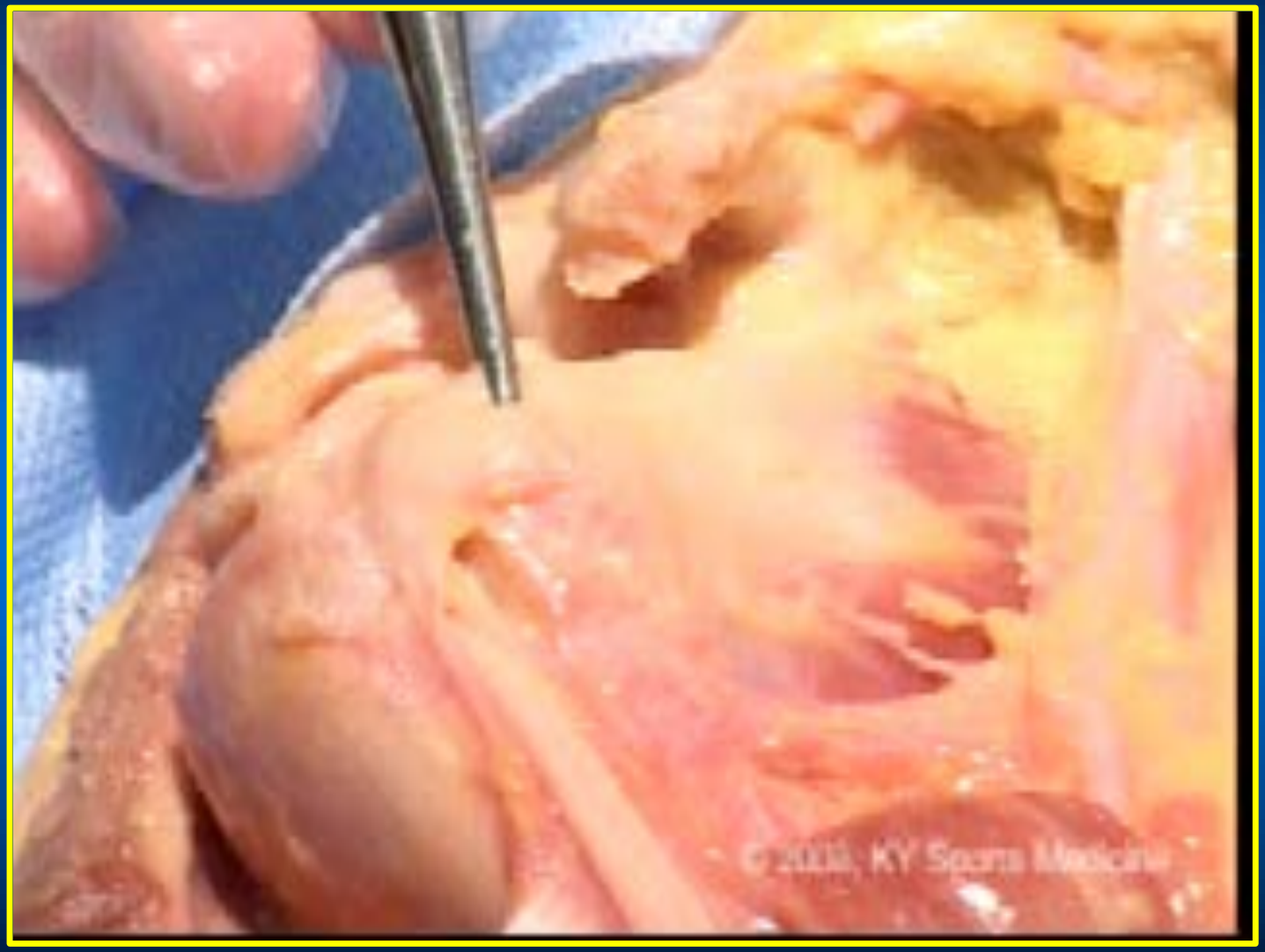
- 2.5 cm superior-to-inferior
- 1.5 cm medial-to-lateral
- Widest superiorly





Nevada analogy by
Stephen Burkhart, M.D.

Subscapularis & Biceps Instability



Clinical exam: subscapularis tear

"I was unable to get my wallet out of my back pocket."

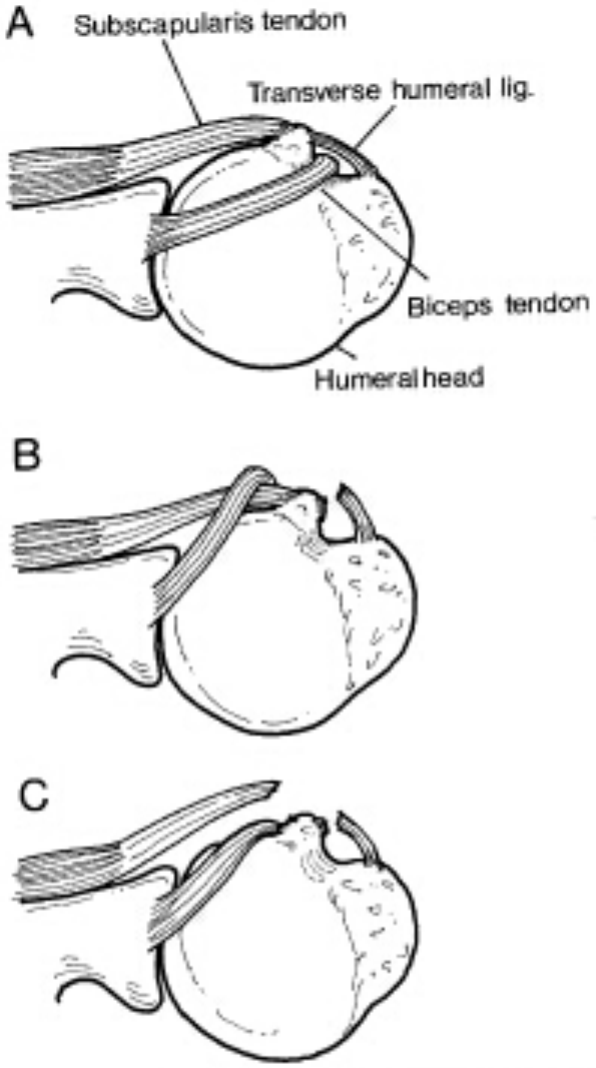
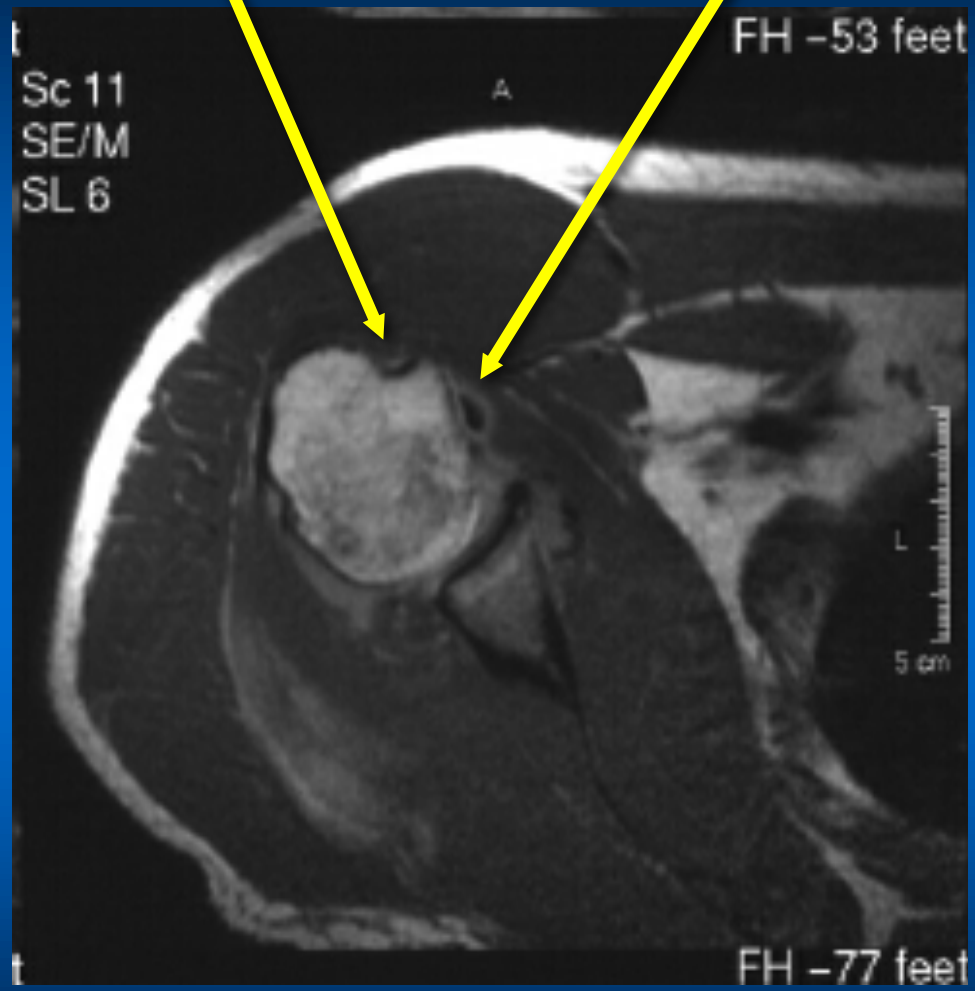
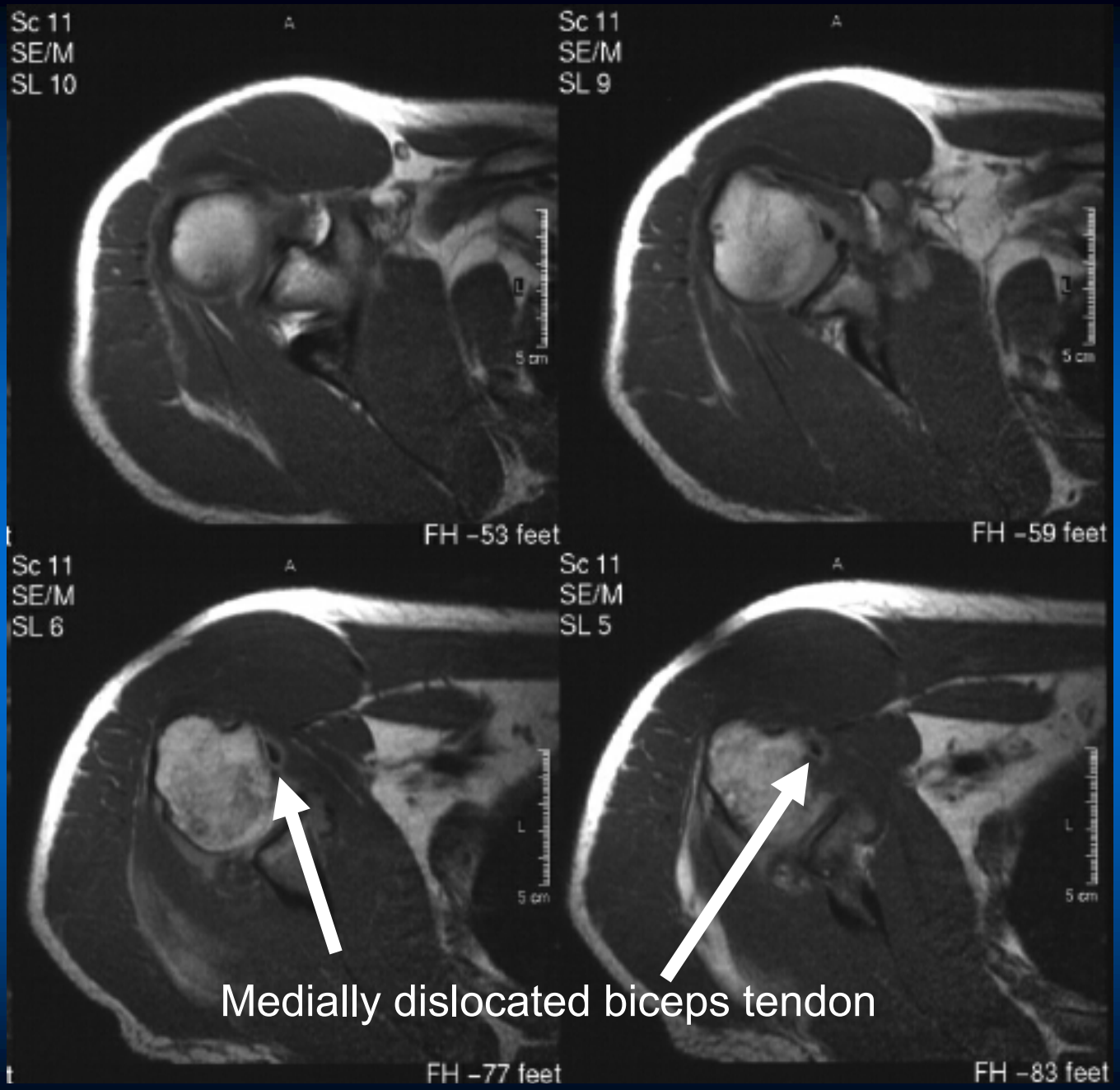
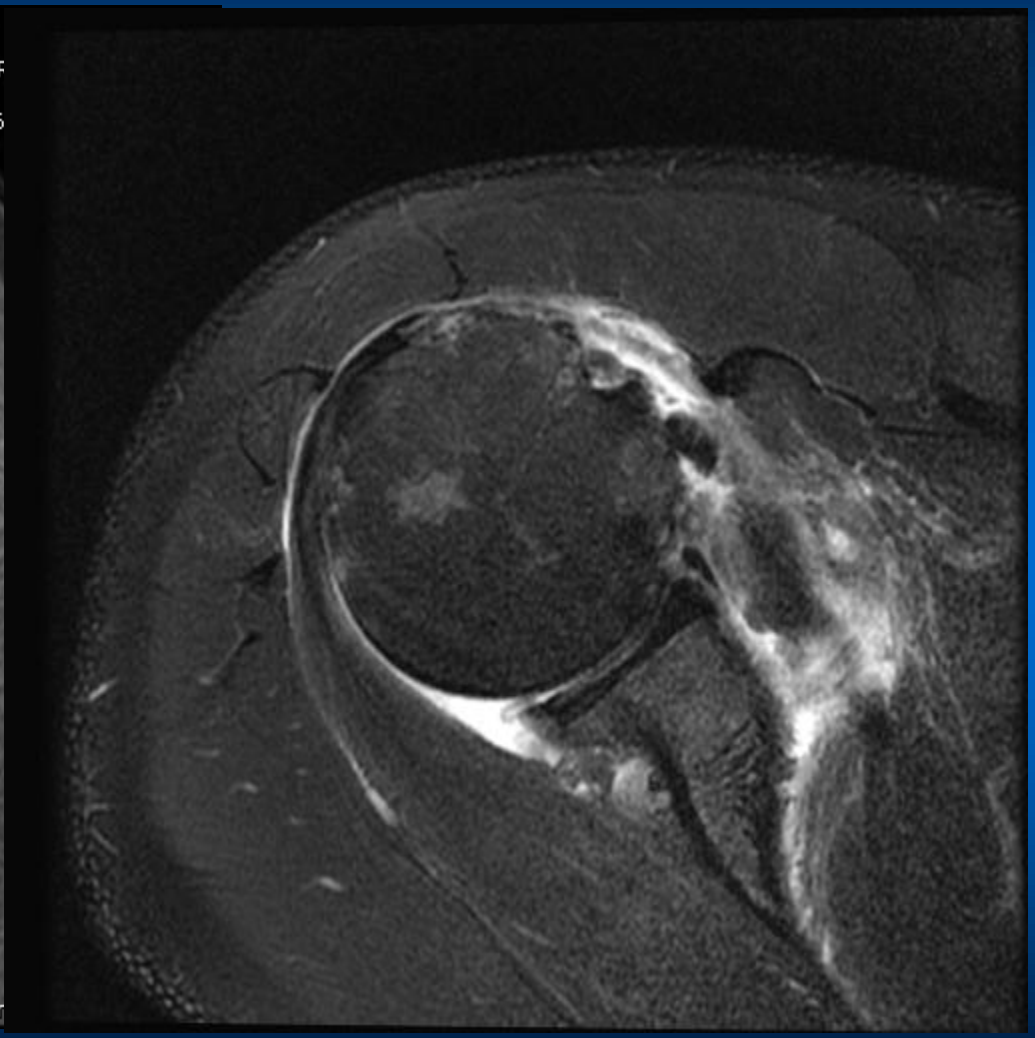


FIG 4. Superior view of right shoulder. (**A**) Normal relation of biceps tendon to bicipital groove. (**B**) Rupture of transverse humeral and coracohumeral ligaments, but no disruption of subscapularis tendon. (**C**) Tear of subscapularis tendon and coracohumeral and transverse humeral ligaments (as occasionally occurs when the humerus dislocates anteriorly. (Modified from Hitchcock HH, Bechtol CO. Observations on the role of the tendon of the long head of the biceps brachii in its causation. *J Bone Joint Surg* 1948;30A:263–273, with permission).




Sc 11
SE/M
SL 10
FH -53 feet
Sc 11
SE/M
SL 9
FH -59 feet
Sc 11
SE/M
SL 6
FH -77 feet
Sc 11
SE/M
SL 5
FH -83 feet
Medially dislocated biceps tendon

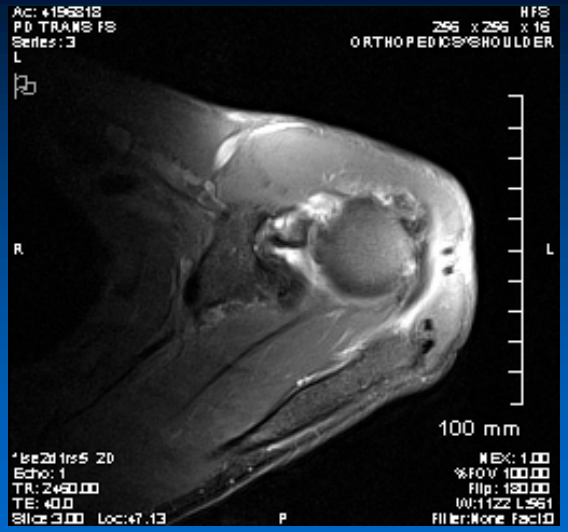
LHBT pathology



57 YO Male Left Shoulder
Subscapularis / Supraspinatus tears

PRE-OP EXAM:


Ac: 4196818
PD TRANS FS
Series: 3
HFS
256 x 256 x 16
ORTHOPEDICS^SHOULDER
R
L
100 mm
*tse2d1rs5 2D
Echo: 1
TR: 2450.00
TE: 40.0
Slice:3.00 Loc:3.27
NEX: 1.00
%FOV 100.00
Flip: 180.00
W:1122 L:561
Filter:None Fact:0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PD TRANS FS
Series: 3
HFS
256 x 256 x 16
ORTHOPEDICS^SHOULDER
R
L
100 mm
*tse2d1rs5 2D
Echo: 1
TR: 2450.00
TE: 40.0
Slice:3.00 Loc:47.13
NEX: 1.00
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Flip: 180.00
W:1122 L:561
Filter:None Fact:0


Ac: 4196818
COR TSE T2 FS
Series: 9
HFS
512 x 512 x 16
ORTHOPEDICS^SHOULDER
R
L
80 mm
*tse2d1_9 2D
Echo: 1
TR: 3500.00
TE: 52.0
Slice:4.00 Loc:71.67
NEX: 3.00
%FOV 100.00
Flip: 180.00
W:822 L:411
Filter:None Fact:0


Ac: 4196818
COR TSE T2 FS
Series: 9
HFS
512 x 512 x 16
ORTHOPEDICS^SHOULDER
R
L
80 mm
*tse2d1_9 2D
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TR: 3500.00
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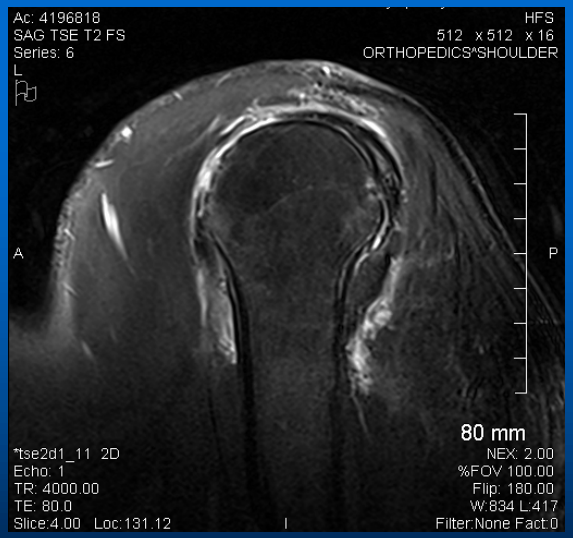
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SAG TSE T2 FS
Series: 6
HFS
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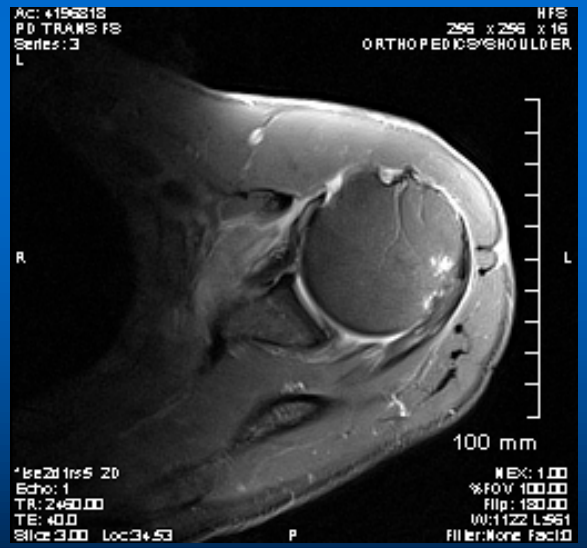
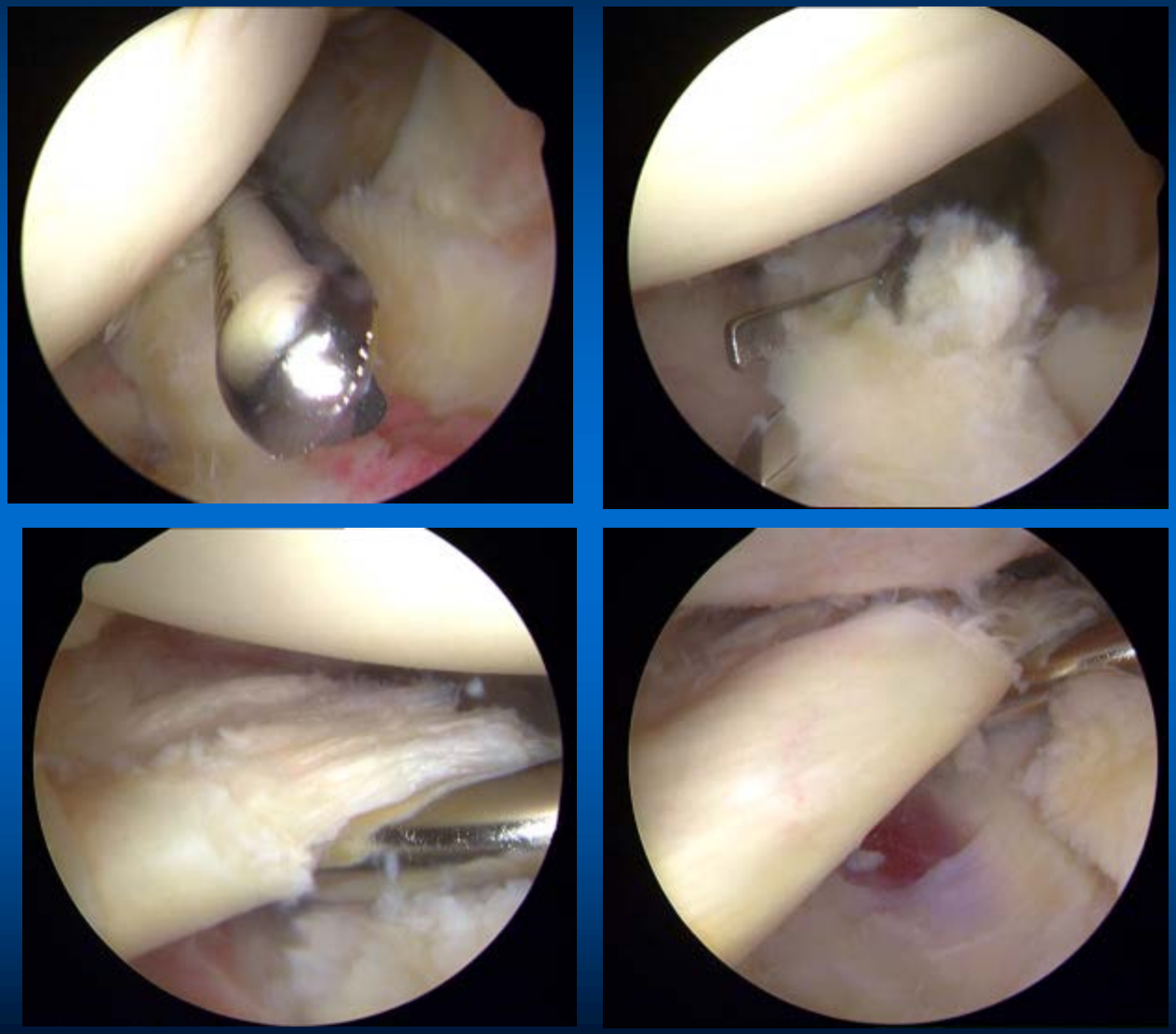
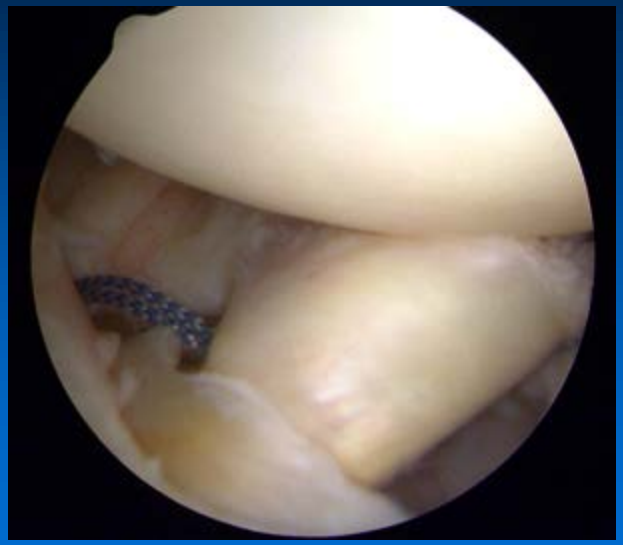
ORTHOPEDICS^SHOULDER
A
P
80 mm
*tse2d1_11 2D
Echo: 1
TR: 4000.00
TE: 80.0
Slice:4.00 Loc:131.12
NEX: 2.00
%FOV 100.00
Flip: 180.00
W:834 L:417
Filter:None Fact:0

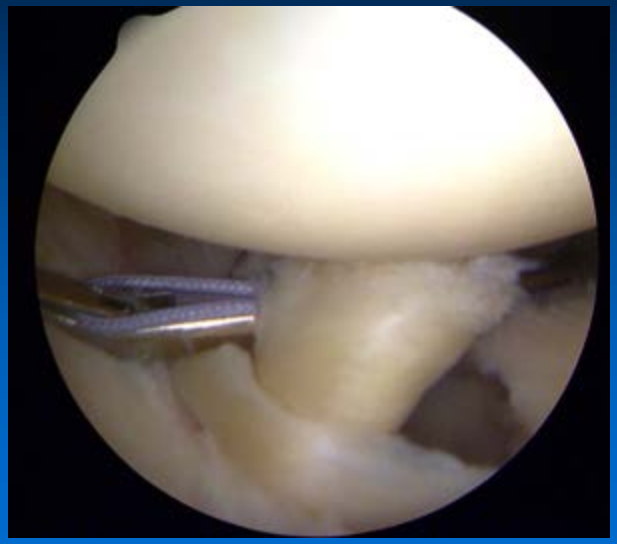

Ac: 4196818
PD TRANS FS
Series: 3
HFS
256 x 256 x 16
ORTHOPEDICS^SHOULDER
R
L
100 mm
*tse2d1rs5 2D
Echo: 1
TR: 2450.00
TE: 40.0
Slice:3.00 Loc:34.53
NEX: 1.00
%FOV 100.00
Flip: 180.00
W:1122 L:561
Filter:None Fact:0

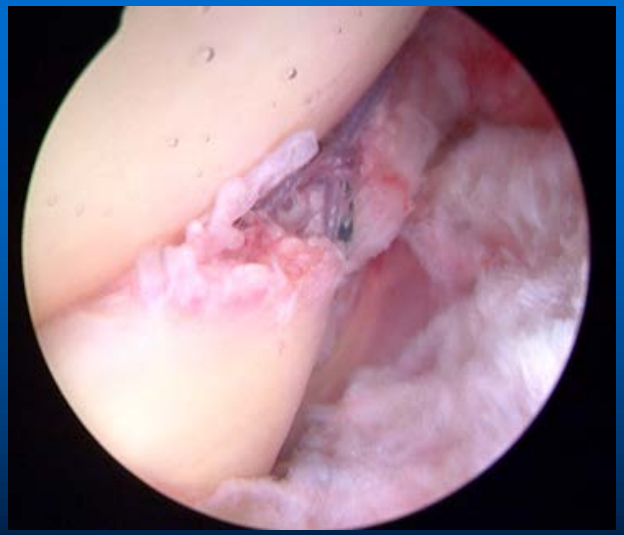
57 YO Male Left Shoulder



57 YO Male Left Shoulder







57 YO Male Left Shoulder

Conclusions

- Imaging in MSK is complex
  - Multiple modalities are available depending on the clinical question
  - MRI is most helpful, but limited with postoperative patients
    - Arthroscopy standard

  -- Cooperation is paramount

"Hey, I'm no orthopedic surgeon – know what I'm sayin'? But this can't be good."

Operative Correlations - Shoulder

- Overall
  - Accuracy
    - Full thickness cuff tear: 98%
    - Partial thickness tear: 94%
    - Biceps tear: 92%
    - Labral tear: 86% (non arthrographic)

MRI Scans of the Shoulder

- Make sure you know the type scanner and radiologist
- Communicate with radiologist regarding your clinical diagnosis
- If you can't read the MRI scan, you shouldn't be ordering it
- A Scan of the Best Quality with Pre Scan Communication with the Radiologist Gives the Best Information for Planning Surgical or Non Surgical Approach. Another Piece in the Diagnostic Puzzle

Beware of new drugs, implants and devices which seem to be too good to be true.

- Charles Dickens

**“Take nothing on its looks.
Take everything on evidence.
There is no better rule.”**

The End
Call of the wild.
Circle of Life.

Intro

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- James E. Ireland Foundation
- Web Links
- Other Readings and Discussion
- ACSM_TPC_2017

Mary Lloyd Ireland M.D.

MENU

Quit