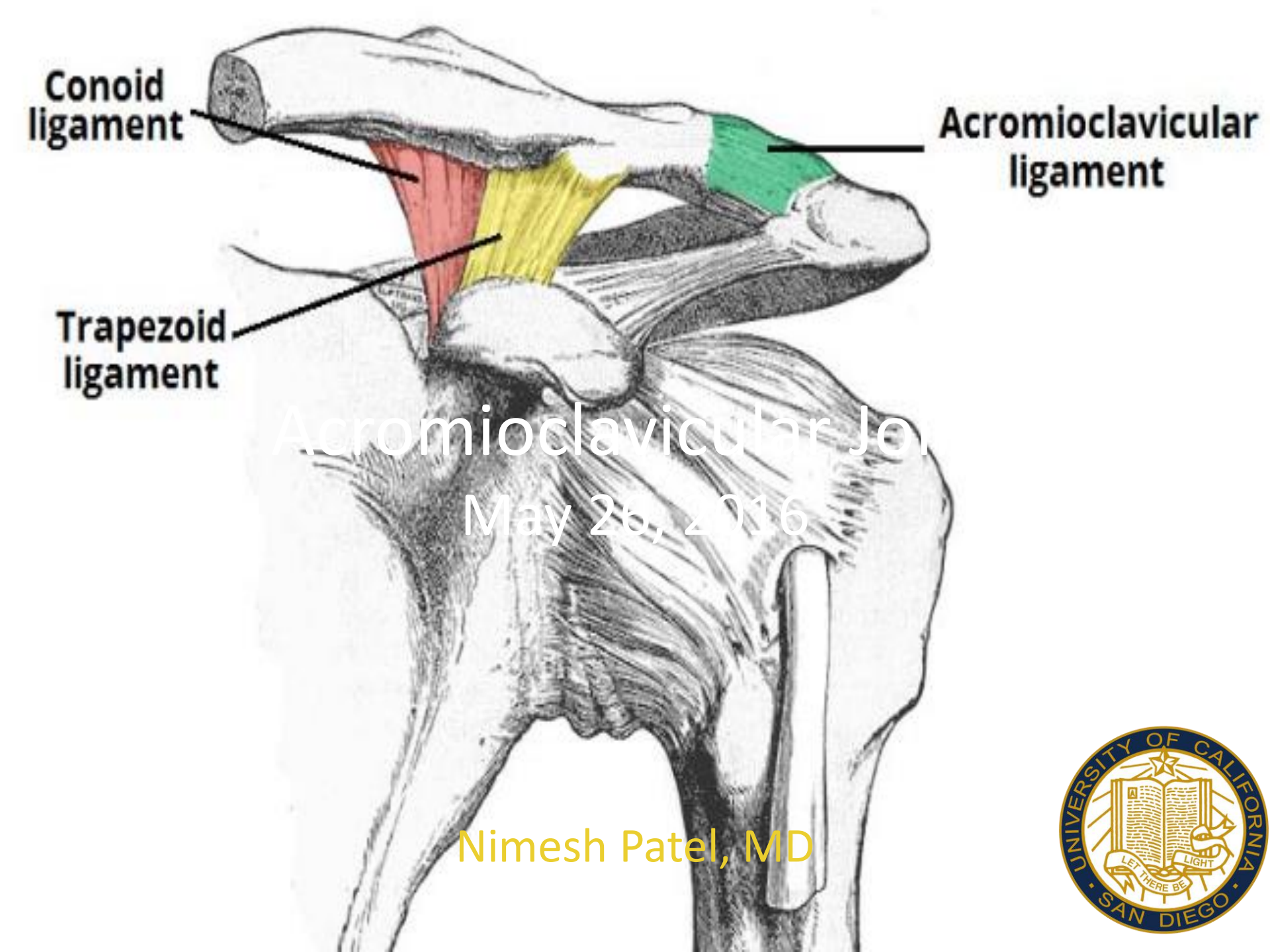


Acromioclavicular Jo

May 2e, 2016

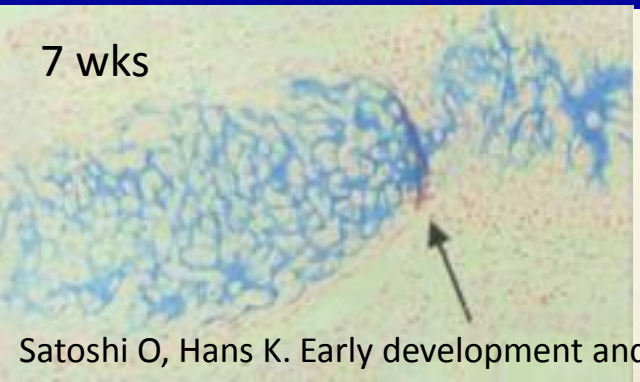
Nimesh Patel, MD

Goals of Presentation

- Brief developmental review of the AC joint
- Review the normal anatomy of the Acromioclavicular Joint (ACJ).
- Clinical/radiographic evaluation of ACJ injuries
- Traumatic pathology and grading classification
- Treatment options

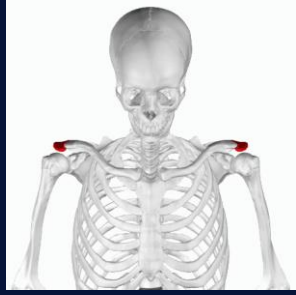
Anatomy: Clavicular Development

- Derived from Latin word *clavicula*, meaning "small key"
- Membranous bone
- 1st bone to ossify at 5 weeks
- 1 primary diaphyseal ossification center – intramembranous ossification, contributing to increased width.
- 2 secondary medial and lateral epiphyseal ossification centers –enchondral ossification.
- Medial epiphysis, last epiphysis to form 18-20 y/o

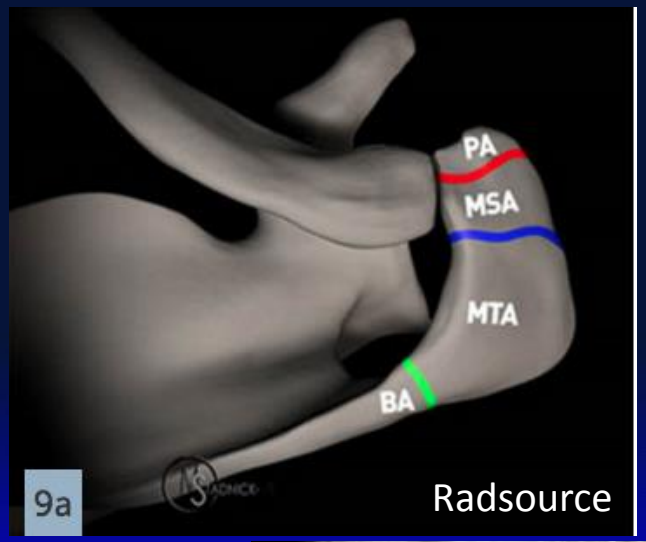


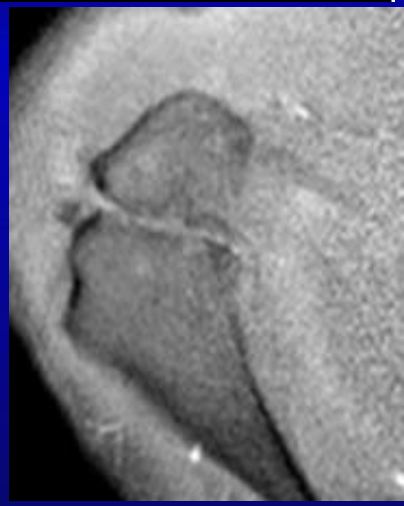
Satoshi O, Hans K. Early development and ossification of the human clavicle. Acta Orthop Scand. 1990; 61(4)

Anatomy: Acromion Development



- Seven primary ossification centers– 6-8 weeks gestation, remainder cartilaginous
- 4 secondary ossification centers, appear 15-18 y/o
  - Coalesce into: Preacromion, mesoacromion, meta-acromion, basi-acromion
- Complete fusion by 20-25 y/o



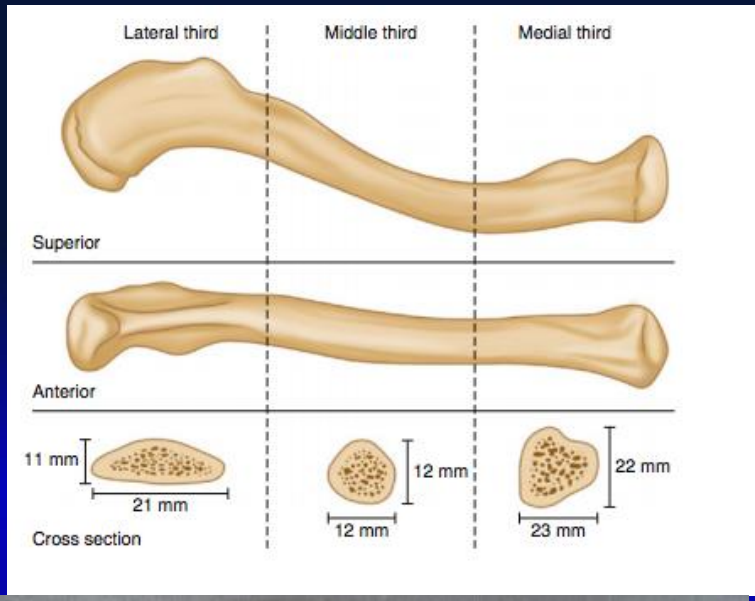


Radiologyassistant.com

J. Phadnis, G.I Bain. Clavicle Anatomy. Normal Anatomy and Pathology of the Shoulder. 2015

Gross Anatomy: Clavicle

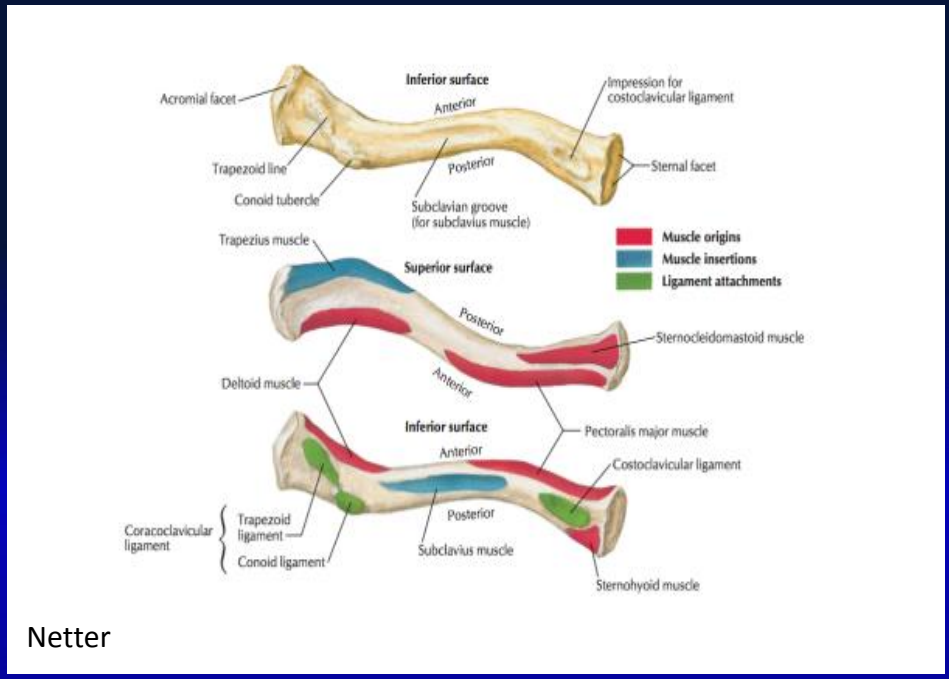
- S-Shaped tubular bone
  - 2 radii of curvature
    - Medial anterior convex
    - Lateral anterior concave
- Undersurface anatomy
  - Medially
    - Rhomboid fossa
  - Laterally
    - Conoid tubercle
    - Trapezoid line
  - Middle
    - Subclavian groove
- Blood supply
  - Thoracoacromial artery



J. Phadnis, G.I Bain. Clavicle Anatomy. Normal Anatomy and Pathology of the Shoulder. 2015

Clavicle: Function

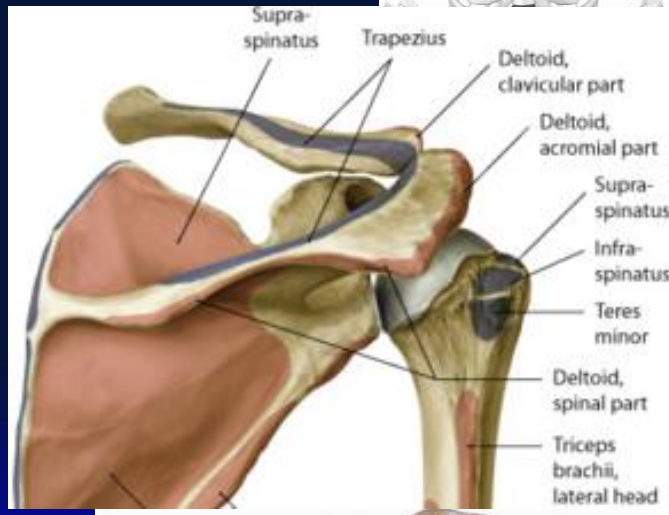
- Function
  - Strut bracing the GHL at fixed distance for movement/power
  - Rigid base for muscular attachments
  - Protects neurovascular structures
- Lateral attachments
  - Deltoid – anterior surface of lateral clavicle
  - Trapezius – posterior aspect of lateral curvature
- Medial attachments
  - Pectoralis – clavicular head portion, anterior surface of medial curvature
  - Sternocleidomastoid – posterior aspect of medial curvature
- Others
  - Sternohyoid
  - Subclavius



Netter

Gross Anatomy: Acromion

- Function
  - Protect the glenohumeral joint and limit upper translation of GHJ.
- Acromion – projects anteriorly from lateral aspect of scapular spine
- Inferior scapular spine contiguous with lateral acromial border, which is irregular and thick
- Superior scapular spine contiguous with medial acromion
- Inferior surface of acromion is smooth and concave
- Muscle attachments – deltoid, trapezius
- Blood supply
  - Thoracoacromial artery

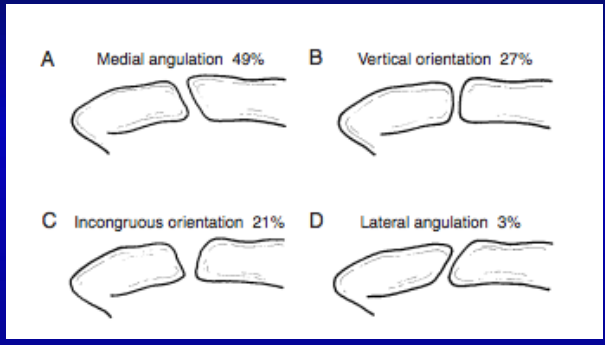


F. Vergara. Acromion and Coracoclavicular arch. Normal Anatomy and Pathology of the Shoulder. 2015

Acromioclavicular Joint

- Synovial type of planar diaarthrodial joint
- Allows gliding, shearing, rotation motion
- Inherently unstable
- Components
  - Articular facets –
    - hyaline covered convex oval facet of anterior distal clavicle and concave facet of anteromedial acromion
    - Hyaline→ fibrocartilage @ acromion 17 y/o and clavicle by 24 y/o
    - Variable
    - Mean size ACJ – 9x19 mm. Avg width 1-3 mm

J. Phadnis, G.I Bain. Clavicle Anatomy. 2015

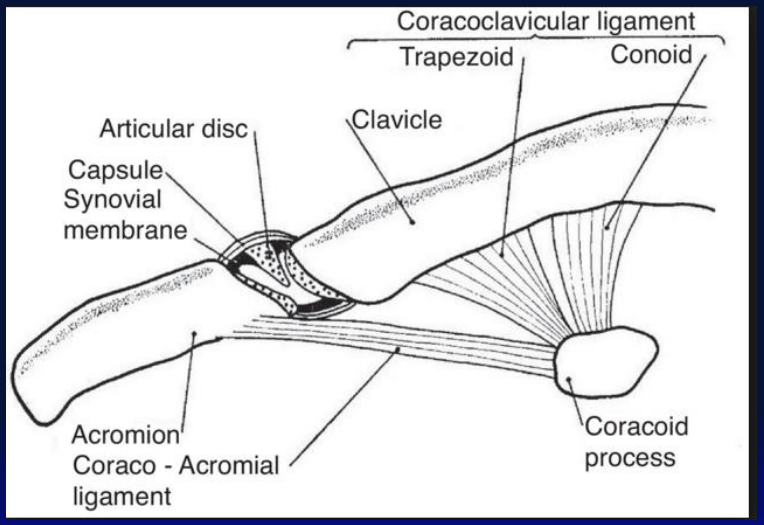


Urist MR. JBJS. 1946

J. Phadnis, G.I Bain. Clavicle Anatomy. Normal Anatomy and Pathology of the Shoulder. 2015

ACJ: Components

- Intra-articular synovium
- Fibrocartilagenous articular disc
- Fibrous capsule
- Stabilizers
  - Dynamic – deltoid/trapezius
  - Static – AC, CC, CA ligaments
- Innervated by suprascapular nerve and lateral pectoral nerve
- Blood – thoracoacromial and suprascapular arteries



Villasenor-Ovies et al. Rheumatology Clinics. 2012

ACJ: Fibrocartilagenous disc

- Function
  - cushions the joint, corrects for incongruences, load bearing; others neglible function
- Variable size and shape
- *Salter et al* – 53 examined discs, 25 meniscoid, 16 remnants, 11 no disc, 1 had complete disc. Diameter 6-10 mm
- Formed by radiations of superior/inferior joint capsule, superior > inferior
- *De Palma et al* - Degeneration @ 2nd decade, sig degeneration by 4th decade

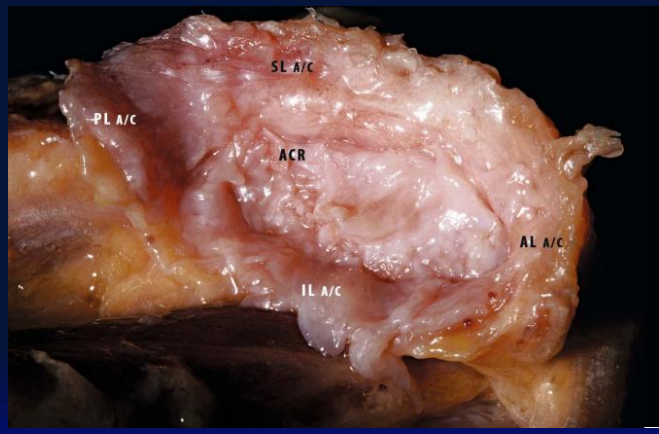
Heers et al. Skeletal Rad. 2007

Salter EG et al. Anatomical observations on the acromioclavicular joint in supporting ligaments. AJSM. 1987

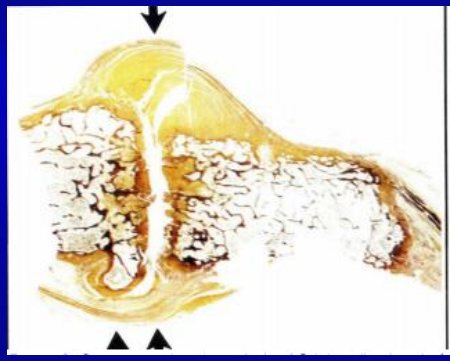
De Palma AF. Surgical anatomy of the acromioclavicular and sternoclavicular joints. Surg Clin North Am. 1963;43:1541–1550

ACJ: ACL's/Joint capsule

- Course between acromion and distal clavicle
  - superior, inferior, anterior, posterior AC ligaments
  - Debski et al - Primary restraint for 90% posterior clavicular displacement & 50% anterior displacement. Restraint posterior axial rotation
  - Superior AC ligament is thicker, stronger and more defined
  - Superior + posterior most important(56% and 25% restraint)
  - Anterior + inferior ACL posterior restraint(6% and 11%)
  - Debski et al – 100% ant/post disp after transecting AC capsule, without superior translation



Giacomo GD et al. Atlas of Functional Shoulder Anatomy. 2008

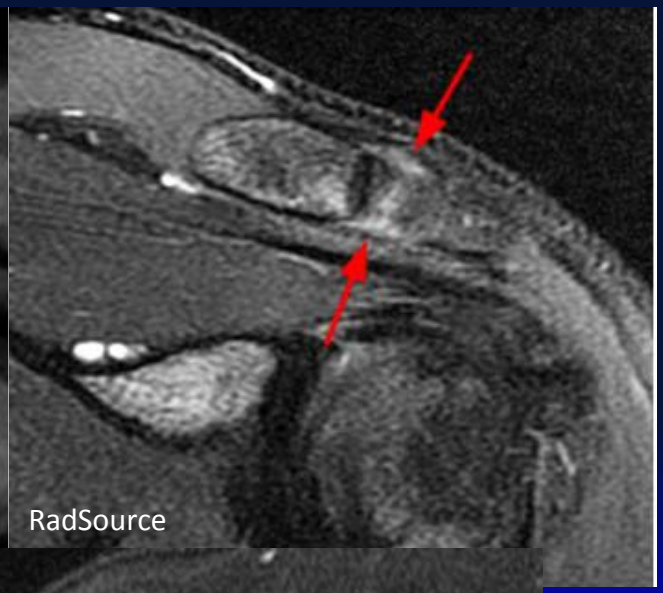


Salter EG et al. AJSM. 1987 (Right)

- Load to failure – 828 N

ACL: MRI Appearance

Faisal et al. Radiographics. 2008



RadSource

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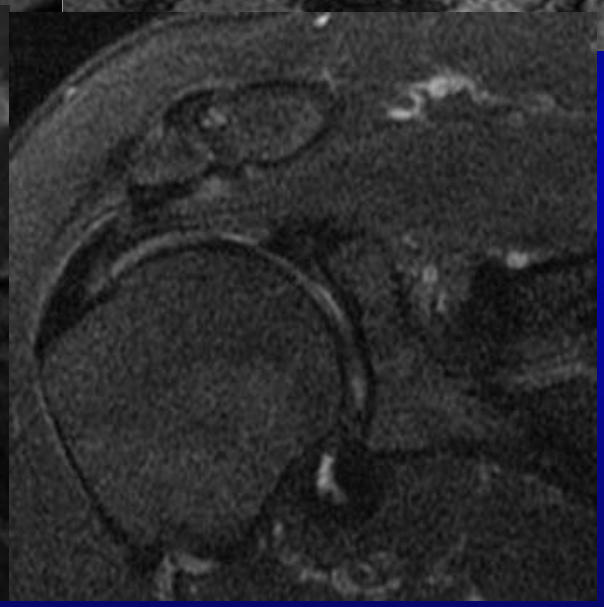
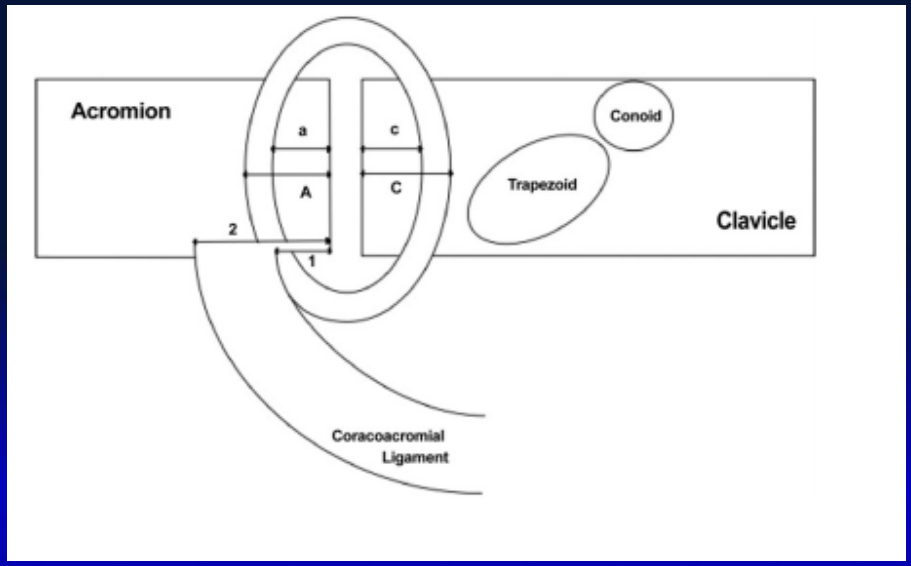


Analysis of the Capsule and Ligament Insertions About the Acromioclavicular Joint: A Cadaveric Study

Ian A. Stine, M.D., and C. Thomas Vangsness Jr, M.D.

ARTHROSCOPY
The Journal of Arthroscopic and Related Surgery

Goal – determine capsular and ligamentous insertions of the ACL on the ACJ to determine safe amount of bone that can be removed during distal clavicular resection



a) Medial acromion-intracapsular insertion: *c)* lateral clavicle – intracapsular insertion
A)Medial acromion-capsulolig insertion *C)* lateral clavicle – capsulolig insertion

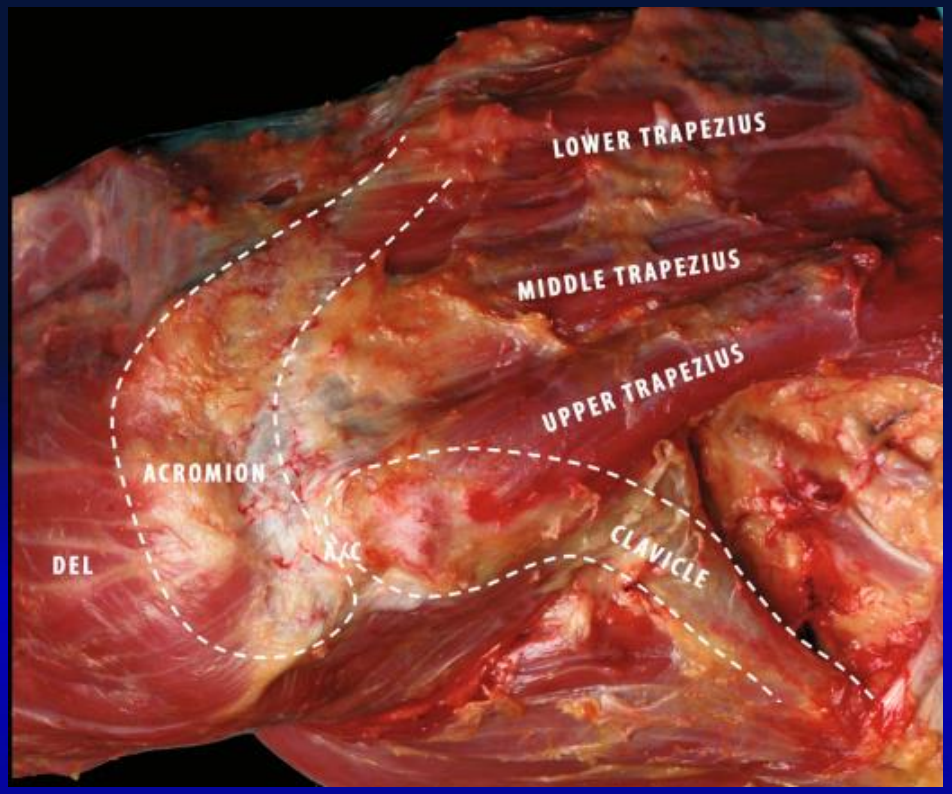
Acromion sided capsular lig's start at 2.8 mm (width 1.6-2.5) mm Clavicle sided capsular lig's start at 3.5 mm (width 2.2-2.9 mm)

CONCLUSION: 2-3 mm acromion/3-4 mm distal clavicle can be resected, w/o removing AC capsular lig insertions. If > 4mm acromion and > 6 mm clavicle resected, removing complete ACL

Stine et al. Analysis of the Capsule and Ligament Insertions about the Acromioclavicular Joint: A Cadaveric Study. Arthroscopy. 2009

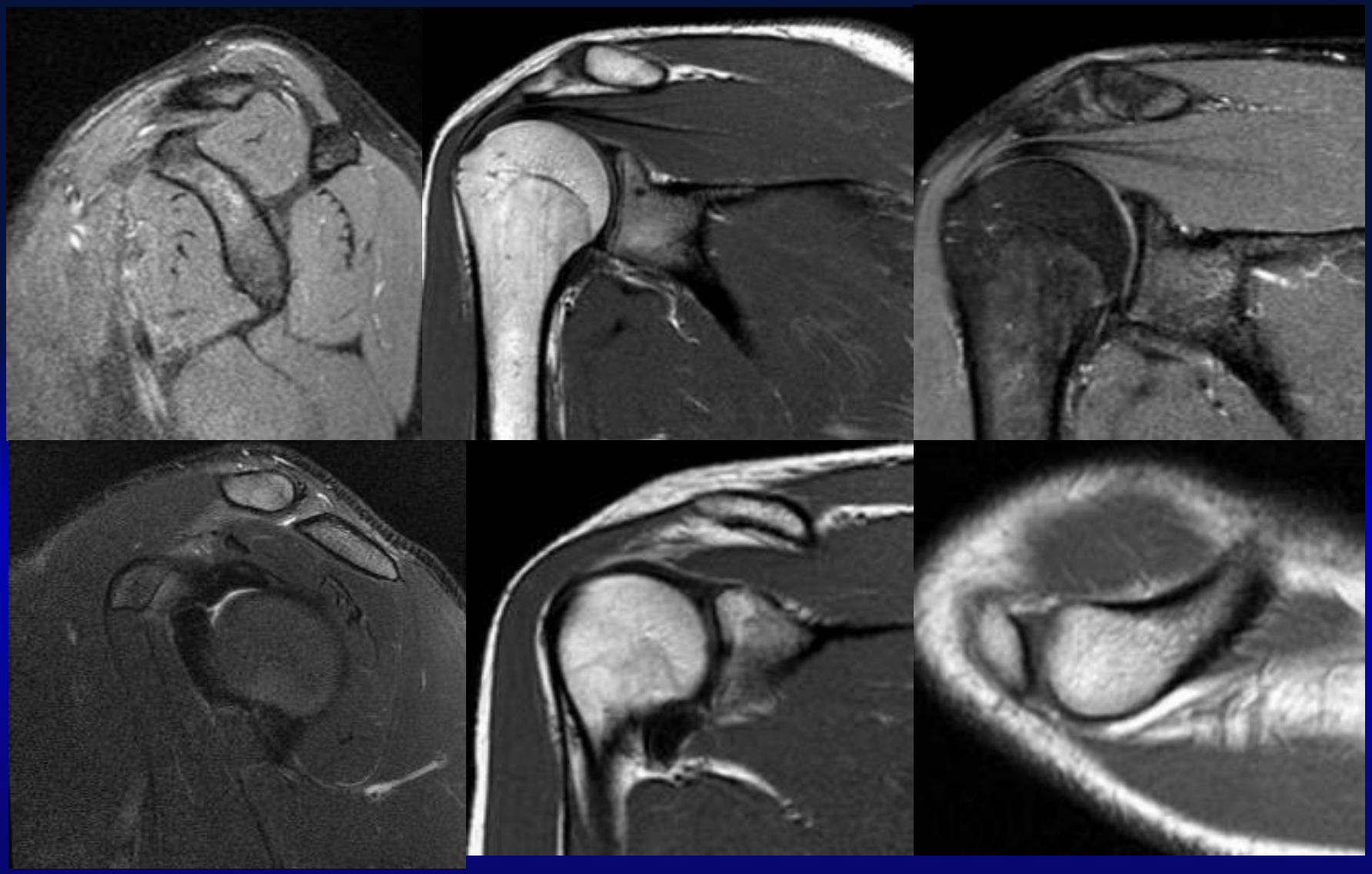
ACJ: Additional support

- Deltoid, trapezius and serratus anterior muscles offer dynamic stabilization
  - Deltoid and trapezius aponeurosis continuous with superoposterior AC Capsule/ligaments
- Trapezius- attaches to scapular spine, acromion and distal clavicle –with aponeurosis contributing to posterosuperior ACJ capsule
- Deltoid attaches to acromion and distal clavicle, with aponeurosis contributing to superior ACJ capsule
- Both muscles contribute to ACJ stability during muscle contraction



Giovanni et al. Atlas of functional shoulder anatomy.

Deltotrapezial fascia: MRI Appearance

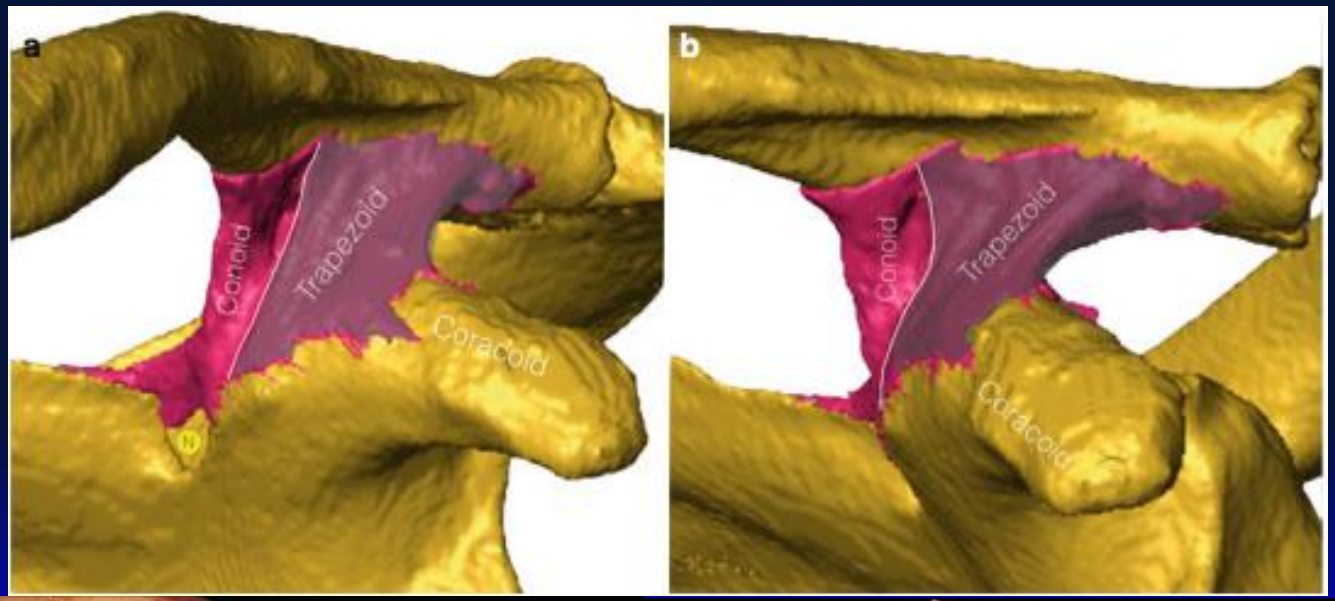


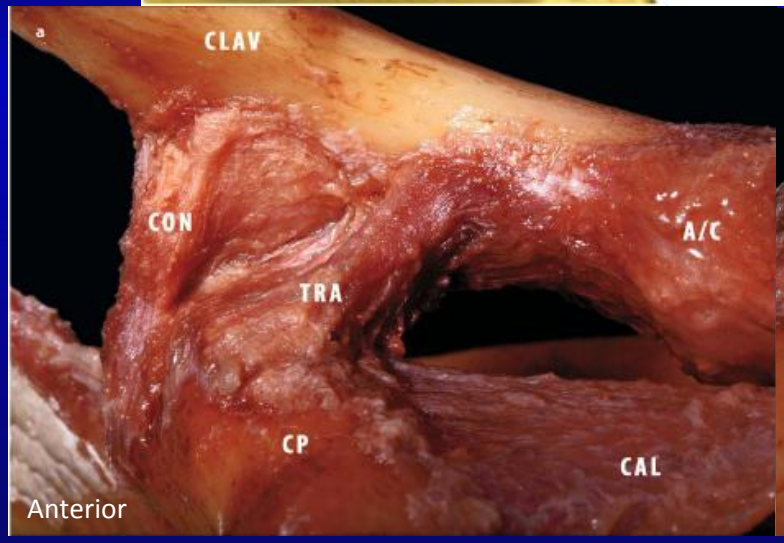
E-anatomy

ACJ: Coracoclavicular ligaments

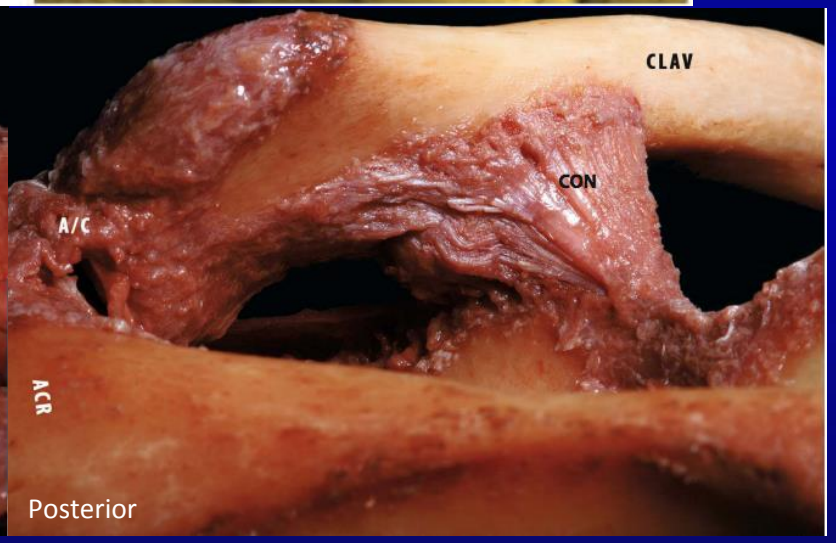
- Responsible for suspending scapula/upper extremity from clavicle
- Primary static stabilizer for superior/inferior stabilization
- Debski et al. – after AC capsular transection, increased mean in situ force > 200% on CC ligaments, conoid > trapezoid
- 2 components – arise from superior aspect of coracoid process
  - Conoid ligament – Prevents superior and anterior displacement
    - More medial of two
    - Thick and triangular morphology
    - Apical lower attachment to posteromedial aspect of coracoid
    - Arises vertically; wide attachment at conoid tubercle, 40-45mm from ACJ
    - Blends medially with clavipectoral fascia
  - Trapezoid ligament – Prevents posterior displacement; restraint for axial loads
    - Anterolateral relative to Conoid
    - Thin and broad/quadrilateral shape
    - Lower attachment at posterosuperior coracoid base
    - Anterior border is free, posterior border is attached to Conoid ligament
    - Posterosuperolateral course to wide attachment at trapezoid line, 25 mm from ACJ
- Load to failure 500-725 N

Coracoclavicular Ligaments





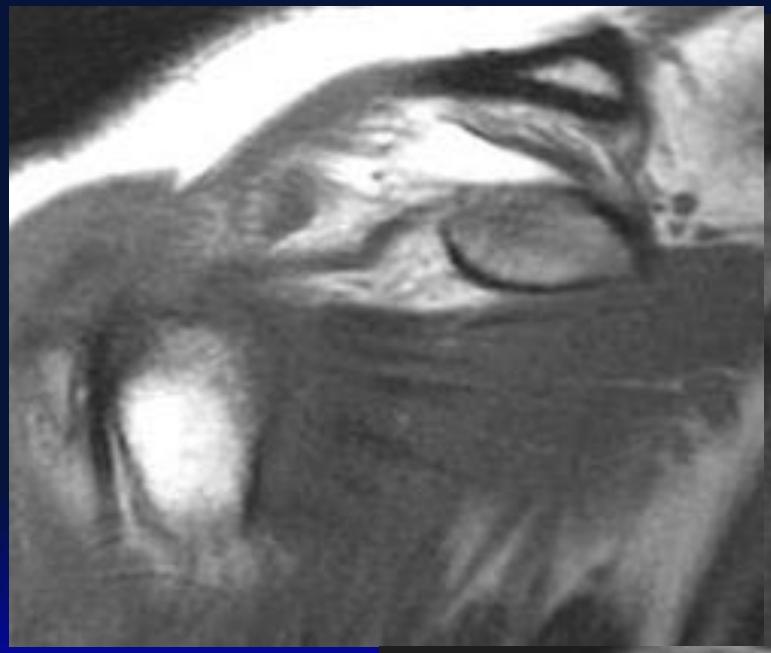
Anterior

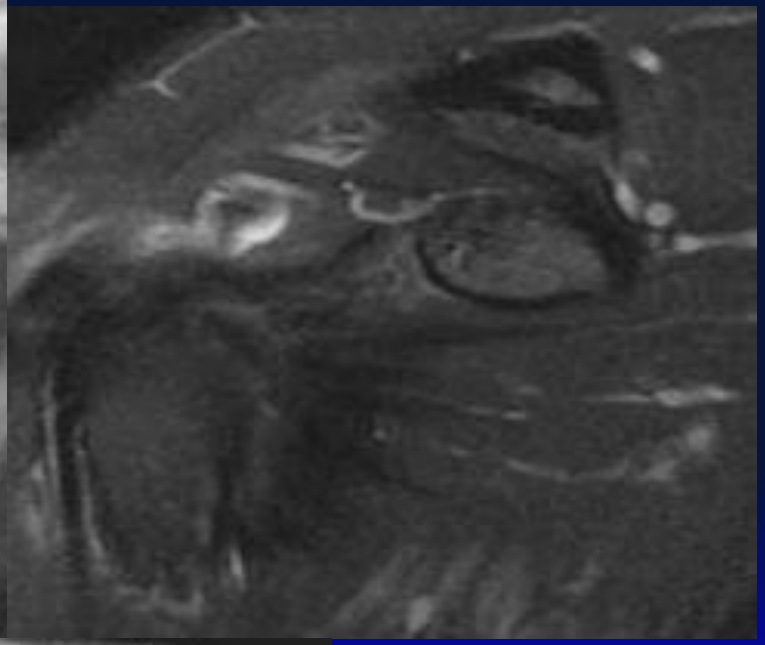


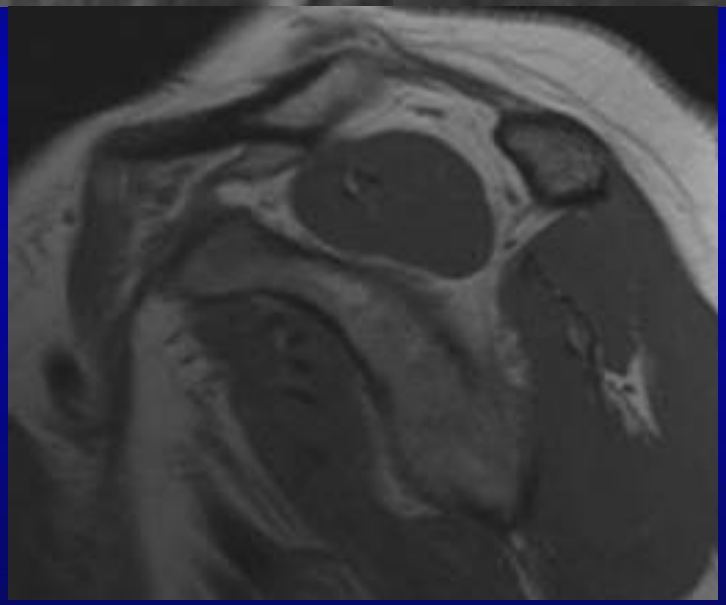
Posterior

Yon Sik Yoo et al. AC Joint. Normal and Pathological Anatomy of the Shoulder.2015

Coracoclavicular ligament: MRI Appearance

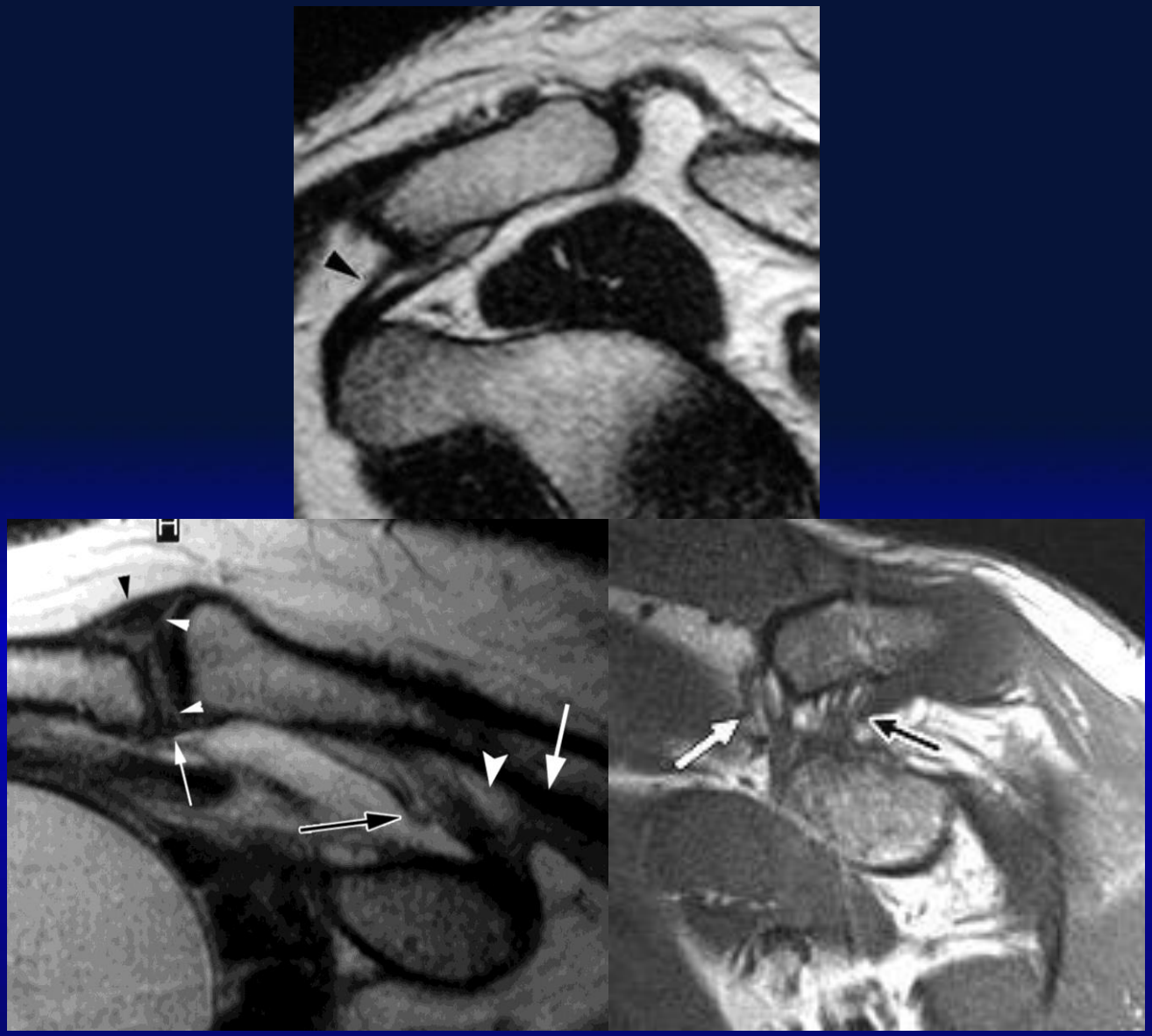






UCSD Case, 30224110

Coracoclavicular ligament: MRI Appearance



Faisal et al.;*RadioGraphics* **2008,** 28, 463-479. (top 2)

ACJ: Clinical Manifestations

- Degenerative and traumatic pathology affect the AC joint.
  - Synovial joint – degenerative, inflammatory, septic etiologies
  - Traumatic - AC joint injuries comprise 9-12 % of all shoulder girdle injuries.
    - Most common in athletes (NFL 30%*), MVA's, direct fall,
    - B/w 20-40 y/o
    - M:F – 8:1
- Clinically, AC joint injury may present as GHJ pathology. Therefore, clinical history/exam are crucial.

*Lynch et al. AJSM. 2013

ACJ: Injury

- Mechanism
  - Direct (70%)

    Direct force to superolateral shoulder with humeral adduction → acromion moves inferiorly and medially

    Injury pattern

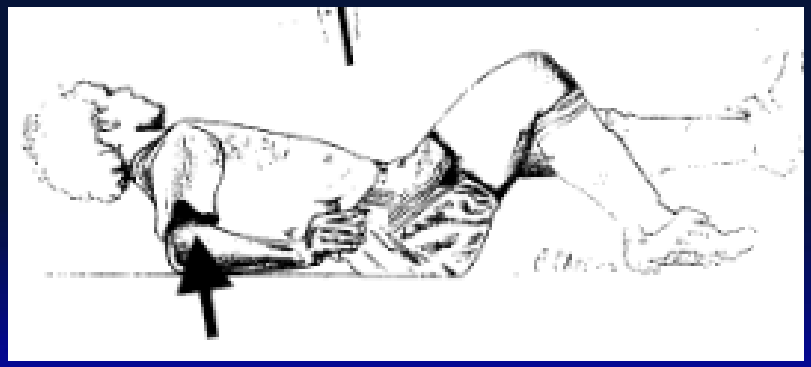
    1) AC
    2) CC
    3) Deltotrapezial complex

ACJ: Injury

Indirect (30%)

- Fall on outstretched hand, forces directed superiorly through humerus→ acromion

- Usually affects ACL's only



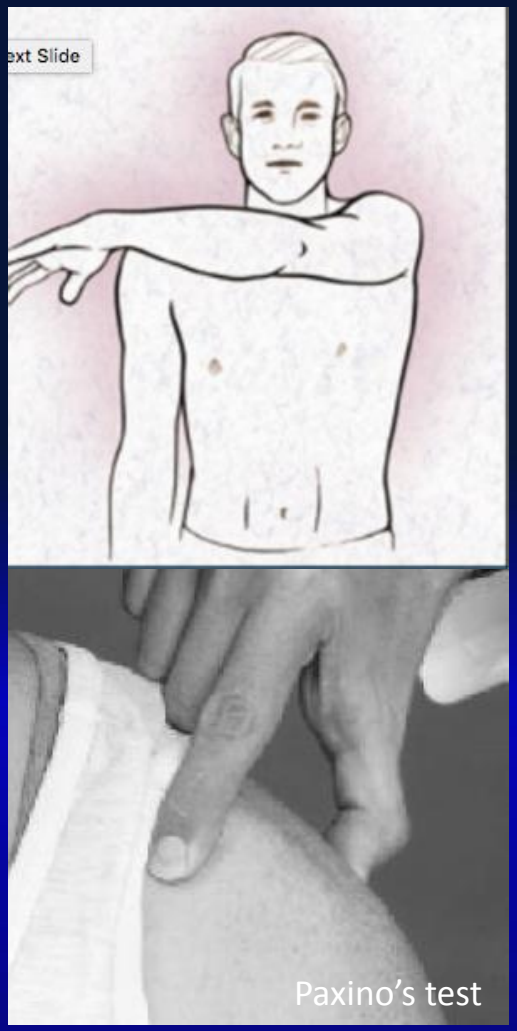
Beim G. Acromioclavicular joint injuries. Jl Athletic Training

ACJ: Clinical examination

- Seated/standing position with elbow unsupported.
- Inspection - Ecchymosis, swelling, clavicular prominence, abnormal skin contour
- Palpation - ACJ, sternoclavicular and coracoclavicular interspace for crepitus and tenderness
- Complete exam of brachial plexus should also be performed

ACJ: Clinical examination

- Cross body adduction test/Scarf test – Arm forward flexion and adducted across body (Sensitivity 77%, Specificity 79%)
- Bell-van Riet test – same as above, w/ internal rotation and resist force (Sensitivity 98%)
- ACJ tenderness – Sensitivity 96%, Specificity 10%
- Paxino's test - Sensitivity 79%, Specificity 50%
- Shoulder shrug – discern Grade III from V

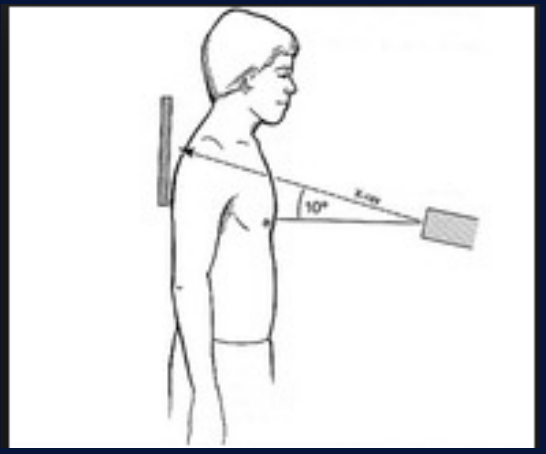


Aafp.org

Walton et al.JBJS. 2004

ACJ: Radiographic evaluation

- Routine AP view
  - Nl AC : 3-7 mm, not differ 2-3 mm (Zanca 1971)
  - Nl CC: 11-13 mm, not differ > 5mm (Bosworth 1949)
- Zanca view – 10-15˚ cephalad angulation, moves scapula out of way
- Ax view – Arm abducted 70-90˚



Eorif.com

AP View

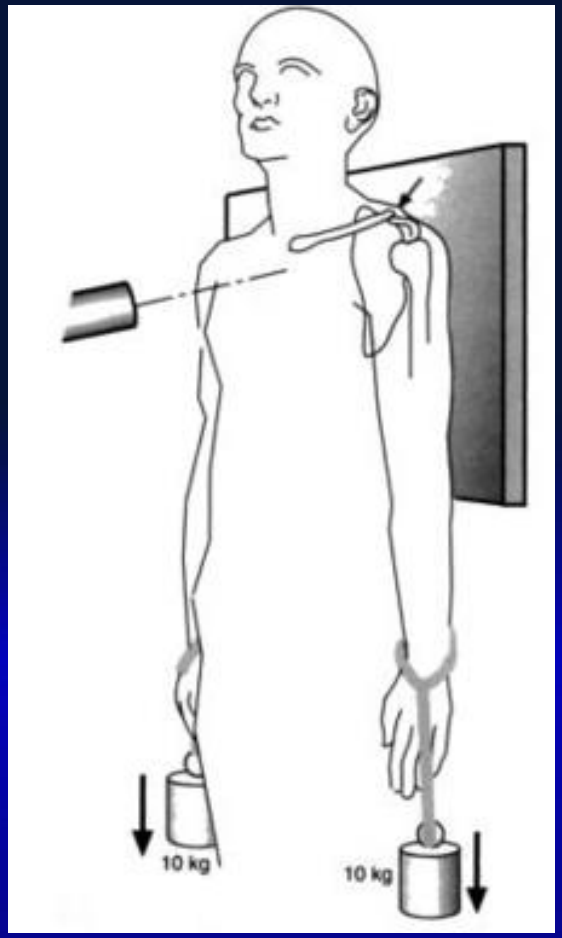
Zanca View

Axillary View

Bucholz RW, Heckman JD. Chapter 29: acromioclavicular joint injuries. In: Rockwood and Green's fractures in adults. 5th ed. Philadelphia, Pa: Lippincott Williams & Wilkins, 2001; 1210–1244.

ACJ: Radiographic evaluation

- Stress views – 10-15 lb weight on forearm/wrist.
  - Differentiate b/w Grade I-II and Grade III.
  - Yap et al. 99' – 105 Orthopods surveyed – 81% didn't recommend use weighted views; majority did not use for surgical decision process
  - Bossart P.J et al – limited benefit, unmasked 4% of higher grade 3 injury
- Contralateral ACJ useful



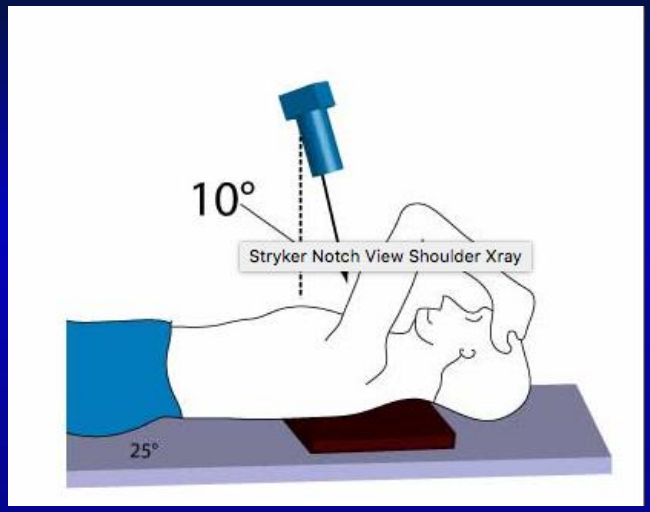
Eorif.com

Bossart et al. Ann Emerg Med. 1998. 17(1): 20-24

ACJ: Radiographic evaluation

- If normal CC interspace, but gross AC dislocation – highly suspicious for coracoid fracture
  - Should obtain Stryker notch view

Stryker notch view



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Shoulder & Elbow. ISSN 1758-5732

ORIGINAL ARTICLE

Reliability of the traditional classification systems for acromioclavicular joint injuries by radiography

Chye Yew Ng*, Emma Kate Smith† & Lennard Funk‡
* Upper Limb Unit, Wrightington Hospital, Wigan, UK
† Medical School, University of Manchester, Manchester, UK
‡ Upper Limb Unit, Wrightington Hospital, Salford University, Wigan, UK

- 24 Zanca view shoulder radiographs; 15 Shoulder orthopedists
- Studies were mixed and presented to same surgeons 1 month later
- Goal was to study intra/inter-observer agreement
- Results: Inter-observer agreement 64.6%, intra-observer agreement 59.4%
- Conclusion: Use of radiographs for AC classification has limited reliability and consistency in clinical practice.

Knee Surg Sports Traumatol Arthrosc
DOI 10.1007/s00167-014-3436-0

SHOULDER

Inter- and intraobserver reliability of the Rockwood classification in acute acromioclavicular joint dislocations

M. M. Schneider · M. Balke · P. Koenen · M. Fröhlich · A. Wafaisade · B. Bouillon · M. Banerjee

- Visual vs. digital measurement for ACJ injuries
- Visual: Inter-observer 72-74%, Intra-observer 67-93%
- Measured: Inter – 85-93%, Intra – 90-97%
- Conclusion: Recommend digital analysis of ACJ injuries;

ACJ: Role of CT/MRI evaluation

- CT –
  - Limited role, only for complex fractures
- MRI
  - Majority of cases, comparison view x-ray will allow correct classification.
  - When confounding clinical exam and radiographic findings
  - Limited clinical experience.
  - Evaluate surrounding soft tissue injury

Alyas et al. Radiographis. 2008. 28(463-479

October 2011, Volume 197, Number 4

MRI Versus Radiography of Acromioclavicular Joint Dislocation

Ursula Nemec[1], Gerhard Oberleitner[2], Stefan F. Nemec[1], Michael Gruber[1], Michael Weber[1], Christian Czerny[1] and Christian R. Krestan[1]

44 patients with suspected unilateral ACJ injury
All underwent AP(non wt bearing), Axillary and Zanca view, MRI
Assessed: AC/CC distance, clavicle displacement, trapezoid/deltoid, articular surfaces
Classified into Rockwood classification

Xray: 12 Rockwood I(27.3%), 26 Rockwood II (59.1%), 4 Rockwood III(9.1%), 2 Rockwood IV(4.5%)

Results: Xray and MRI concordant 23/44(52.2%), after MRI 16(36.4%) patients had to be reclassified to less severe injury and 5(11.4%) to a higher severity

- Rockwood I – 7 discordant; less severe in 4 and more severe in 3
- Rockwood II – 18 discordant; less severe in 10 and more severe in 2
- Rockwood III – 1 discordant; reclassified to less severe
- Rockwood IV – 1 discordant; reclassified to less severe

Conclusion

Top of page

We found that MRI findings change the Rockwood classification based on radiographic findings in a considerable number of patients with acromioclavicular joint dislocation. In addition to the traditional Rockwood classification of assessment of increased joint distances on radiographs, our adapted MRI classification entails exact visualization of each ligament, and the findings may influence therapeutic decisions. In particular, MRI findings account for differentiation of type II and type III injuries. Our results indicate that MRI is a useful adjunct to clinical examination and radiography in selected cases.

We thank Mary McAllister, Johns Hopkins University, Baltimore, MD, for help in editing the manuscript.

ACJ: Injury Classification

Classification systems

- Tossy (1963) and Allman (1967) – I, II, III
- Rockwood(1984) – later added categories IV, V and VI

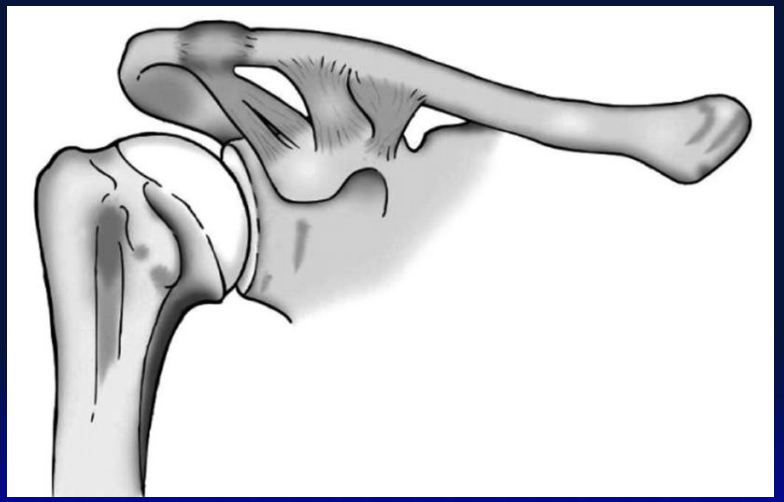
Type	AC ligament	AC joint capsule	CC ligament	AC joint displacement	Delta-trapezial fascia
Type I	Sprained	Intact	Intact	None	Intact
Type II	Torn	Disrupted	Intact	50% AC subluxation	Intact
Type III	Torn	Disrupted	Torn	100% AC superior dislocation	Intact
Type IV	Torn	Disrupted	Torn	100% AC posterior dislocation. Posterior displacement of the distal clavicle into or through the trapezius muscle	Disrupted
Type V	Torn	Disrupted	Torn	100–300% AC superior dislocation. Complete detachment of deltoid and trapezius muscle from their clavicular insertion	Disrupted
Type VI	Torn	Disrupted	Torn	100% AC inferior dislocation. Inferior displacement of the distal clavicle into a subacromial or subcoracoid position	Intact

JBJS The Journal of Bone & Joint Surgery

J.A. Fraser-Moodie, N.L Shortt, C.M Robinson. Injuries to the Acromioclavicular joint. JBJS. 2008; 90-B

Rockwood: Grade I Injury

- AC ligament - sprain/partial tear
- ACJ Capsule - intact
- CC ligament - intact
- Deltoid + Trapezius are intact
- ACJ remains stable

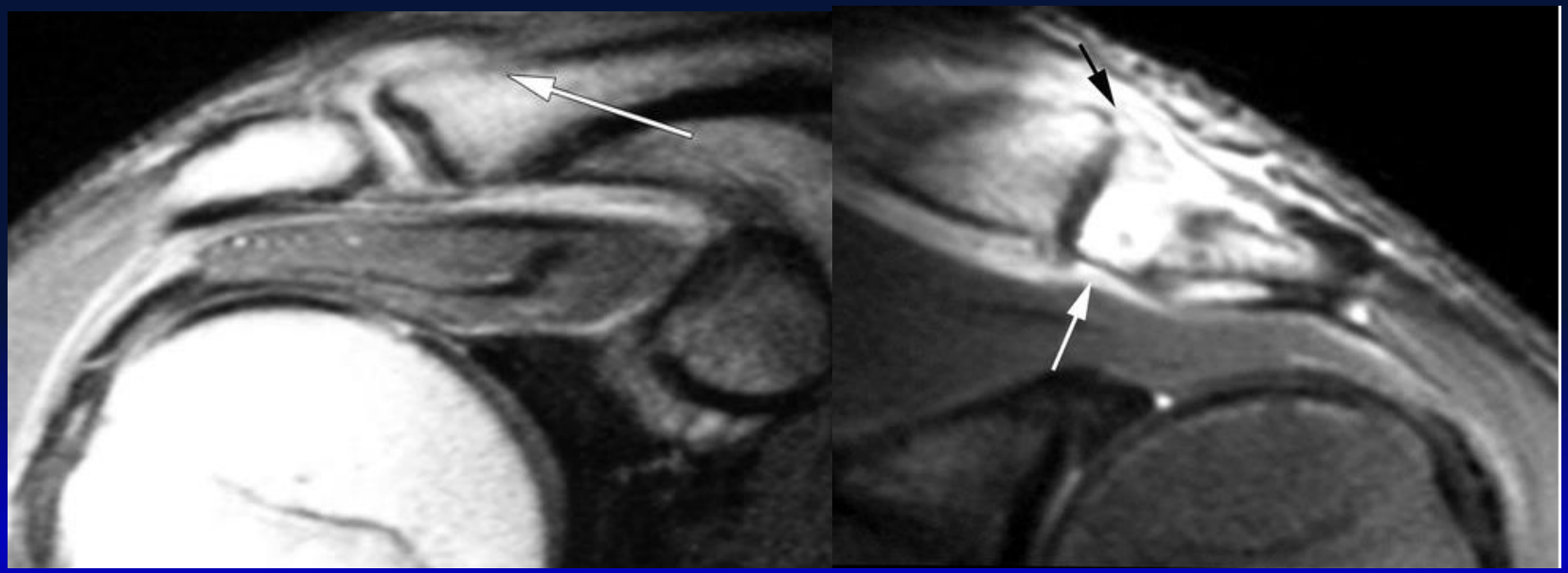


- PE
  - Minimal to moderate ACJ tenderness, mild swelling
- X-rays
  - Mild swelling; normal; +/- weight bearing
- MRI
  - Partial tear/edema of superior AC ligament, osseous/pericapsular edema or hemorrhage if acute
  - Others, no specific MRI features, may indicate normal aging/degeneration changes

The Journal of Bone & Joint Surgery

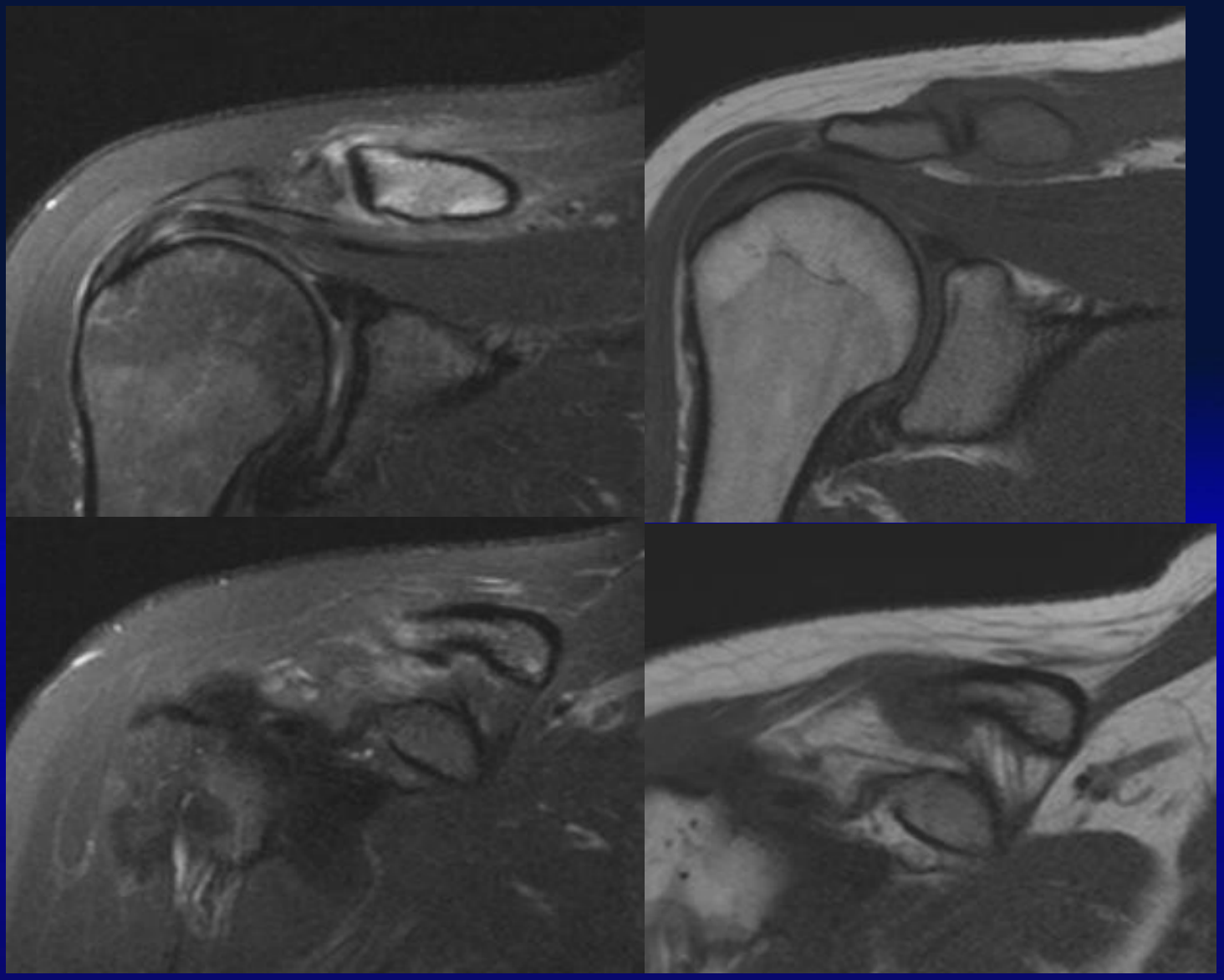
J.A. Fraser-Moodie, N.L Shortt, C.M Robinson. Injuries to the Acromioclavicular joint. JBJS. 2008; 90-B

Rockwood: Grade I Injury

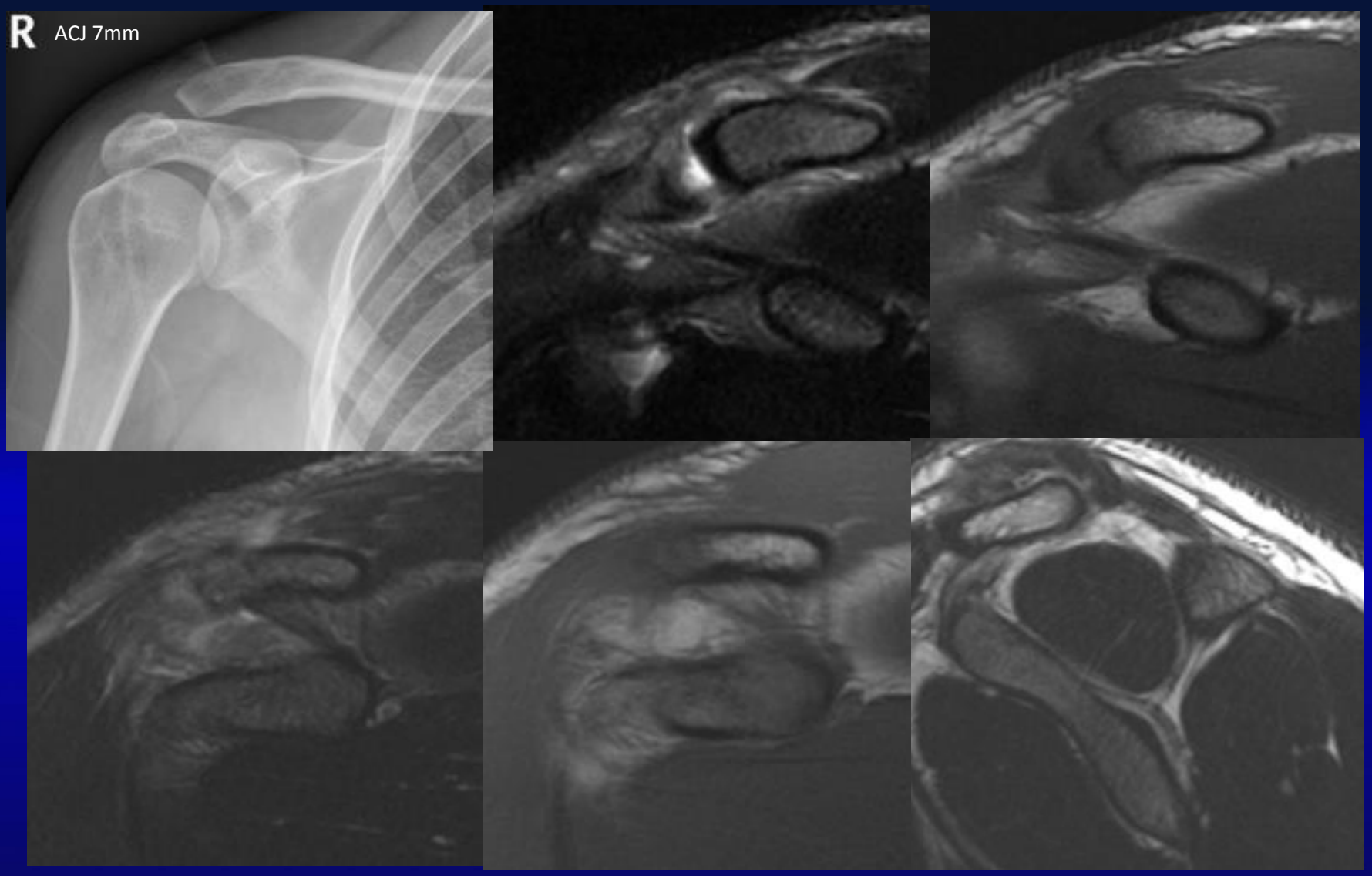


Faisal et al. 2008

Rockwood: Grade I Injury

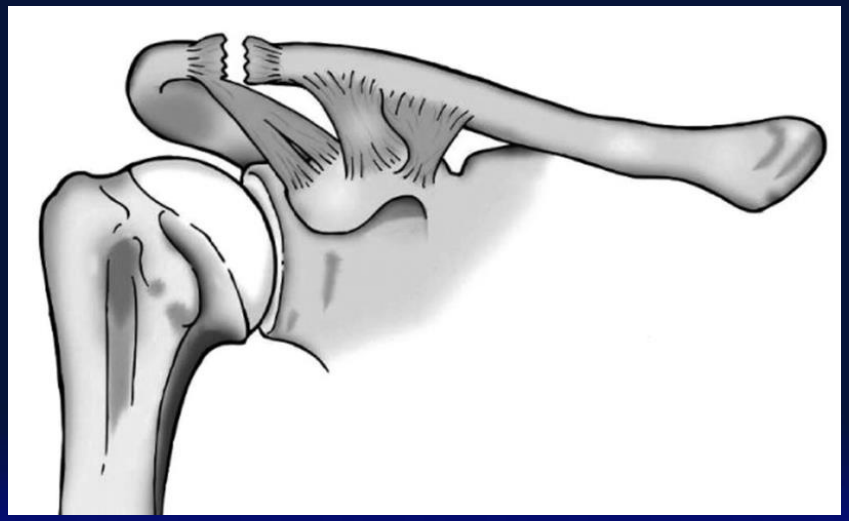


Rockwood: Grade I Injury



Rockwood: Grade II Injury

- AC ligament/capsule – Complete disruption
- CC ligament – intact or sprained
- Deltoid + Trapezius are intact
- Horizontal instability at ACJ
  - Debski et al, JBJS(2001) – anterior 3.6 mm, posterior 6.4 mm

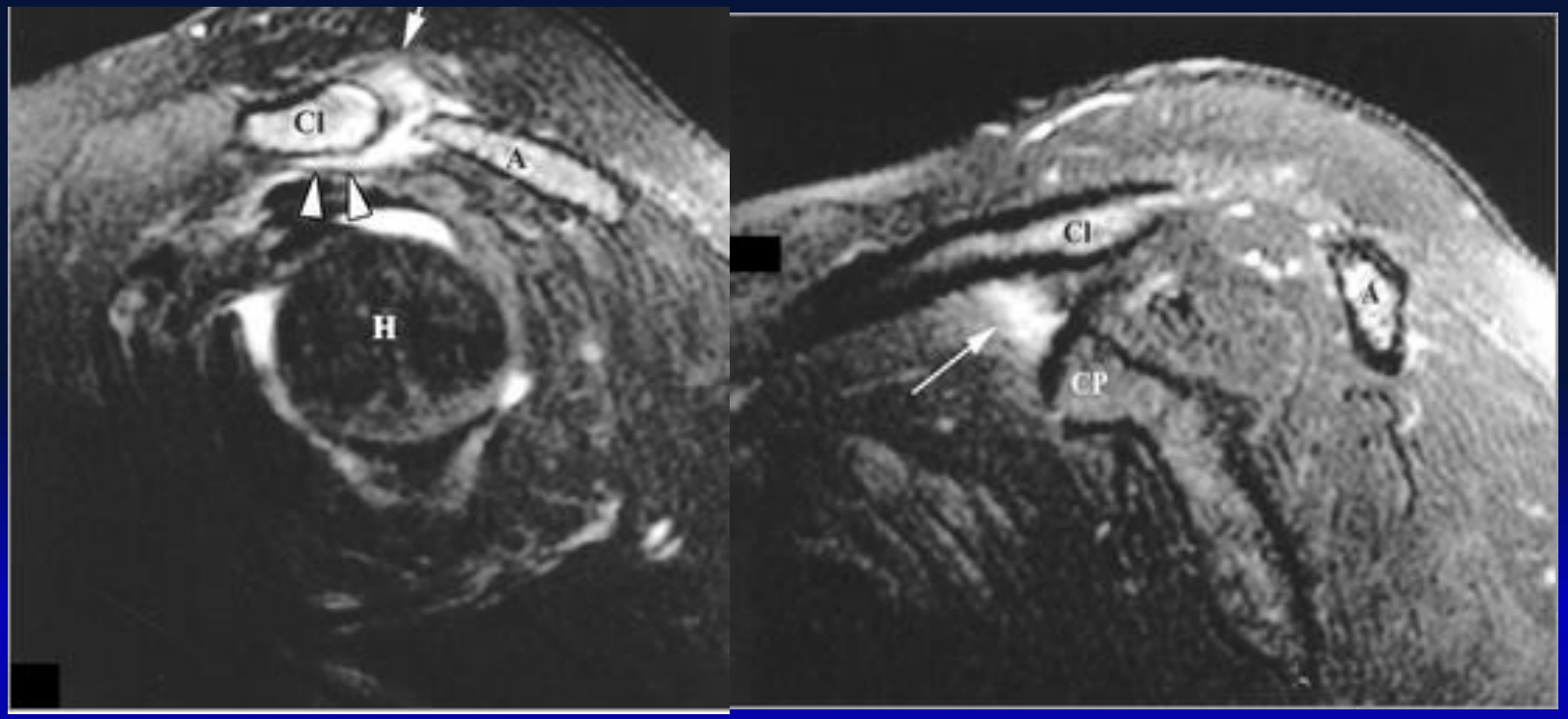


- PE
  - ACJ + CC tenderness, +/- prominence distal clavicle
- X-rays
  - Moderate swelling, wide ACJ, nl or inc CC interspace, <50% vertical clavicle displacement
- MRI
  - Fluid signal and tear AC ligament, partial tear/sprain of CC(conoid> trapezoid), osseous edema, soft tissue edema or hemorrhage if acute

The Journal of Bone & Joint Surgery

J.A. Fraser-Moodie, N.L Shortt, C.M Robinson. Injuries to the Acromioclavicular joint. JBJS. 2008; 90-B

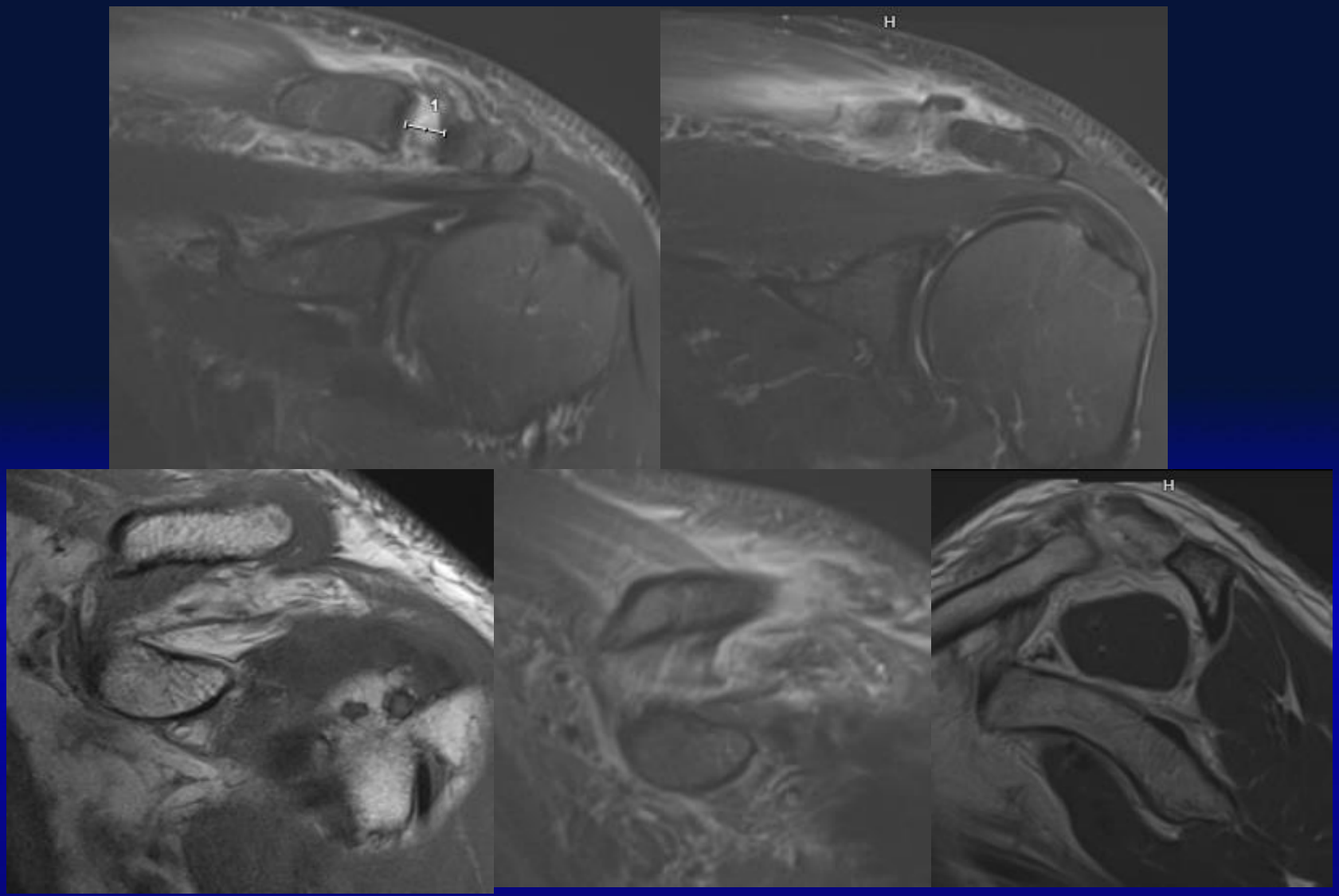
Rockwood: Grade II Injury



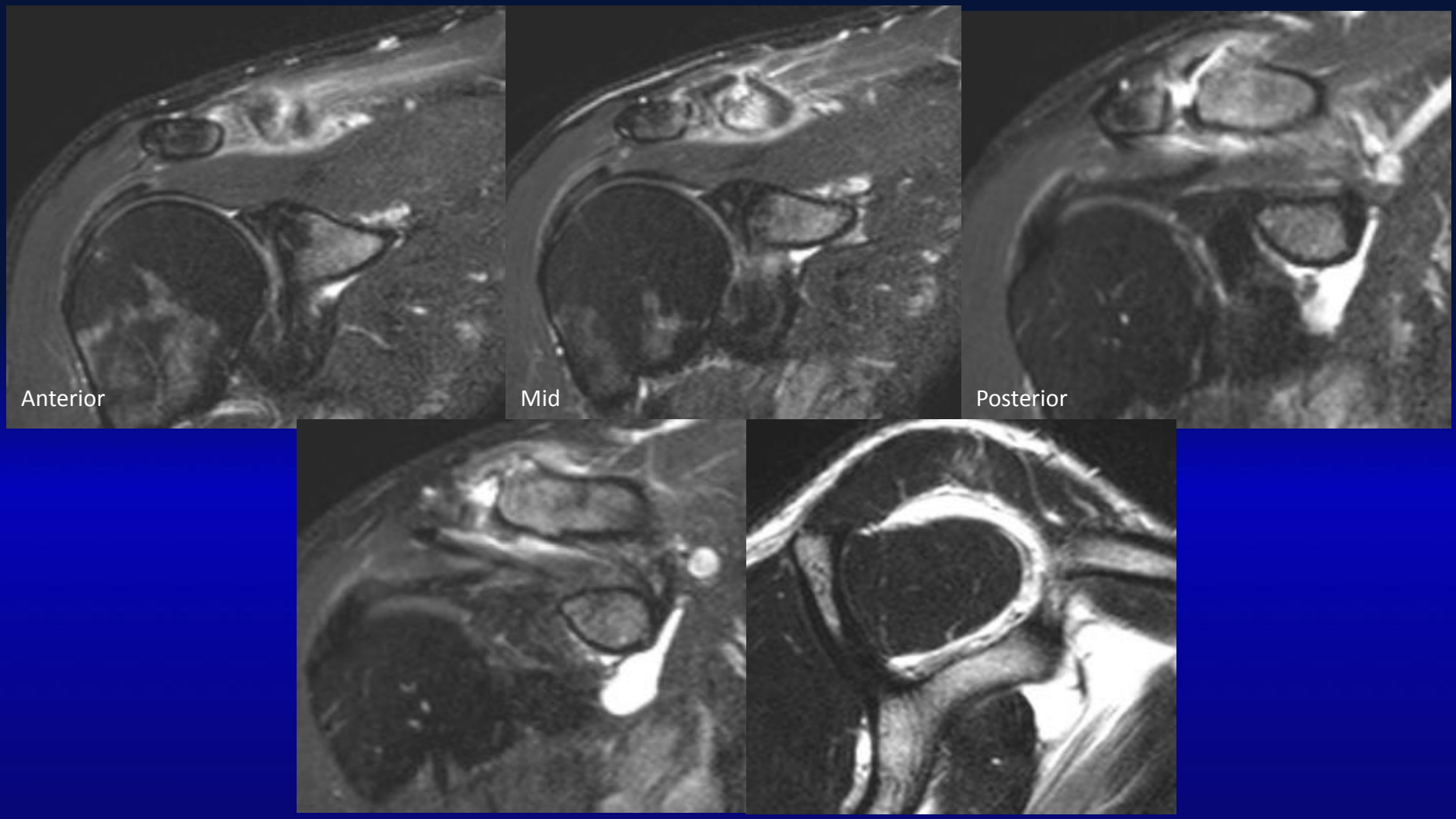
AJR American Journal of Roentgenology
Diagnostic Imaging and Related Sciences

Antonio GE, Cho JH, Chung CB, Trudell, DJ, Resnick D. MR Imaging Appearance and Classification of Acromioclavicular Joint Injury . 2003;180: 1103-1110.

Rockwood: Grade II Injury



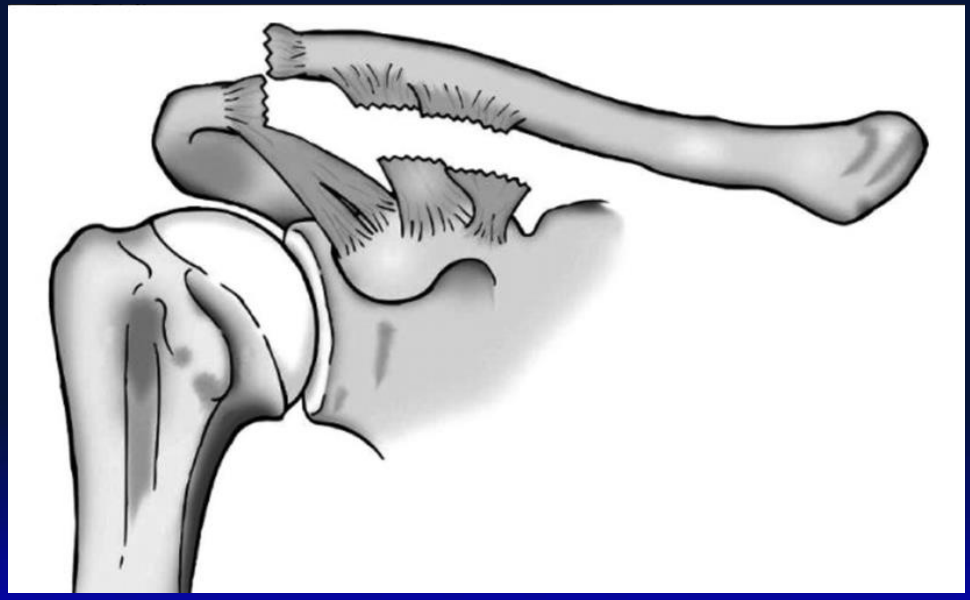
Rockwood: Grade II Injury



Rockwood: Grade III Injury

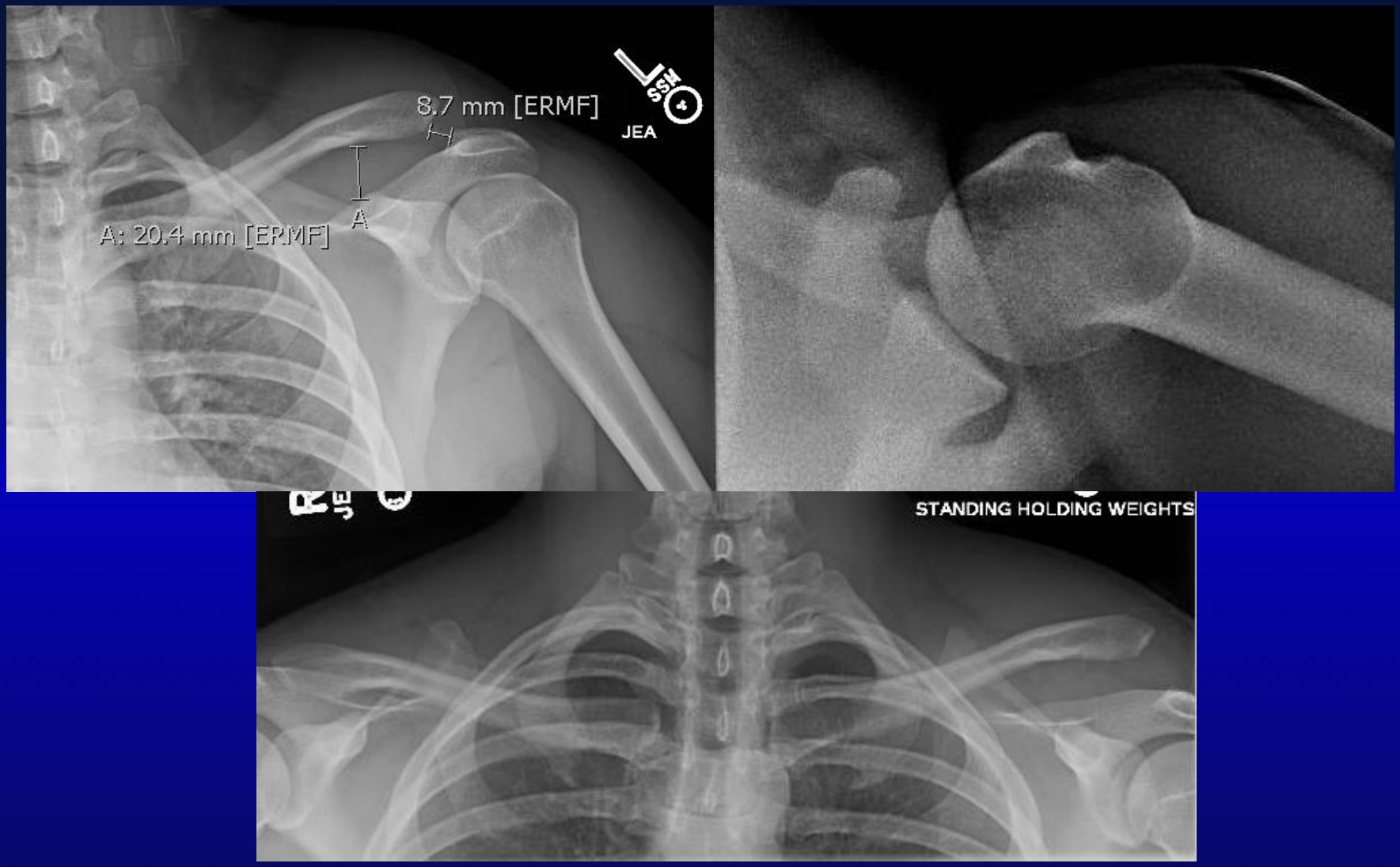
- AC ligament/capsule – Complete disruption
- CC ligament – Complete disruption
- Deltoid + Trapezius - +/- involvement
- Horizontal and vertical instability at ACJ

- PE
  - Distal clavicle tent skin, CC interspace pain, inferior displacement of upper extremity
- X-rays
  - Swelling, wide ACJ, inferior lateral clavicle above inferior acromion, increased CC distance 25-100%
- MRI
  - Fluid signal and tear AC/CC ligaments, osseous edema, +/- tearing of trapezius/deltoid from distal clavicle or periosteal sleeve, soft tissue edema or hemorrhage if acute



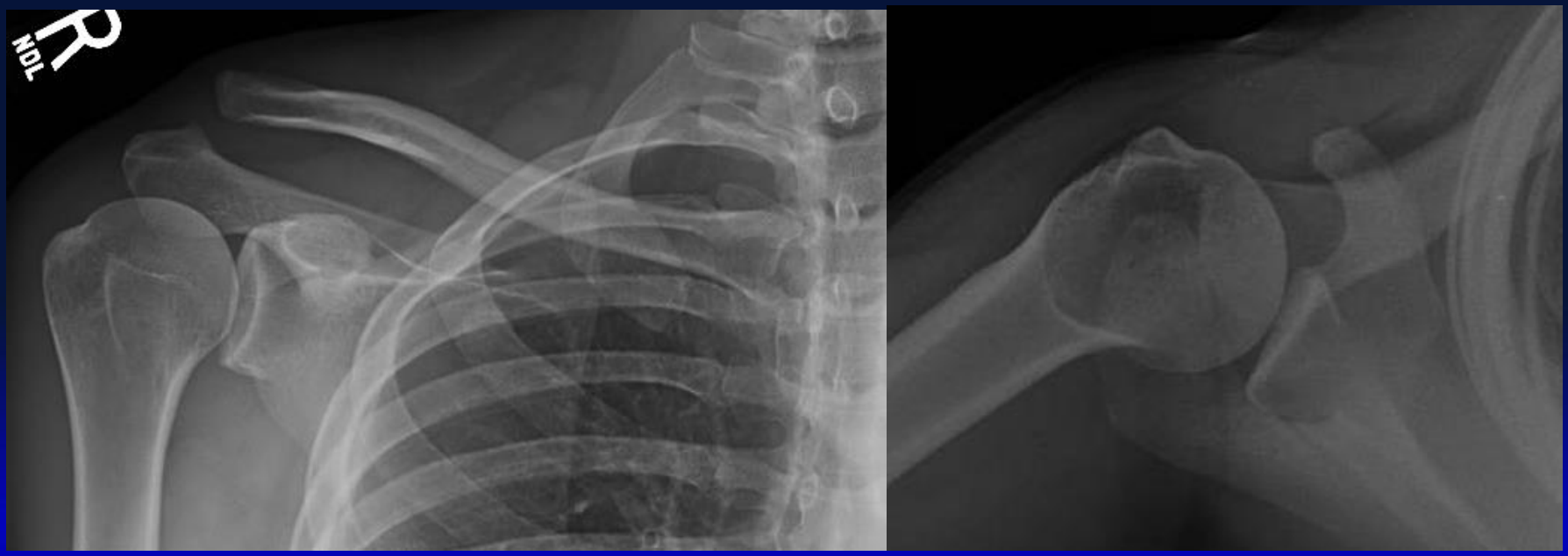
J.A. Fraser-Moodie, N.L Shortt, C.M Robinson. Injuries to the Acromioclavicular joint. JBJS. 2008; 90-B

Rockwood: Grade III Injury

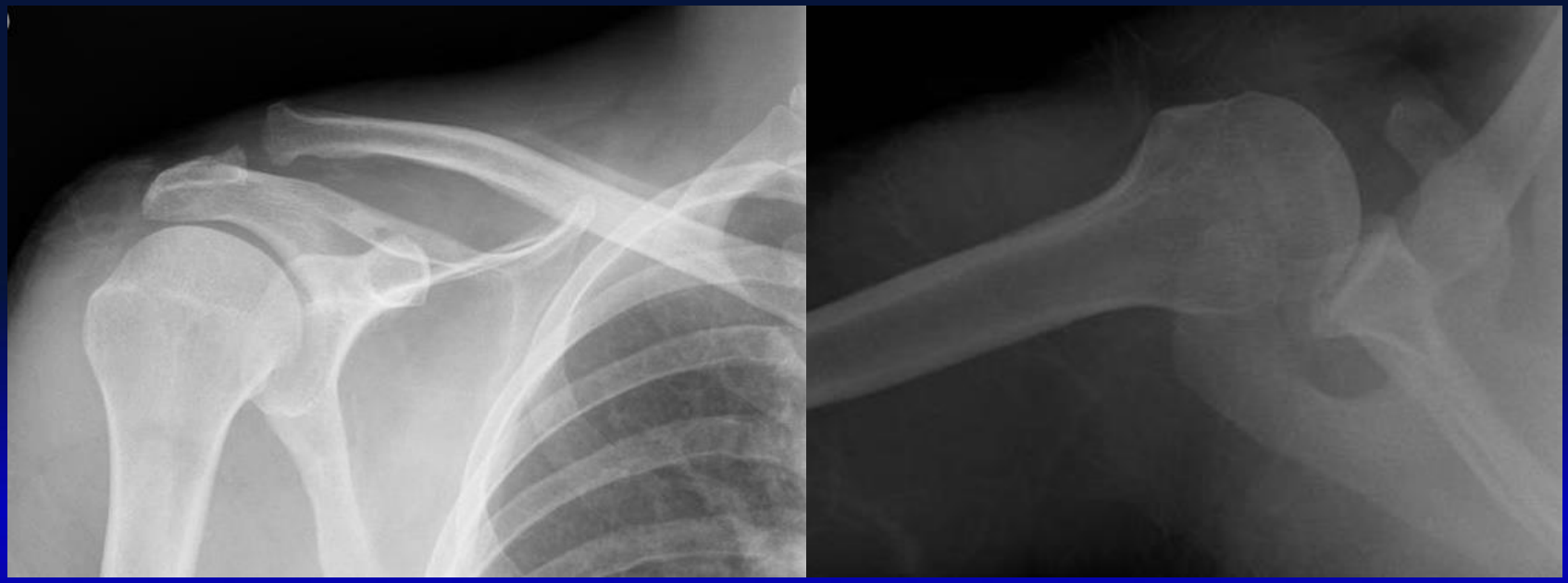


UCSD, Courtesy of Brady Huang, M.D

Rockwood: Grade III Injury

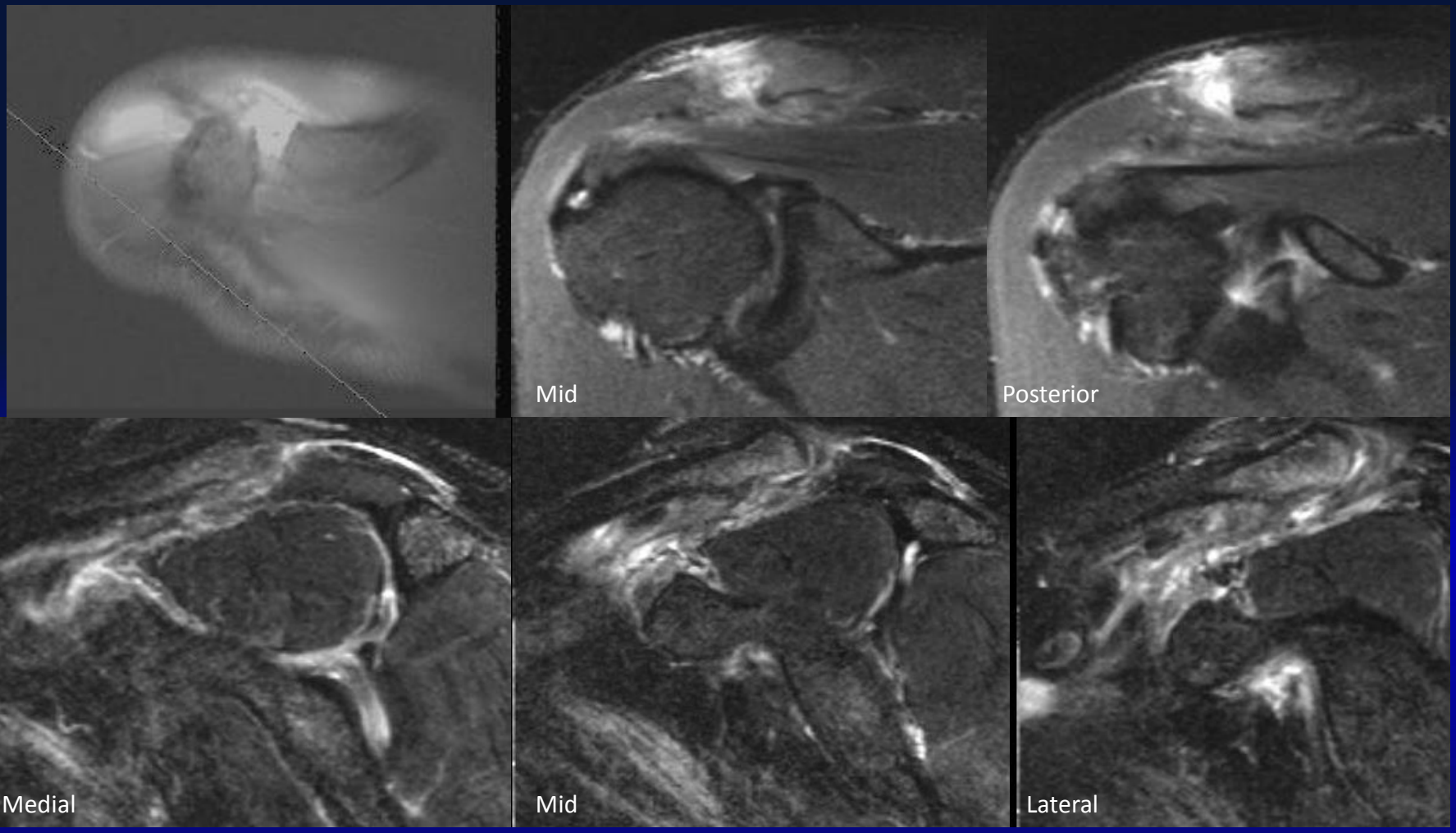


Rockwood: Grade III Injury



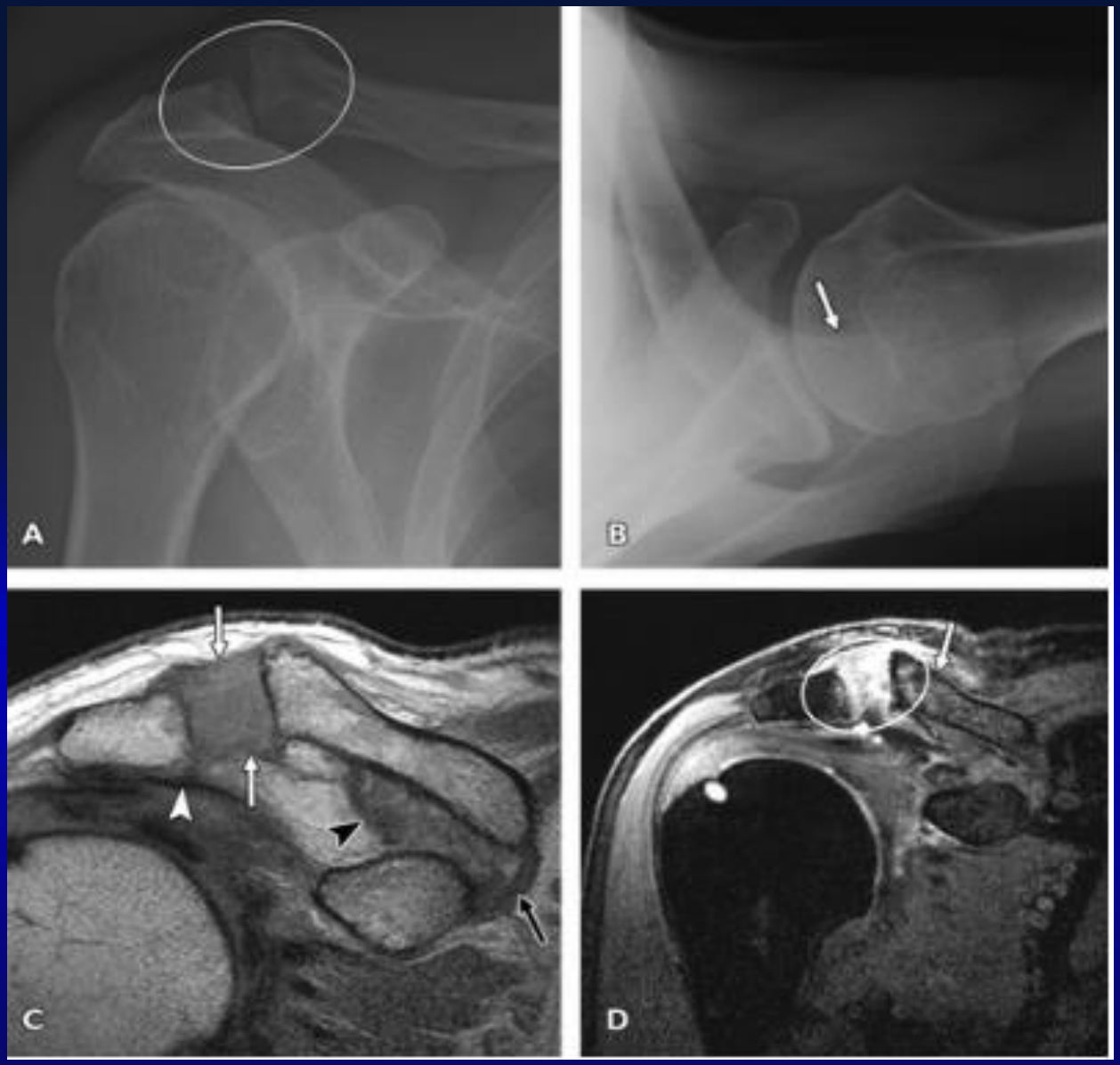
Rockwood: Grade III Injury

Same patient as prior slide



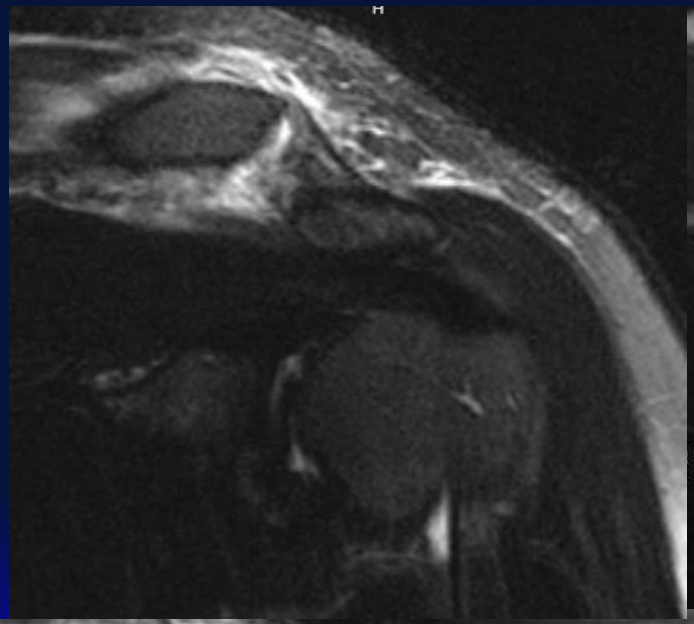
UCSD, Courtesy of Mini Pathria M.D

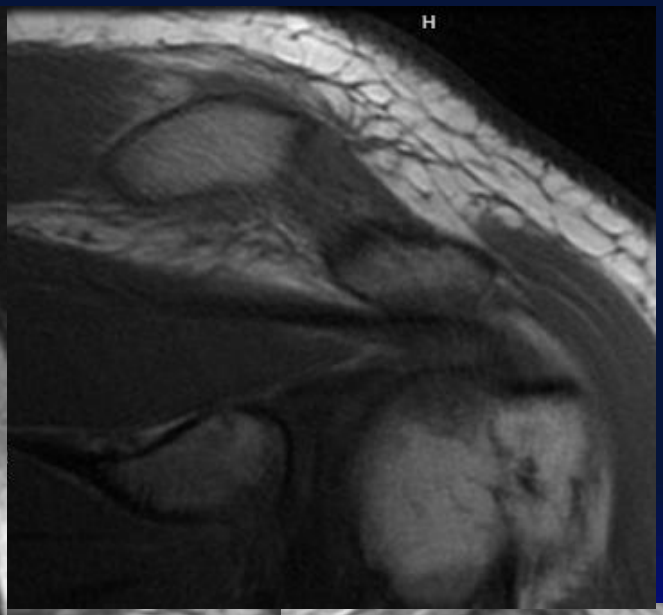
Rockwood: Grade III Injury

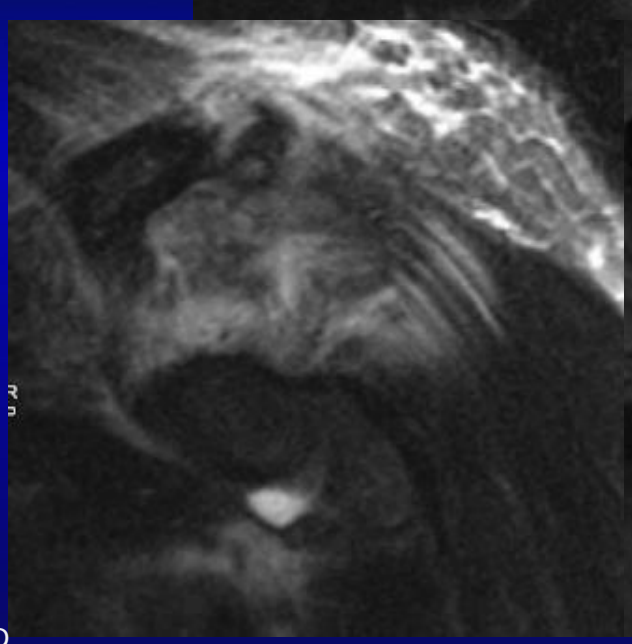


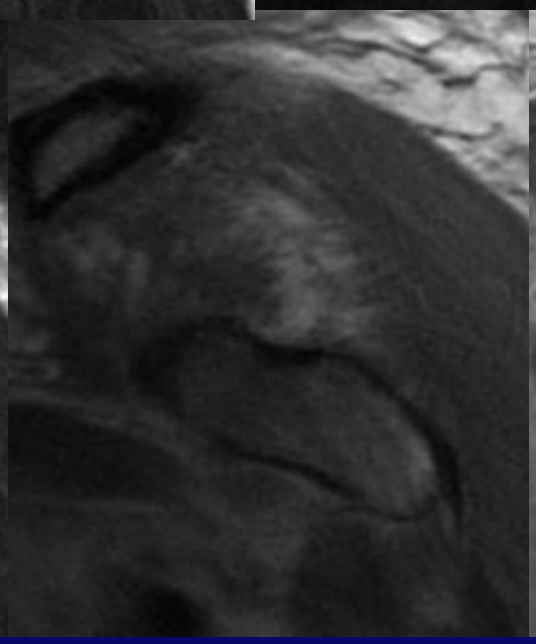
Nemec U, Gerhard O et al. MRI Versus Radiography of Acromioclavicular Joint Dislocation. 2011;197: 968-973.

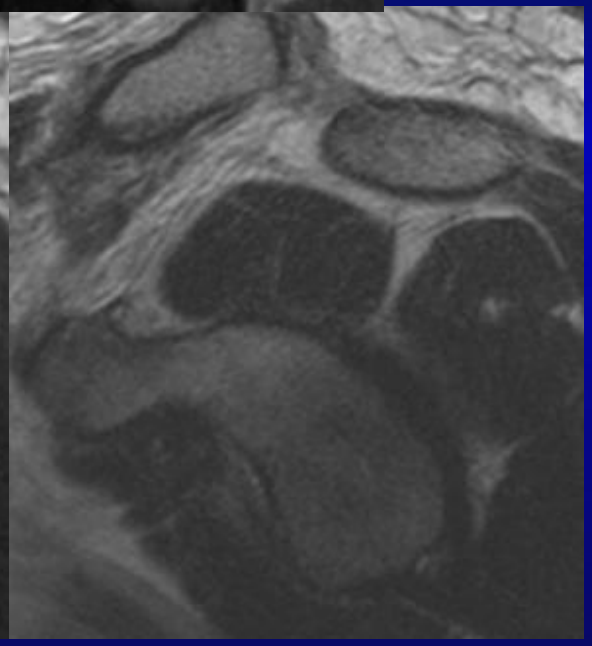
Rockwood: Grade III Injury







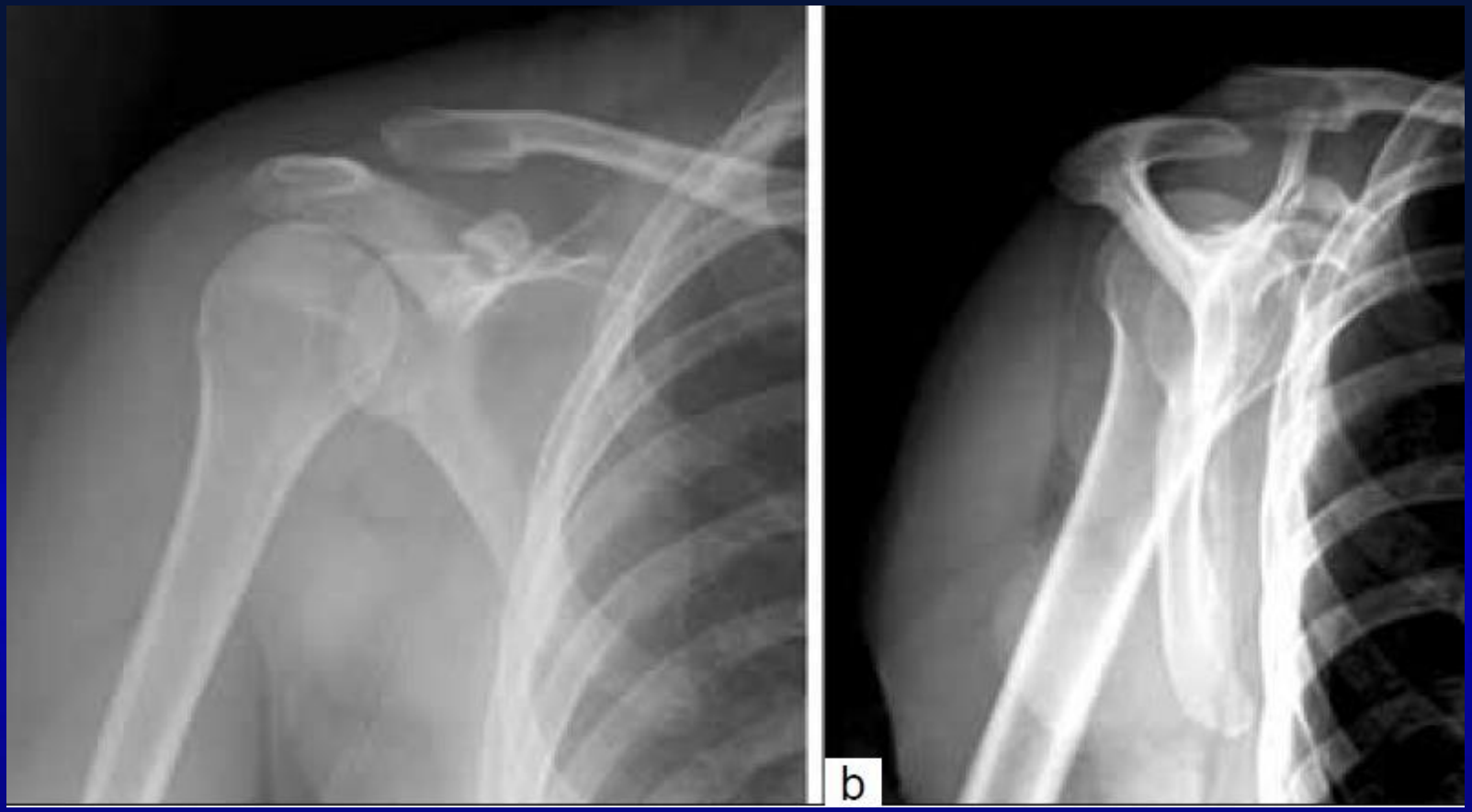




Rockwood: Grade III Injury variants

- 1) Fracture of corocoid process medial/proximal to trapezoid/conoid ligament insertions + AC ligament disruption.
- 2) Pseudodislocation of AC Joint
  - 5% of pediatric clavicular fractures
  - Fracture through distal clavicular physes, with clavicle herniating through fx periosteum, which remains intact to CC ligaments

Rockwood: Grade III Injury variants



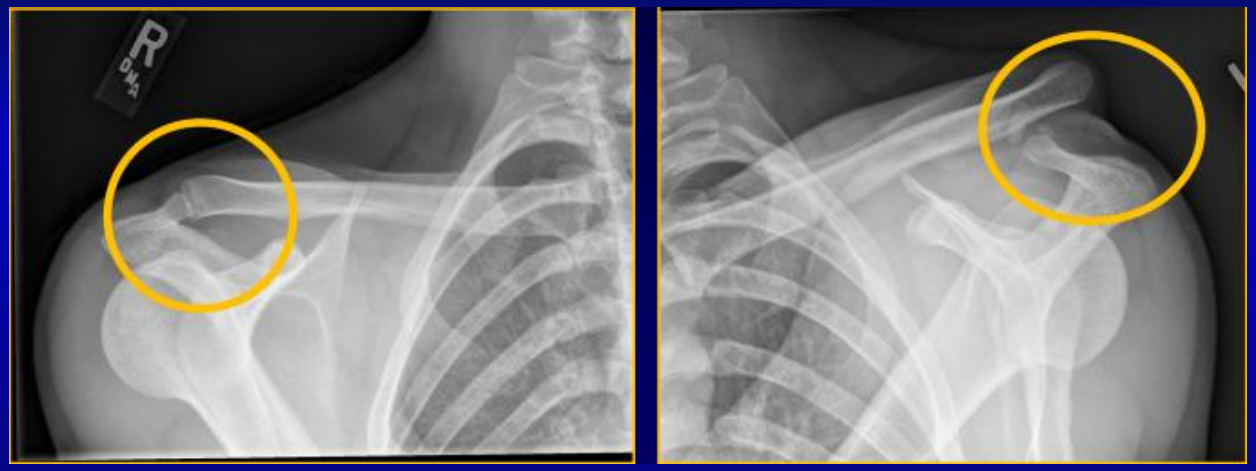
Thomas, K. et al. Int Jl Shoulder Surgery. 2011

Rockwood: Grade III Injury variants

Kotb et al. Case Report Orthop. 2016

ISAKOS- 2014

- To develop a scientific method to stratify stable vs. unstable Grade III ACJ injury patients
  - Grade IIIA – stable
  - Grade IIIB – unstable
  - Suggest 2nd evaluation 3-6 wks post injury, if persistent pain or decreased function → Cross-body adduction/Basamania/Alexander view
    - If clavicle overrides acromion, suggestive of instability of CCL's → operative mgmt



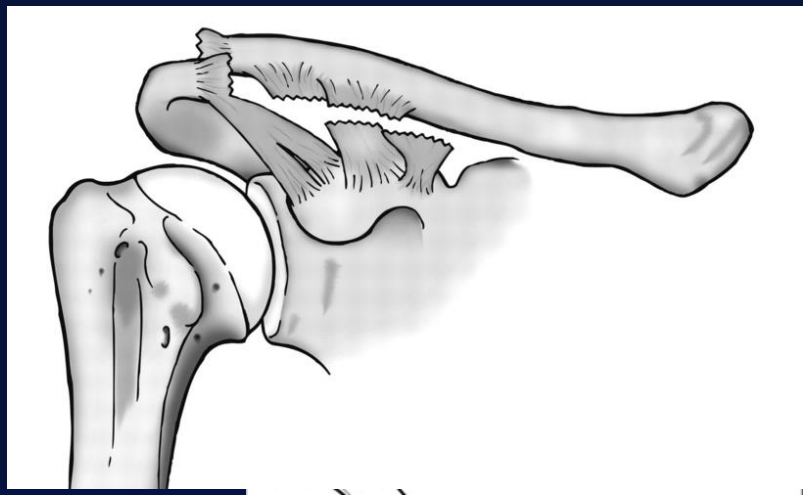
Beitzel K, Mazzocca AD, et alK; Upper Extremity Committee of ISAKOS. ISAKOS upper extremity committee consensus statement on the need for diversification of the Rockwood classification for acromioclavicular joint injuries. Arthroscopy. 2014 Feb; 30(2): 271-8.

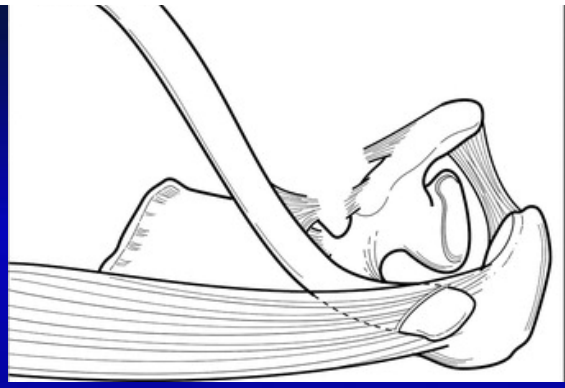
Rockwood: Grade IV Injury

- AC ligament/capsule – Complete disruption
- CC ligament – Complete disruption
- Trapezius – buttonholing
- Horizontal and vertical instability at ACJ
- *Assess for anterior sternoclavicular dislocation

- PE
  - ACJ not reducible

- X-rays
  - Swelling, wide ACJ, no vertical clavicular displacement, posteriorly displaced clavicle
- MRI
  - Fluid signal and tear AC/CC ligaments, osseous edema, tearing of trapezius from distal clavicle or periosteal sleeve, soft tissue edema or hemorrhage if acute





Phadnis et al.

J.A. Fraser-Moodie, N.L Shortt, C.M Robinson. Injuries to the Acromioclavicular joint. JBJS. 2008; 90-B

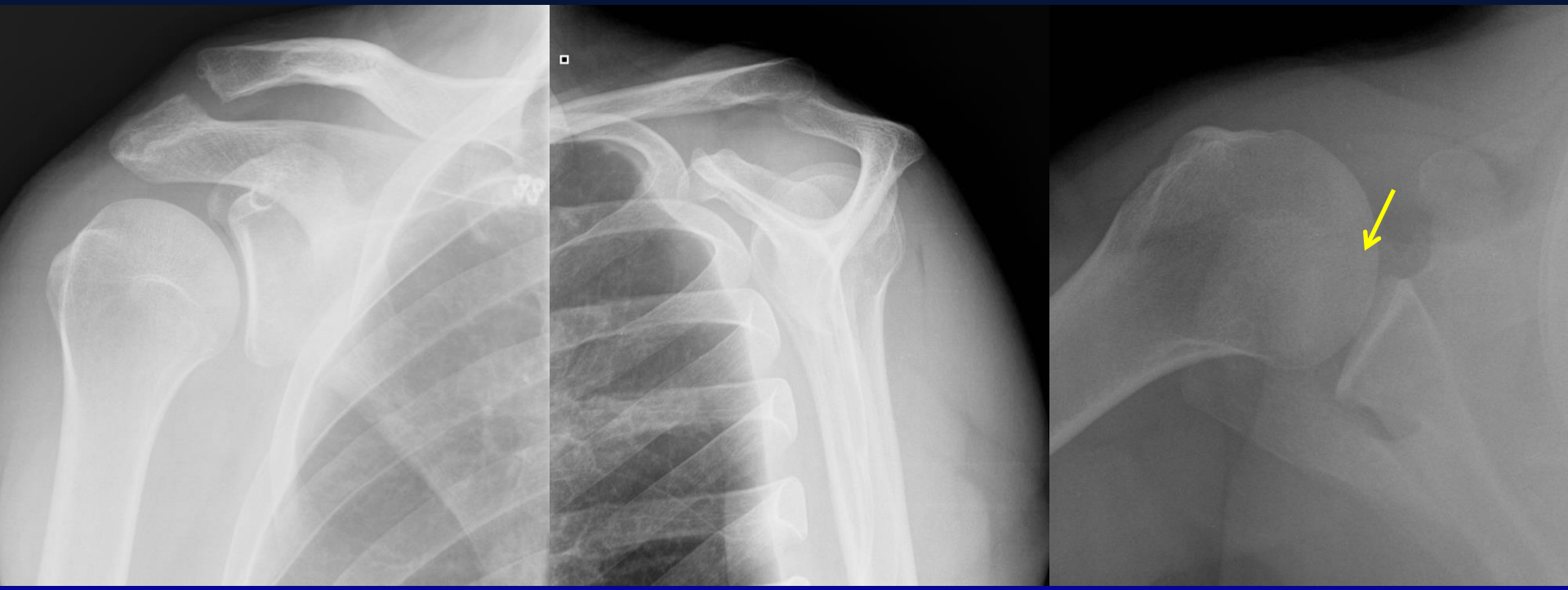
Rockwood: Grade IV Injury

11/2009

UCSD, Courtesy of Mini Pathria

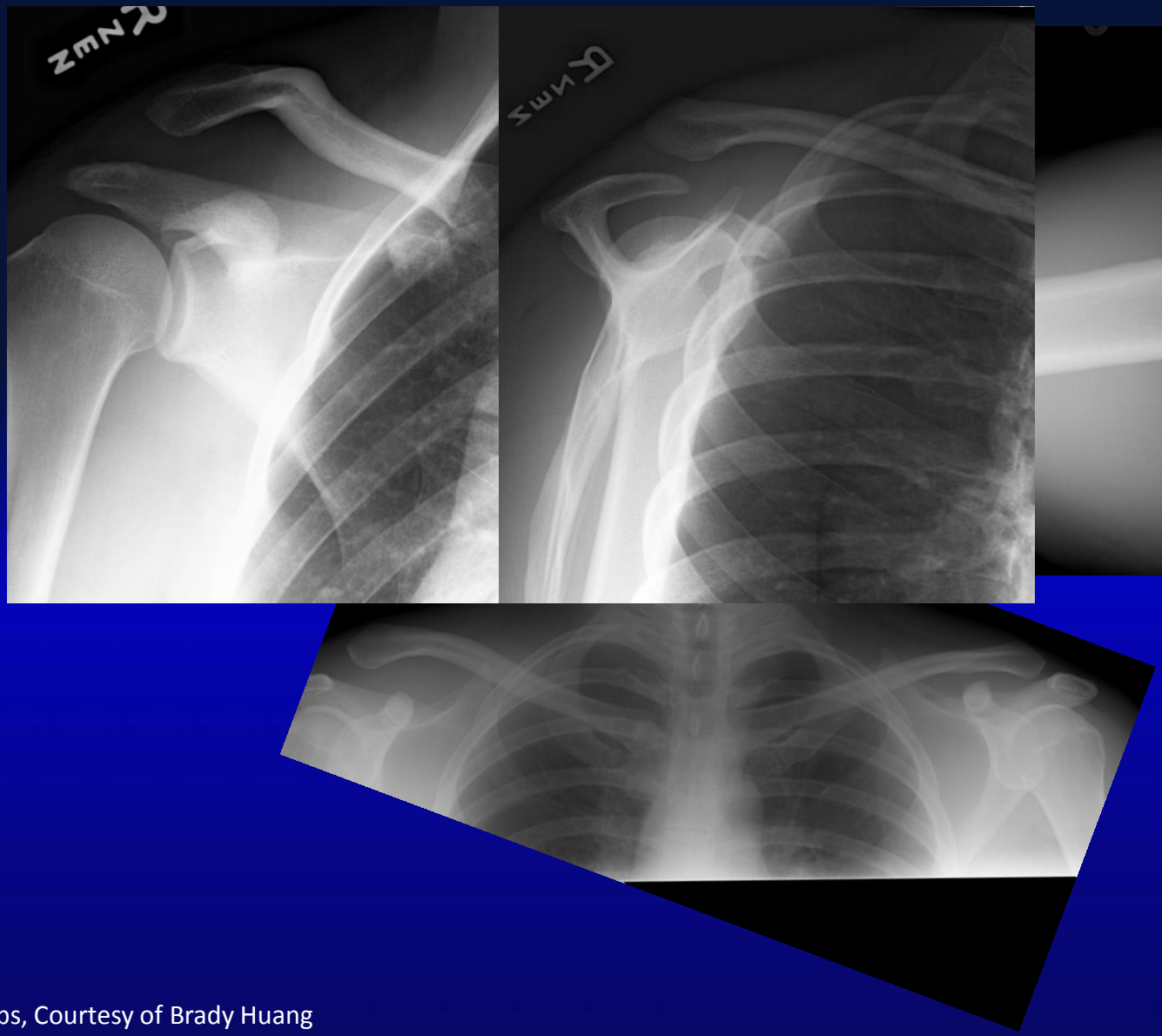
Rockwood: Grade IV Injury

Same patient, 03/2010



UCSD, Courtesy of Mini Pathria

Rockwood: Grade IV Injury

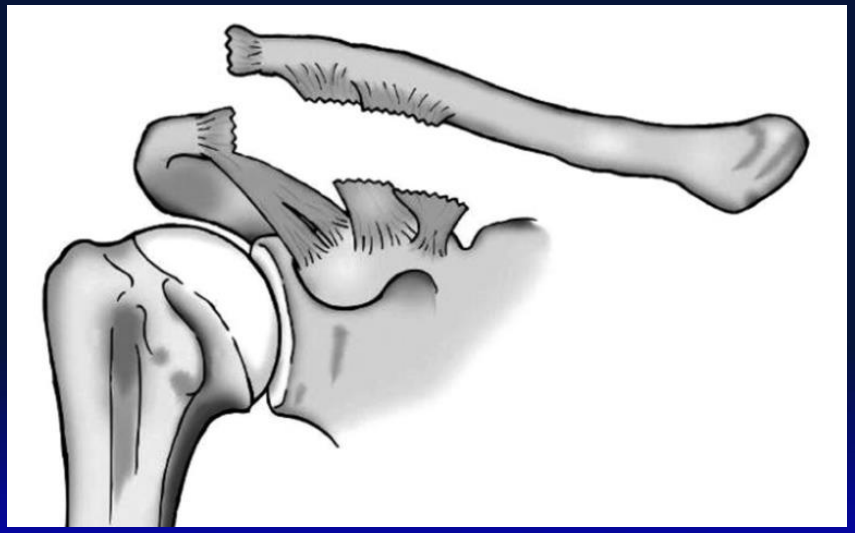


Scripps, Courtesy of Brady Huang

Rockwood: Grade V Injury

- AC ligament/capsule – Complete disruption
- CC ligament – Complete disruption
- Deltoid + Trapezius – disrupted from clavicle
- Horizontal and vertical instability at ACJ

- PE
  - ACJ not reducible, Scapular droop, Significant clavicular displacement, marked palpation of clavicle
- X-rays
  - Swelling, wide ACJ, significant vertical clavicular displacement, increased CC distance 100-300%
- MRI
  - Fluid signal and tear AC/CC ligaments, osseous edema, tearing of trapezius/deltoid from distal clavicle or periosteal sleeve, soft tissue edema or hemorrhage if acute

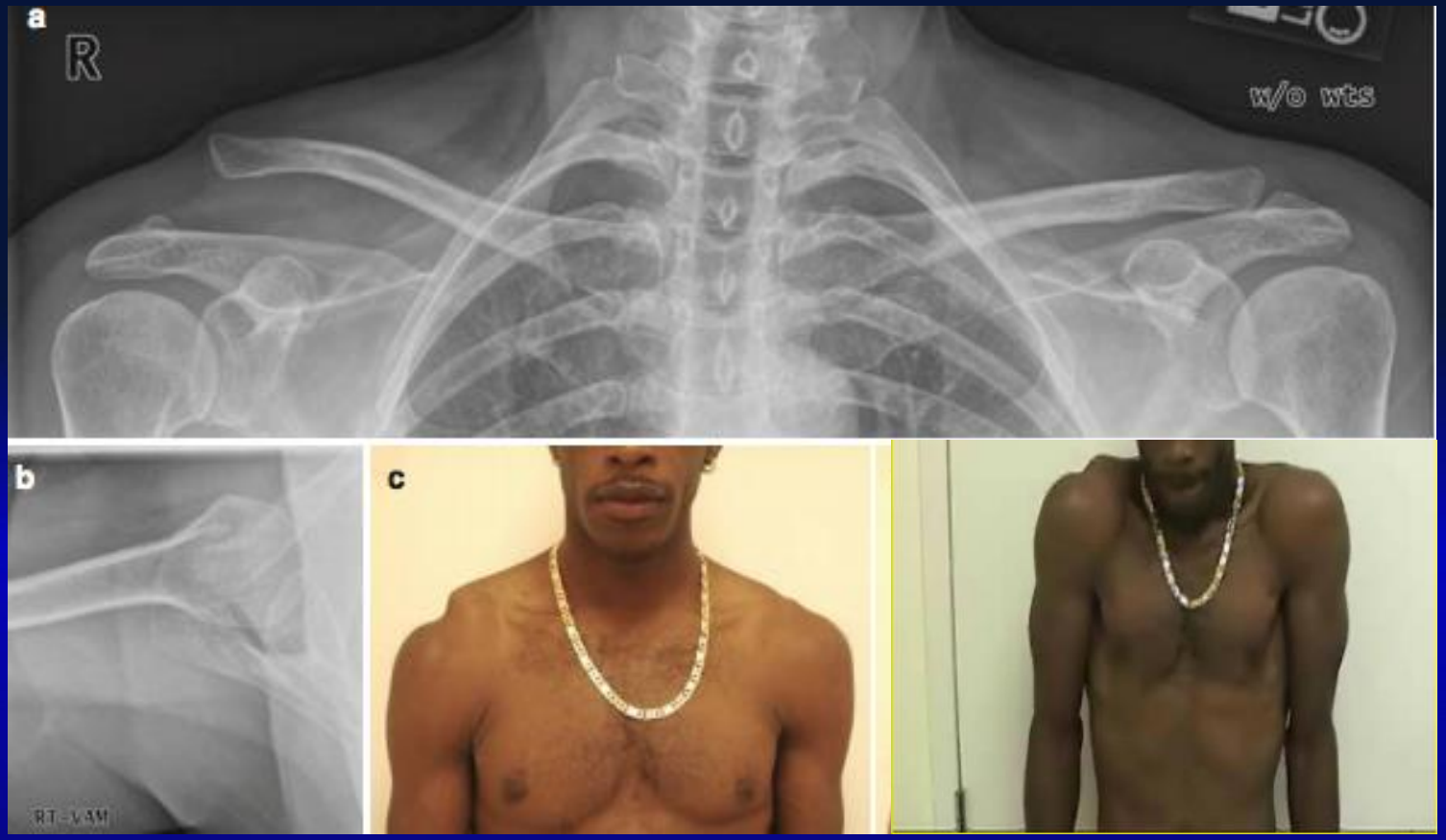


J.A. Fraser-Moodie, N.L Shortt, C.M Robinson. Injuries to the Acromioclavicular joint. JBJS. 2008; 90-B

Rockwood: Grade V Injury

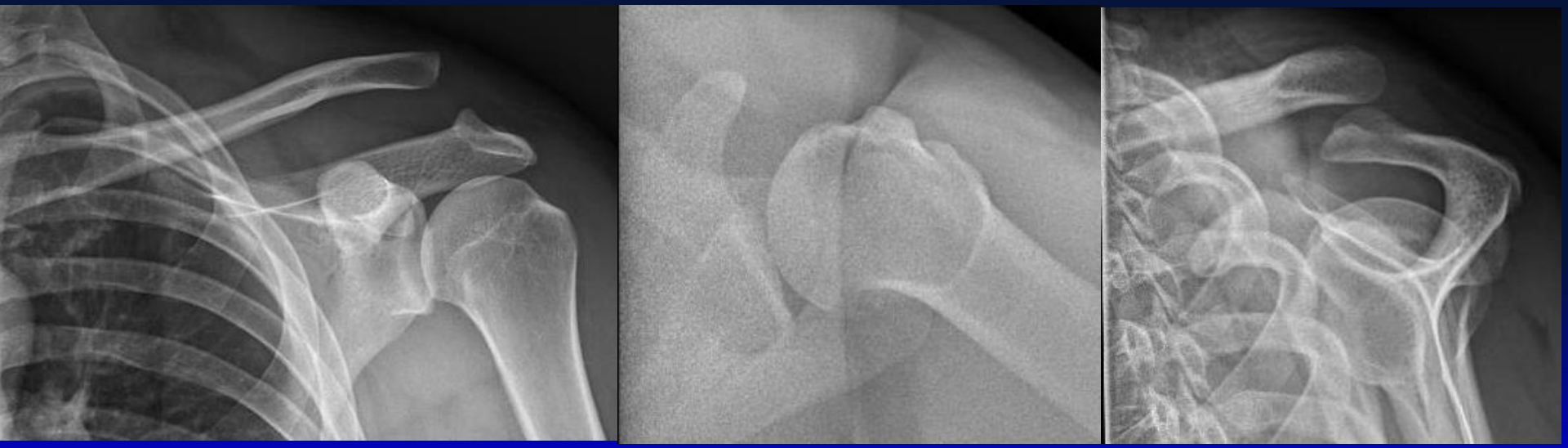
Provencher M, et al. Avoiding and Managing complications of Surgery of the Acromioclavicular Joint. 2008

Rockwood: Grade V Injury



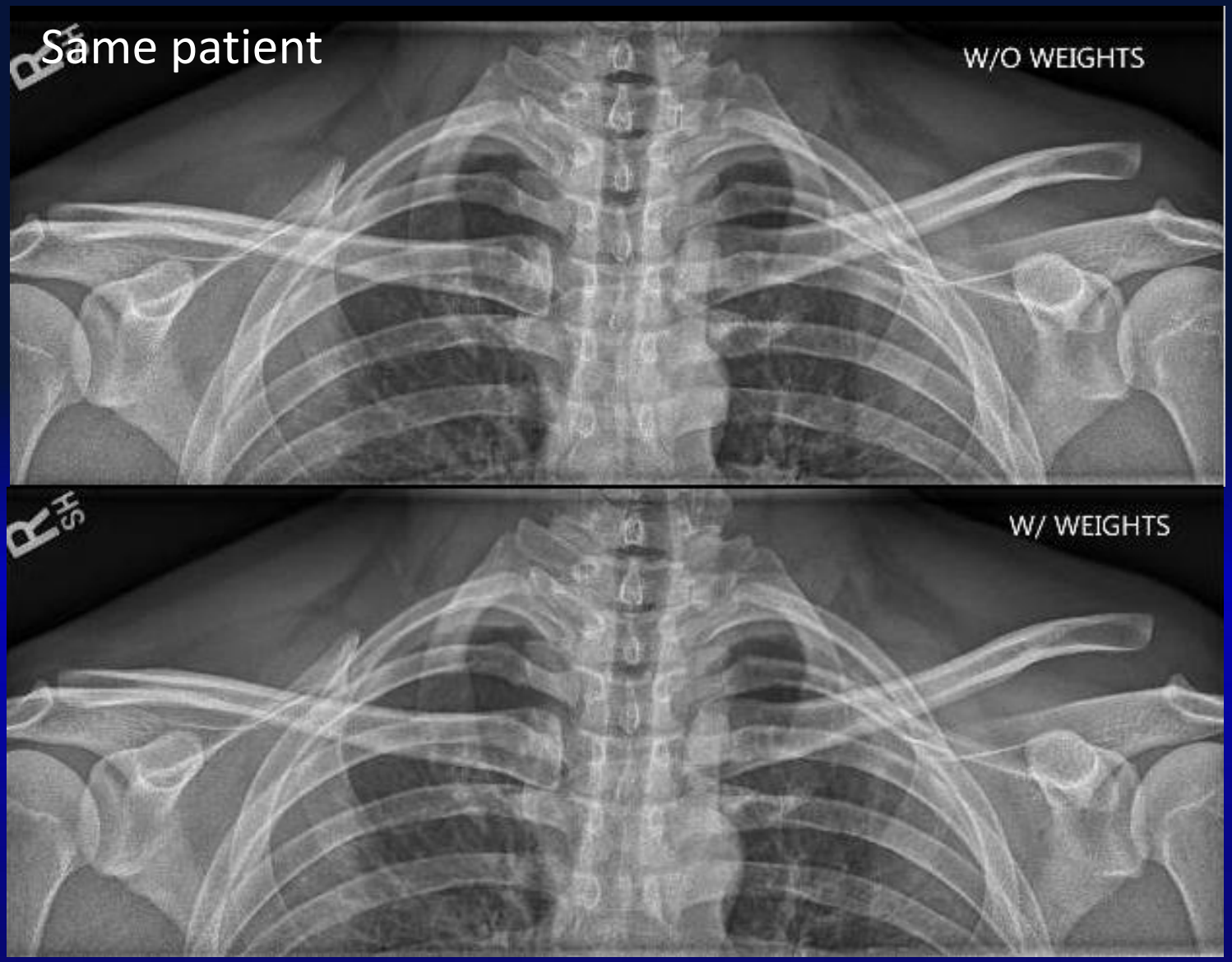
Provencher M, et al. Avoiding and Managing complications of Surgery of the Acromioclavicular Joint. 2008

Rockwood: Grade V Injury

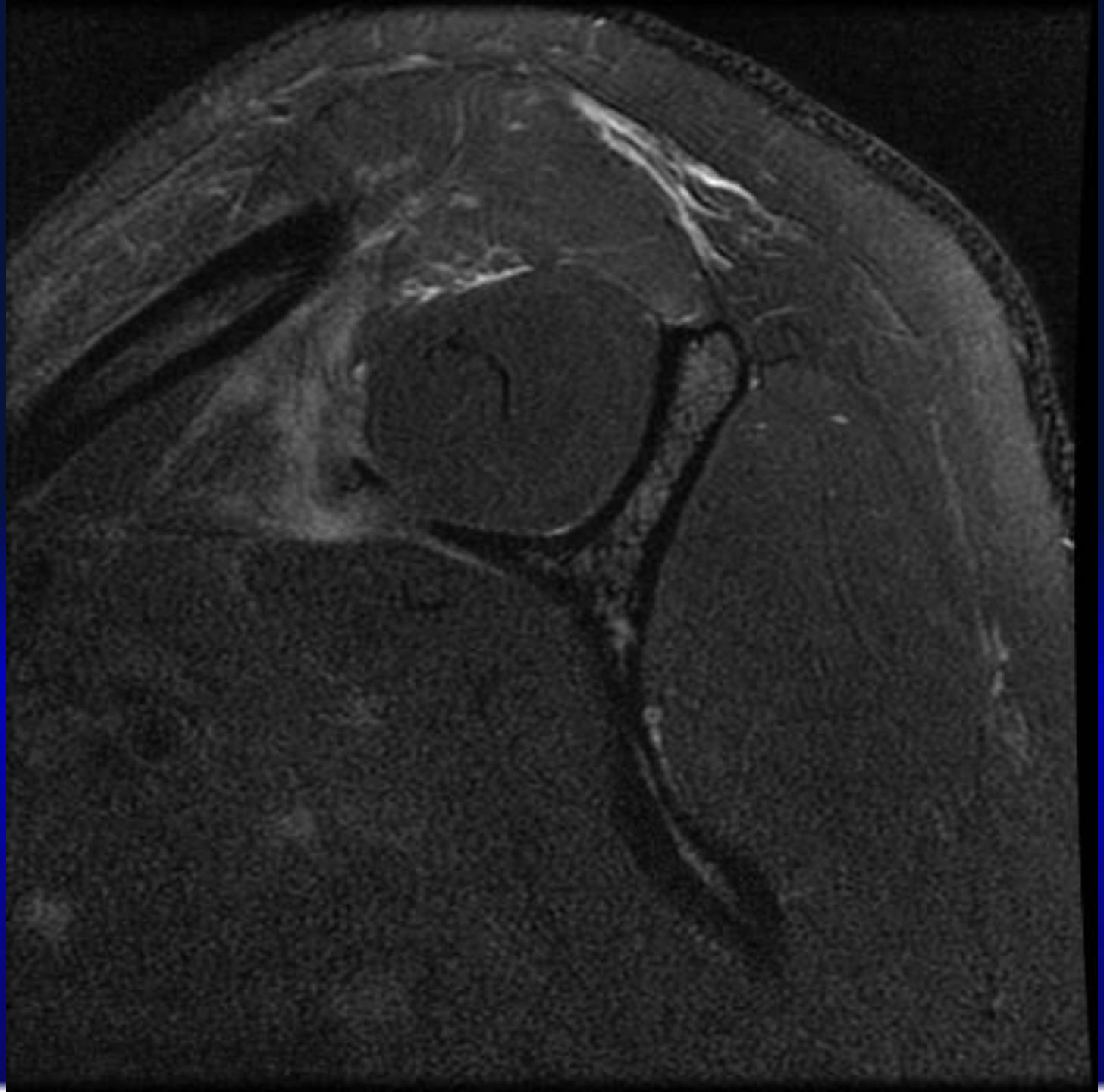


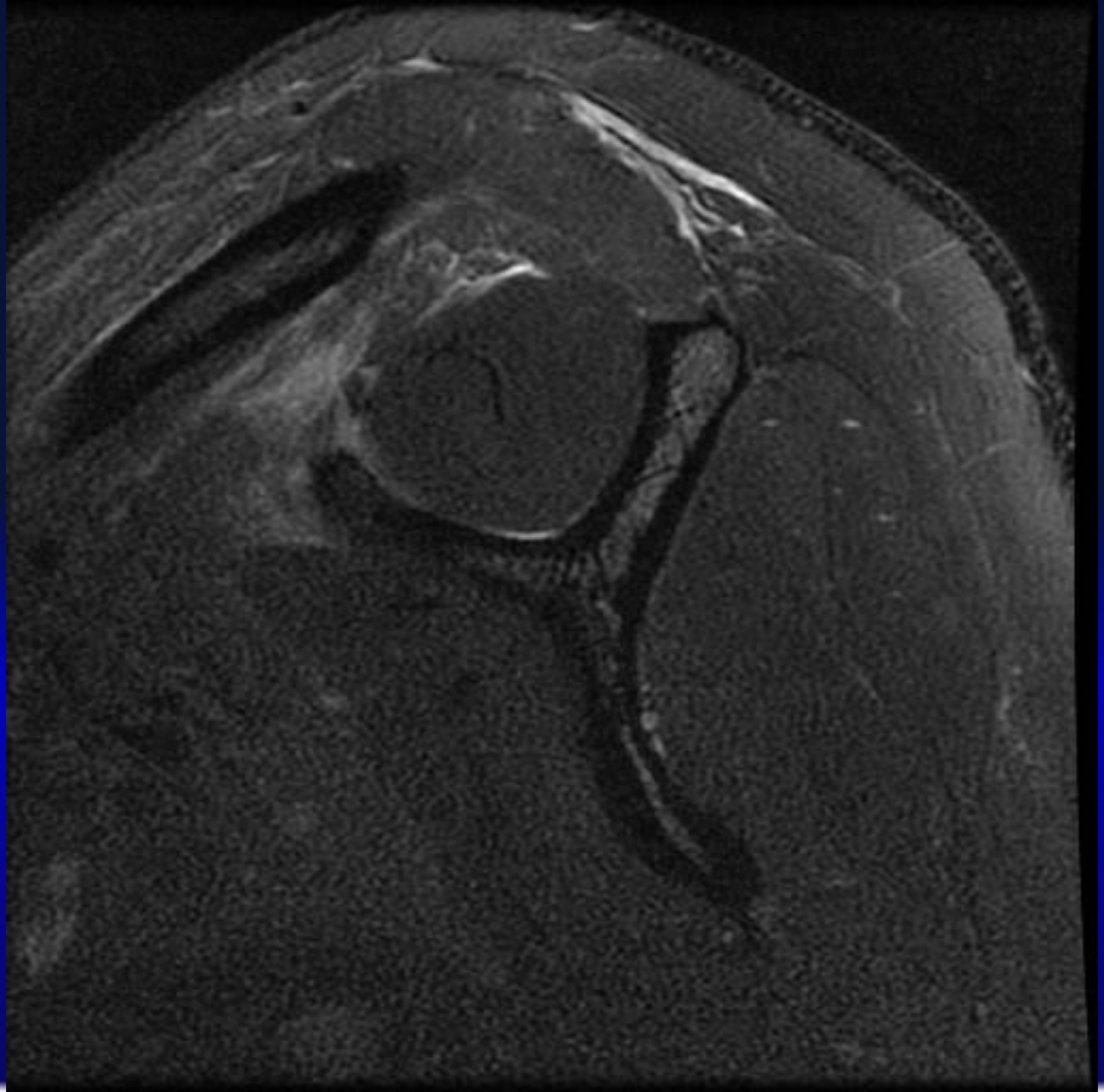
UCSD, Courtesy of Mini Pathria

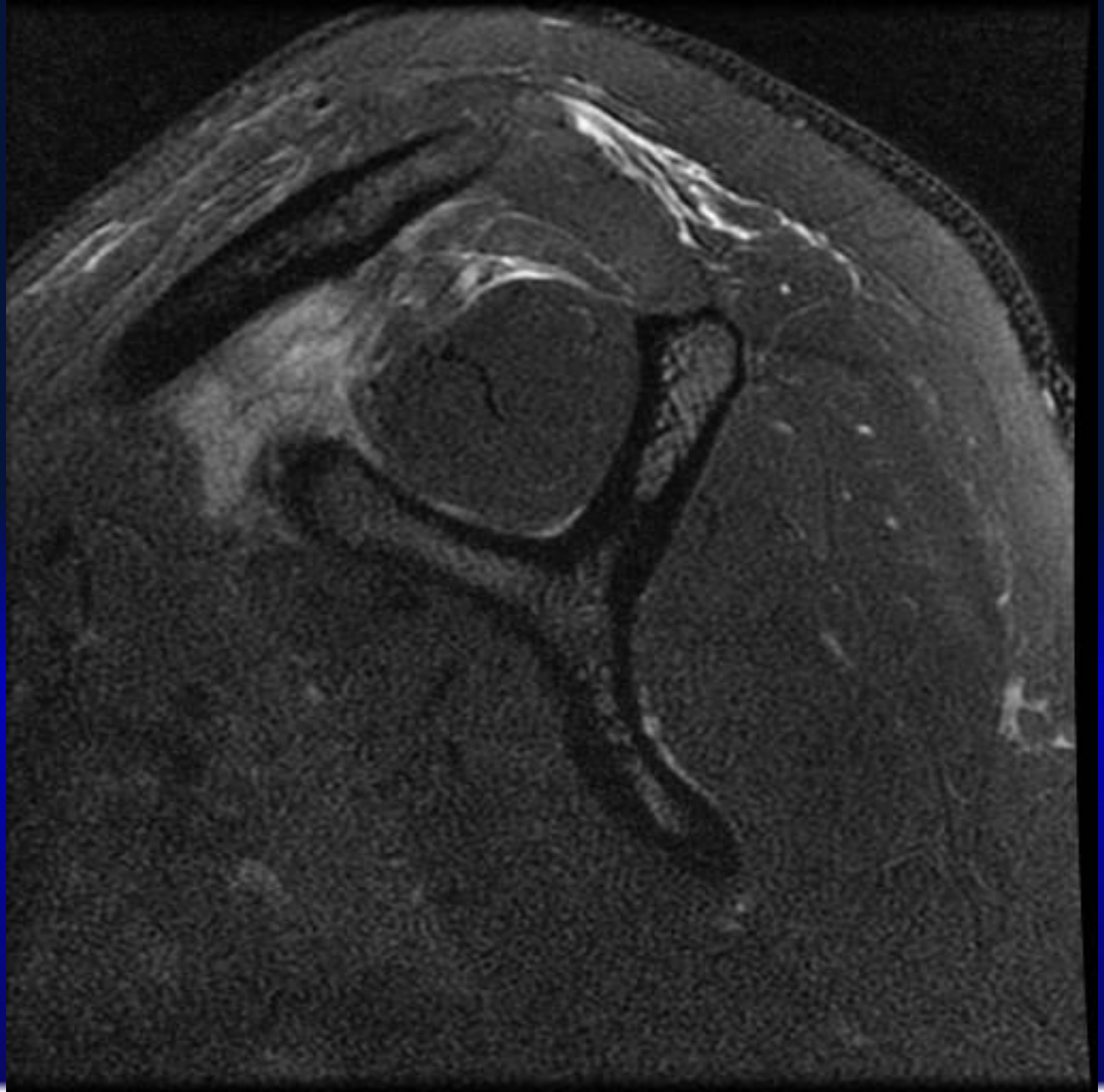
Rockwood: Grade V Injury

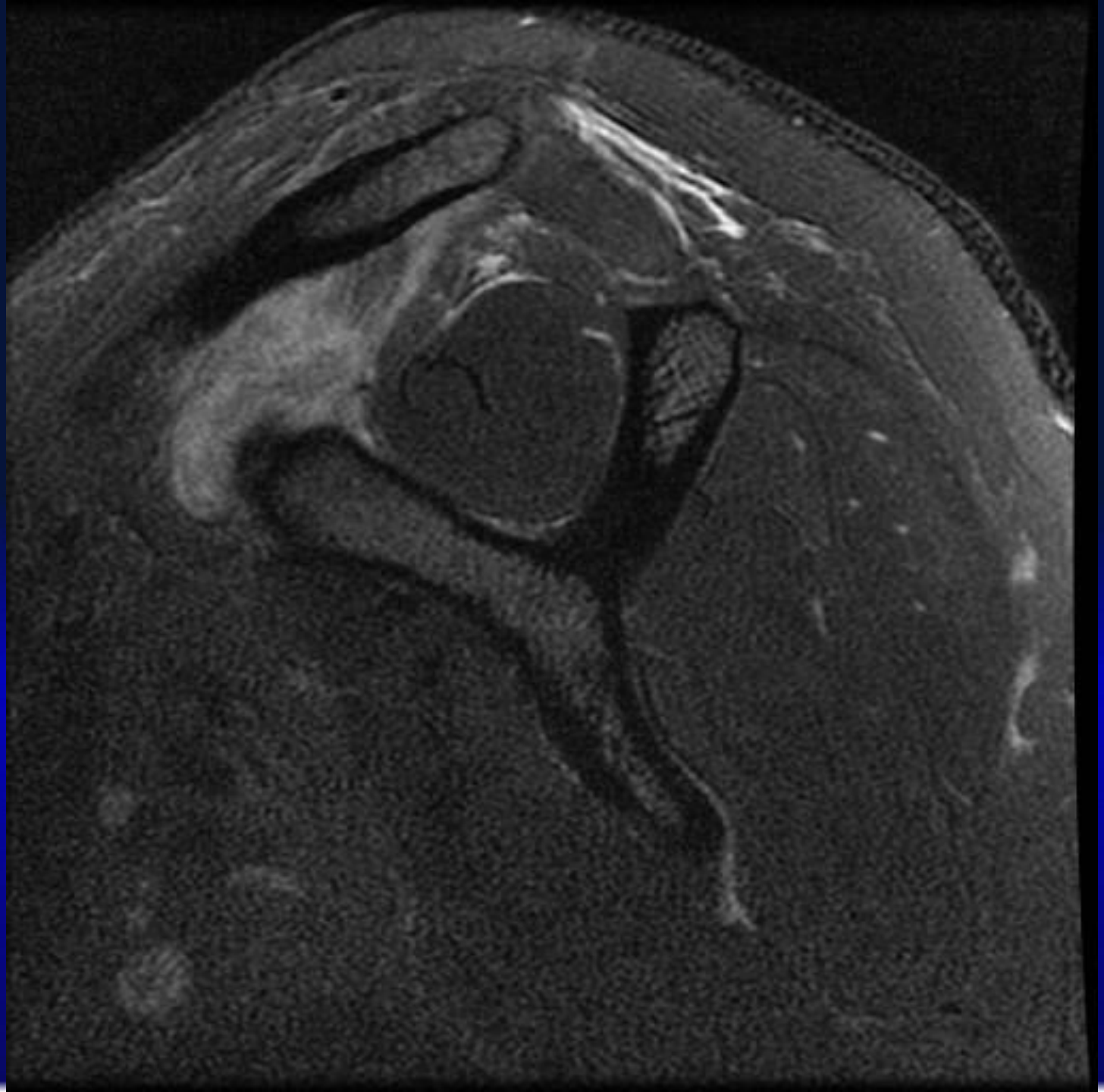


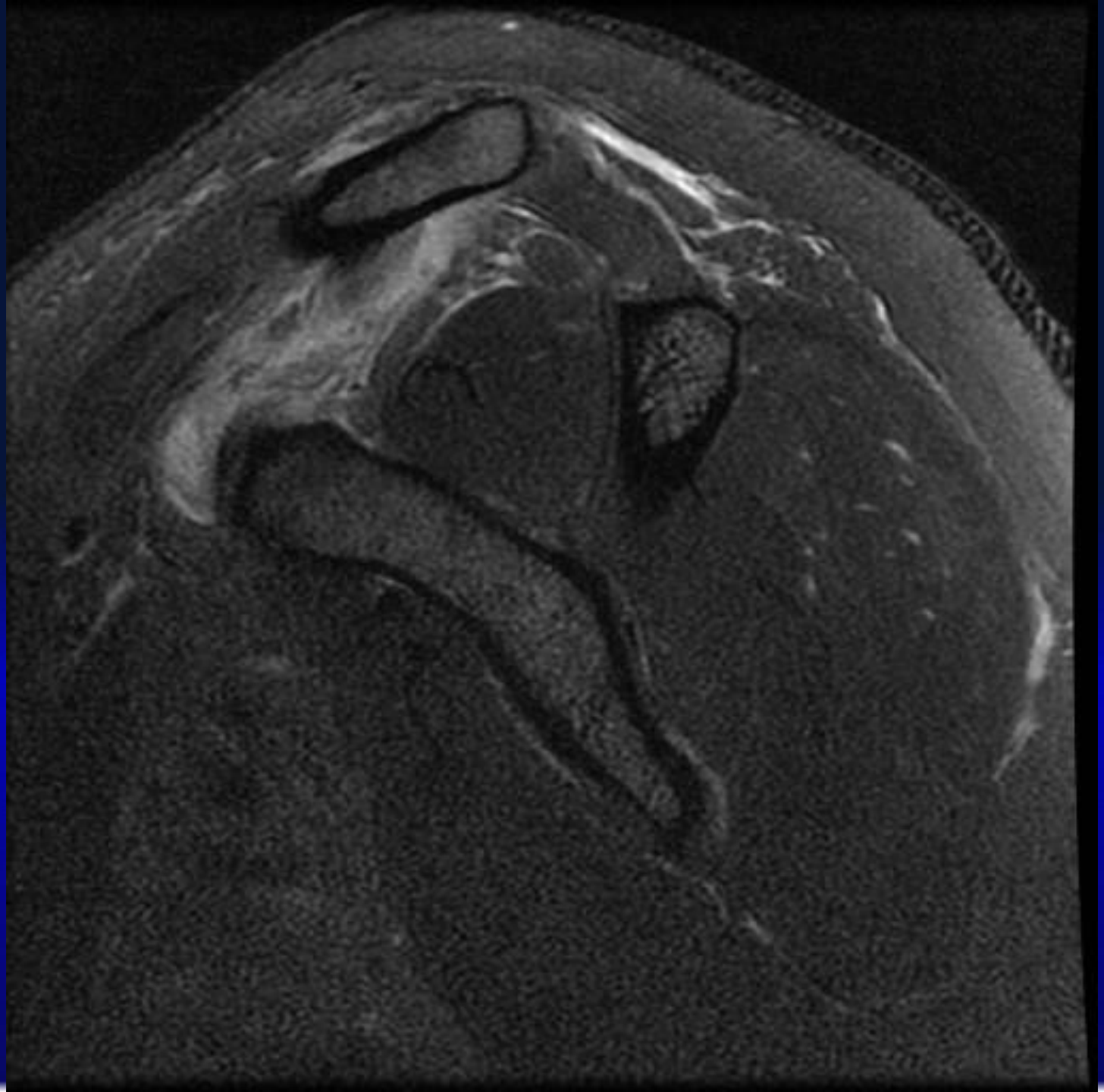
UCSD, Courtesy of Mini Pathria

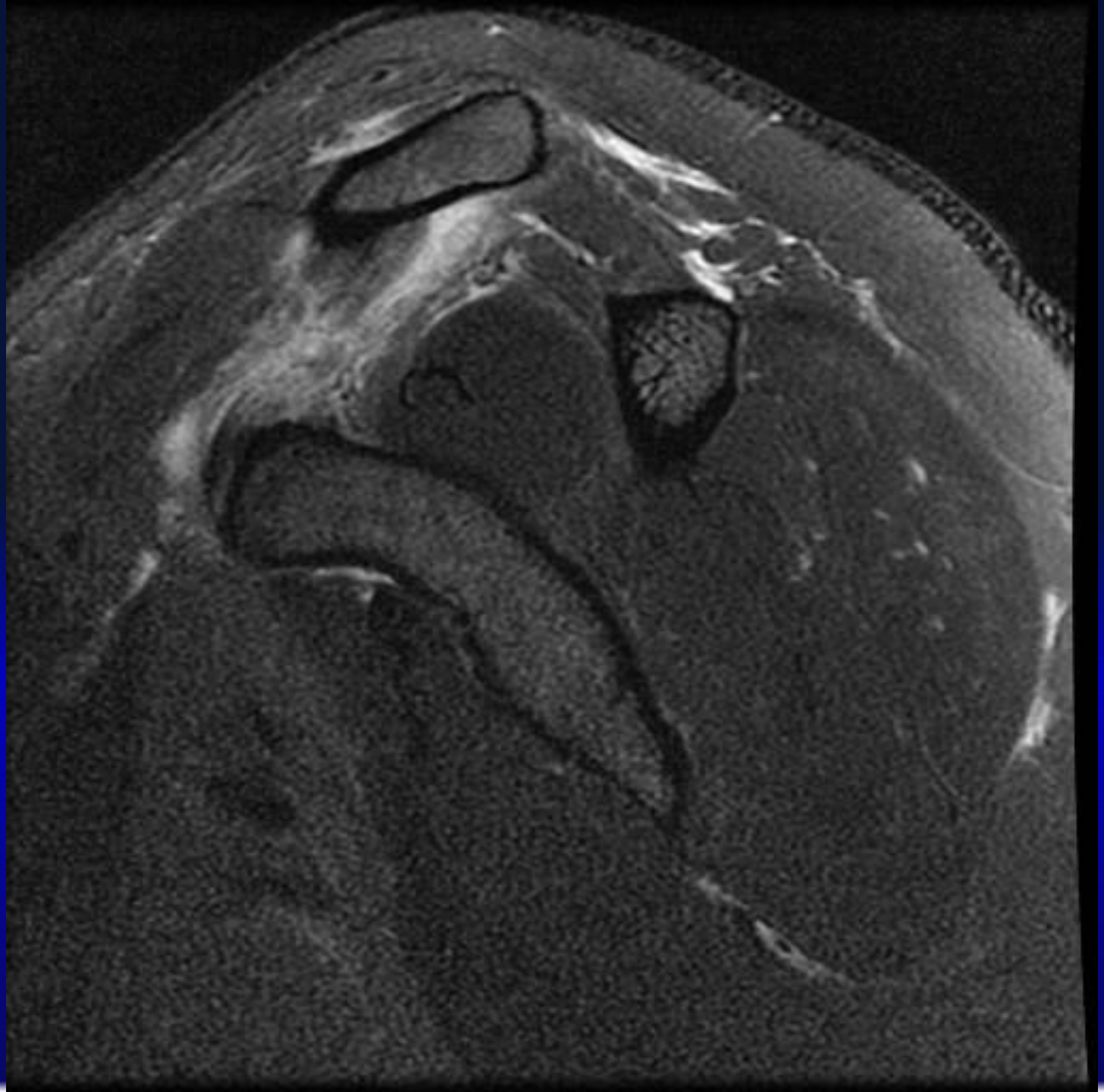


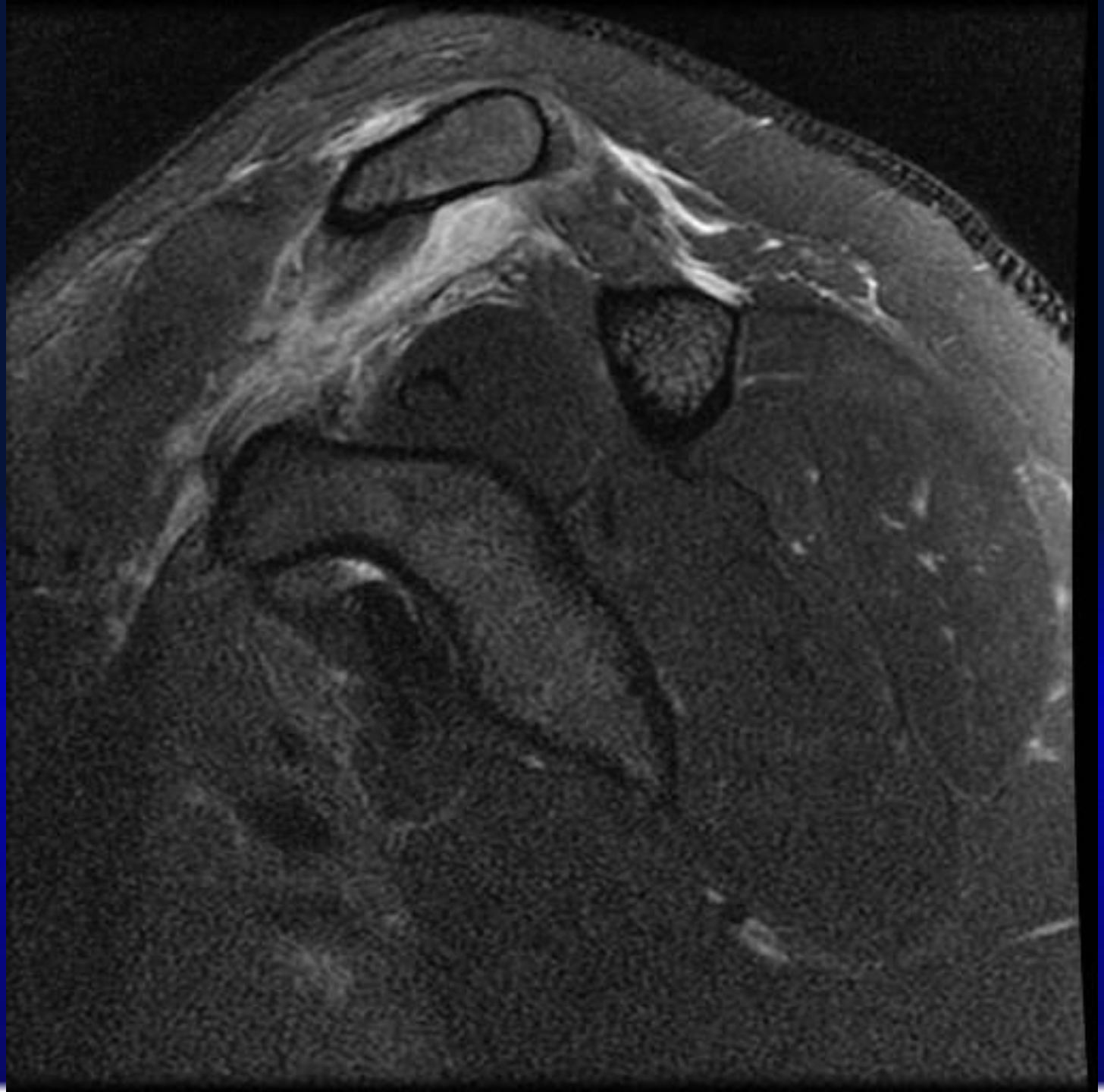


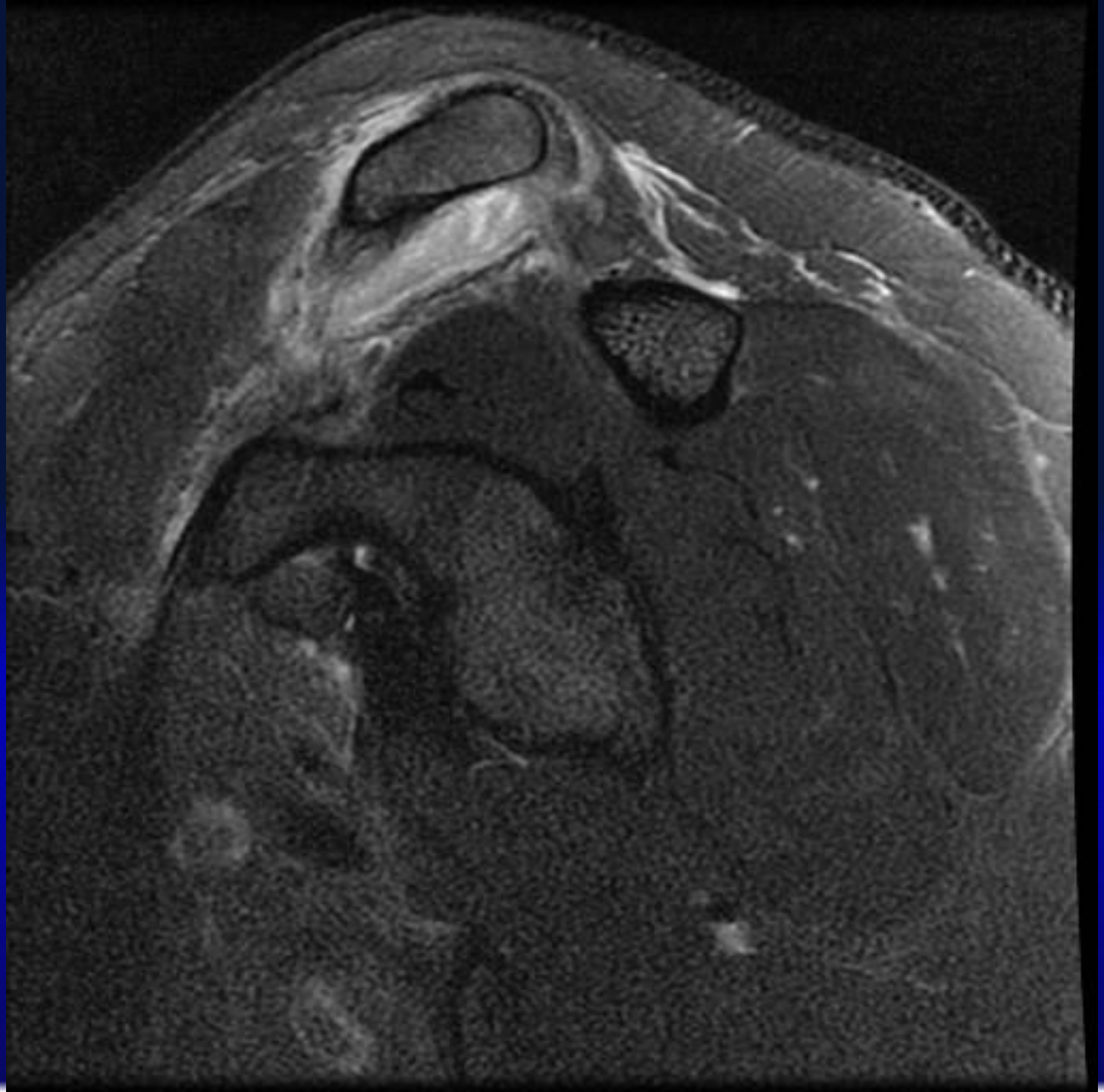


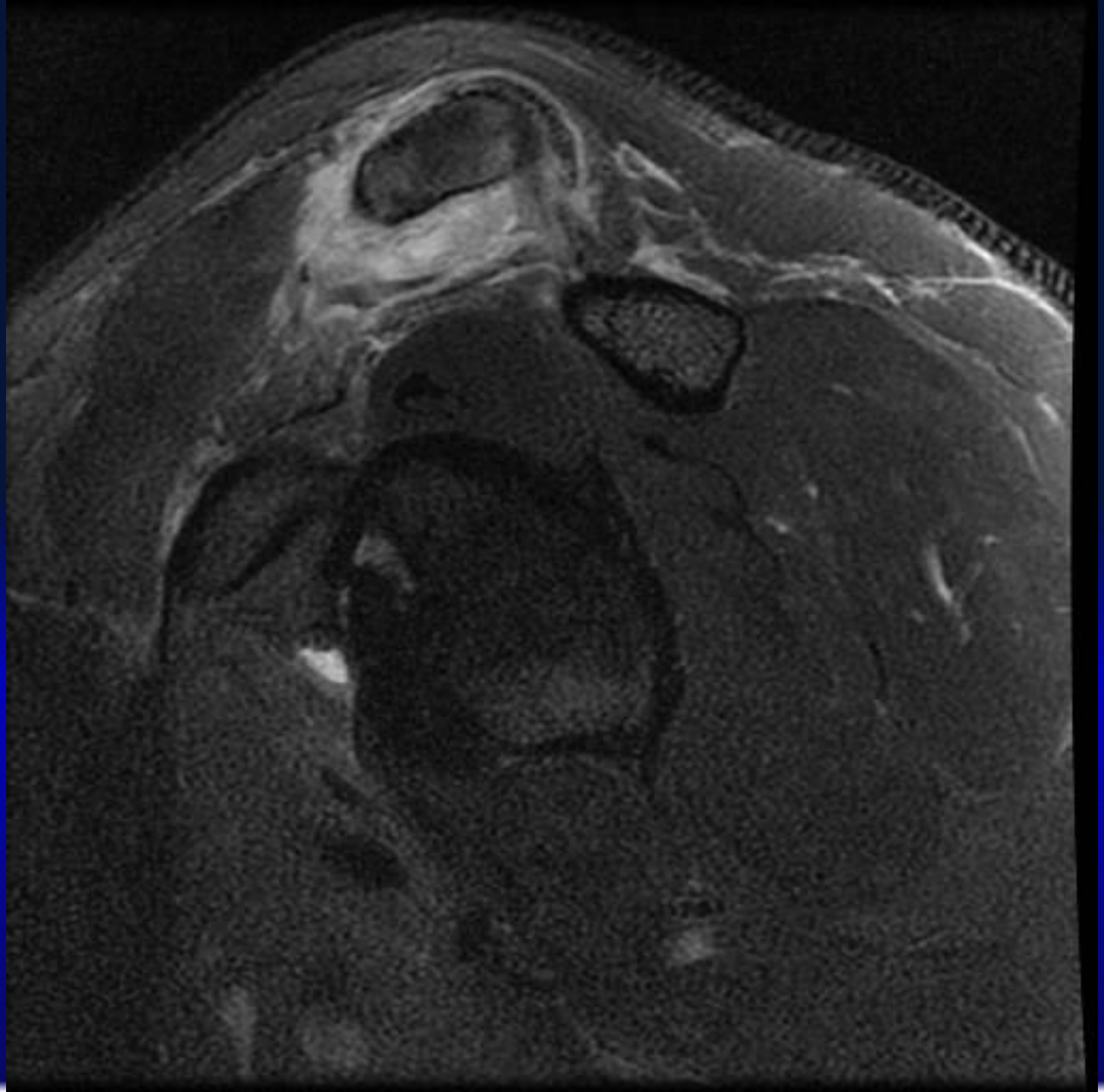


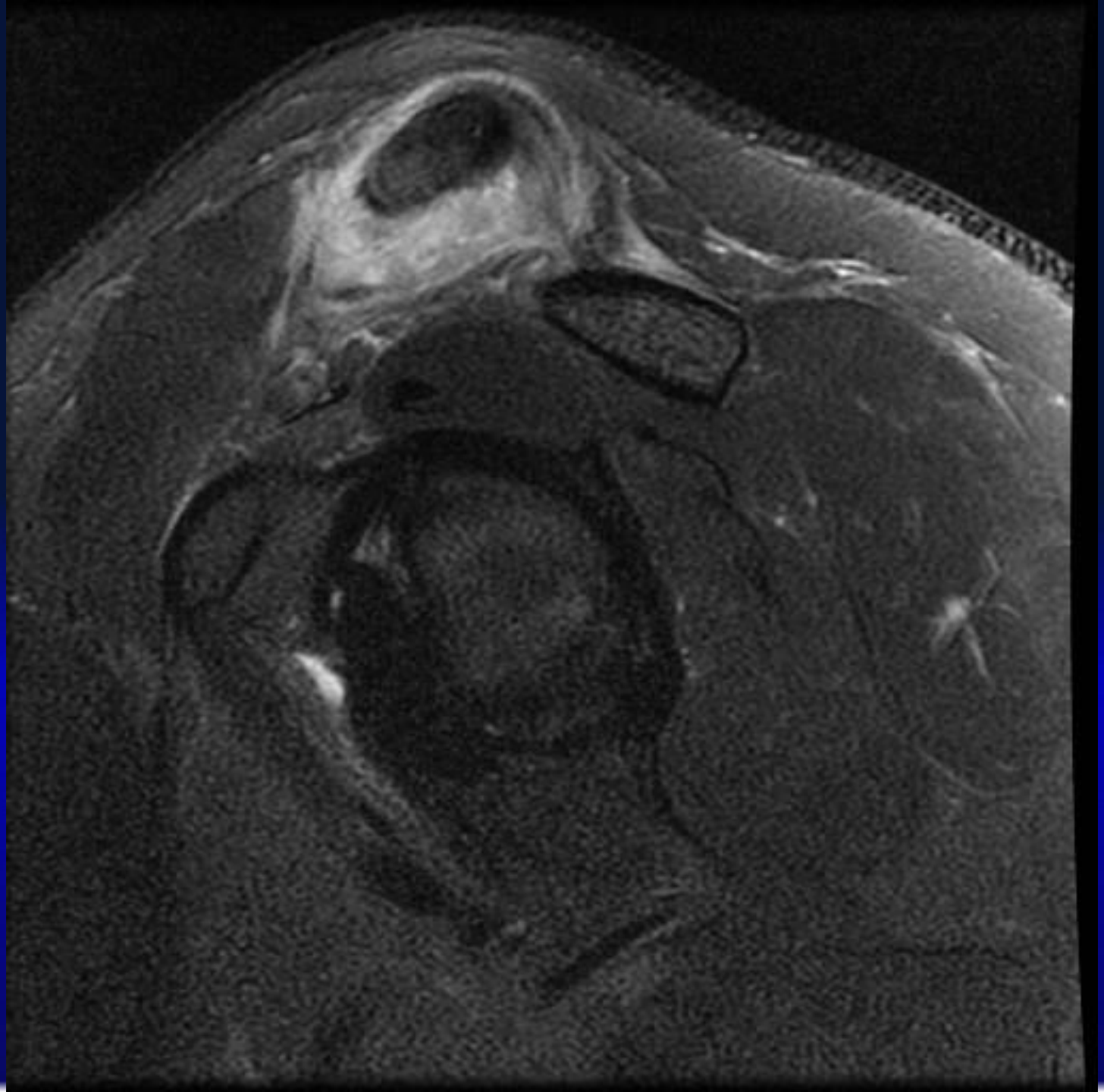


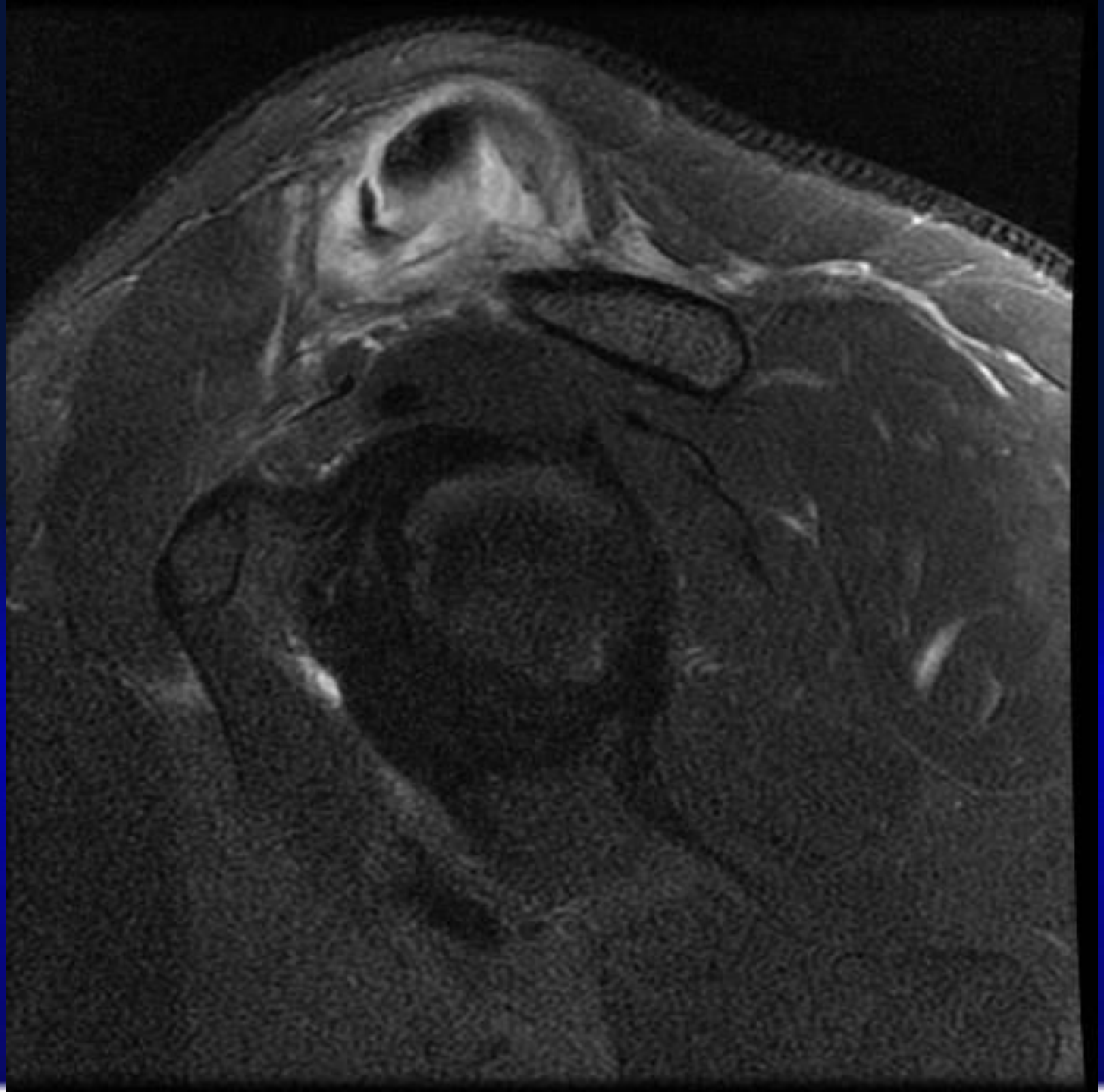


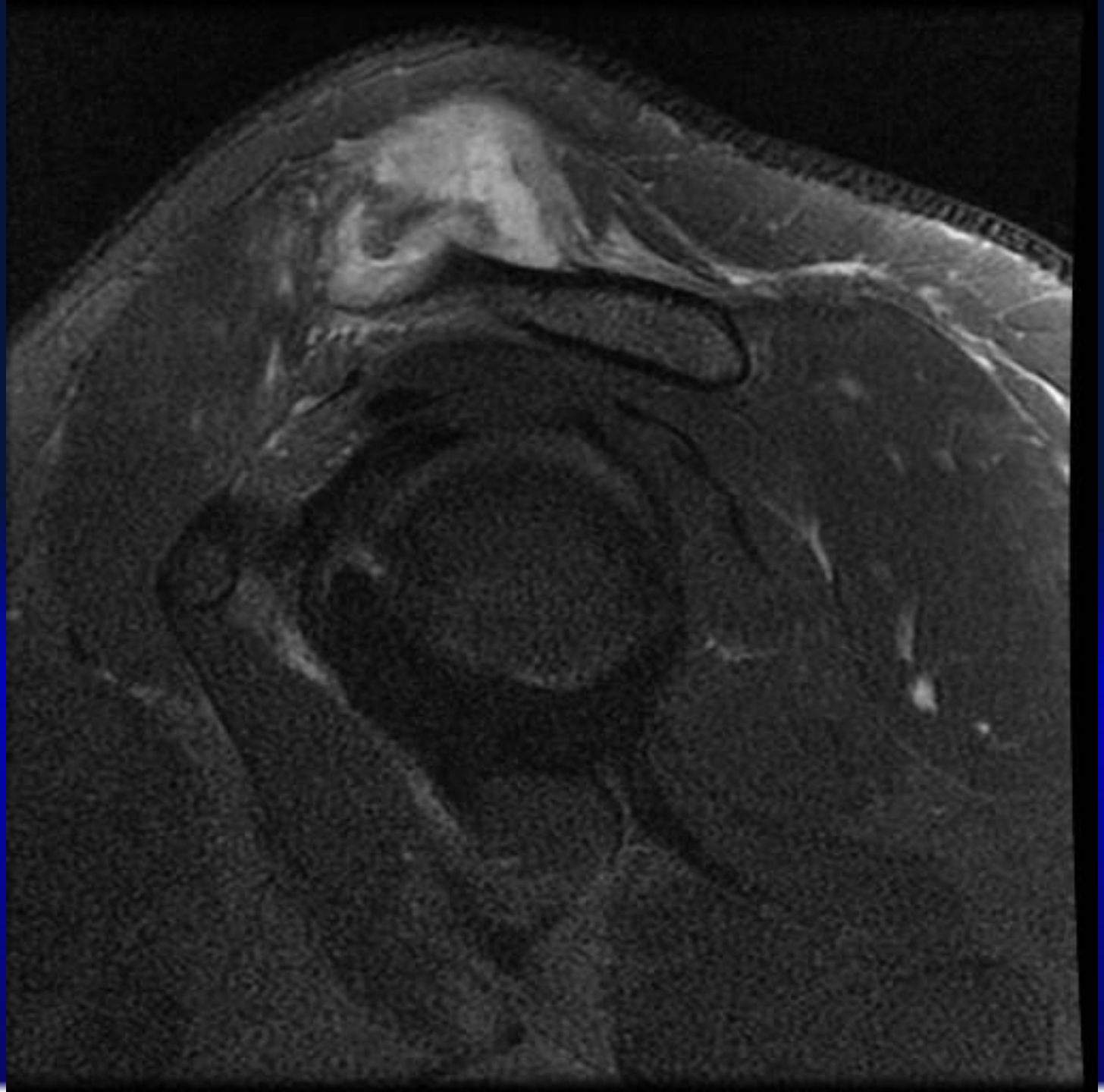


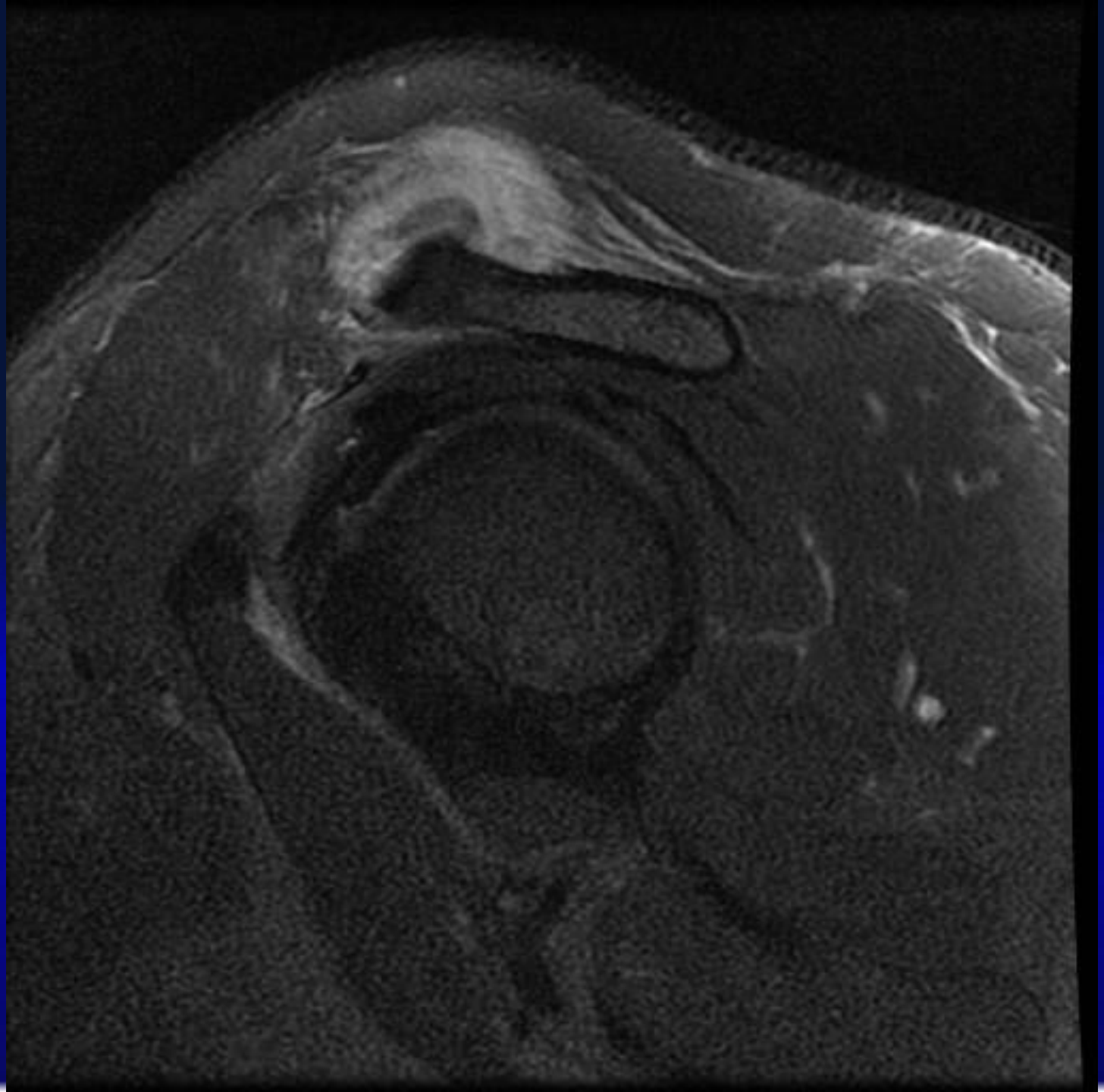


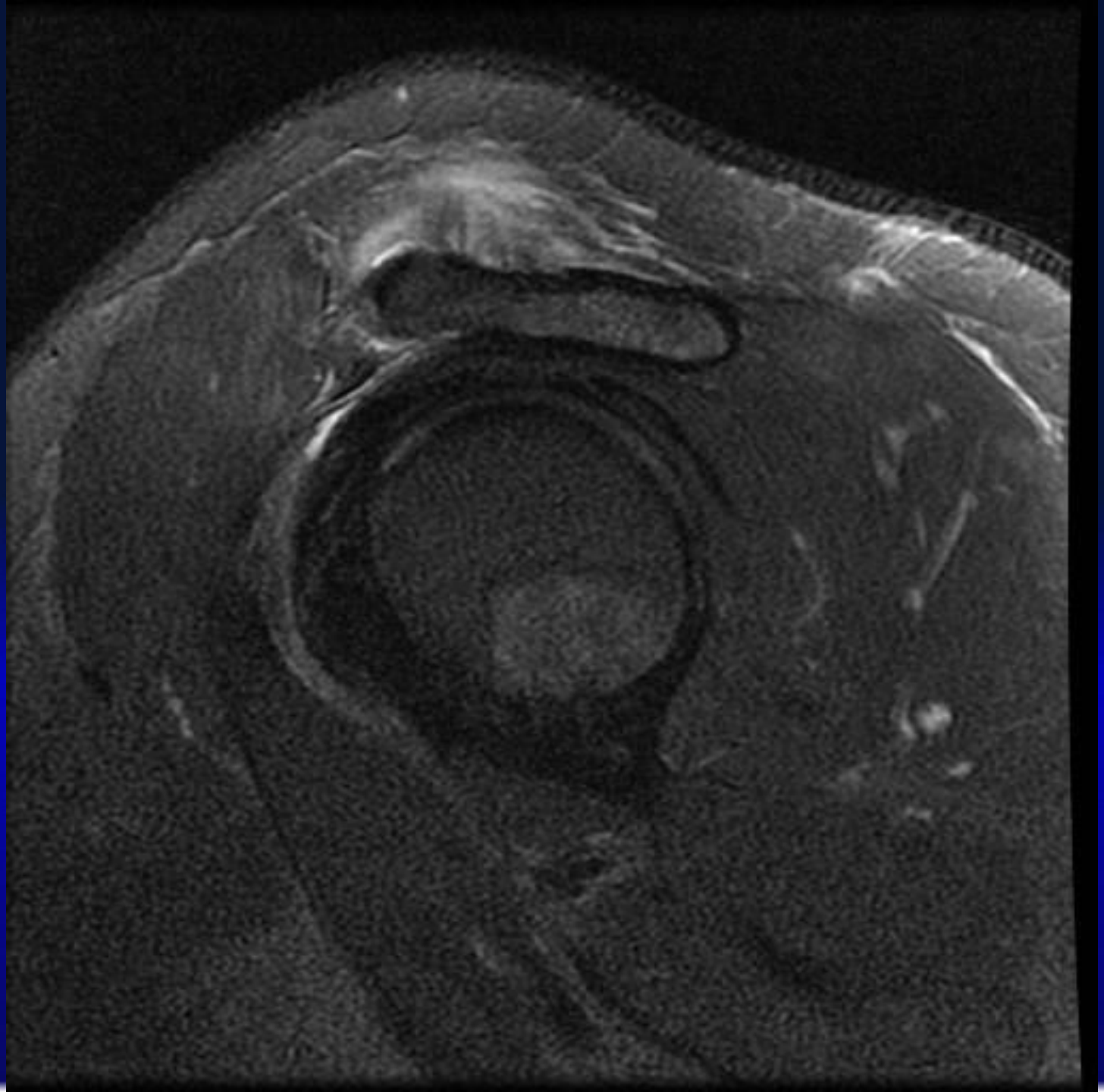


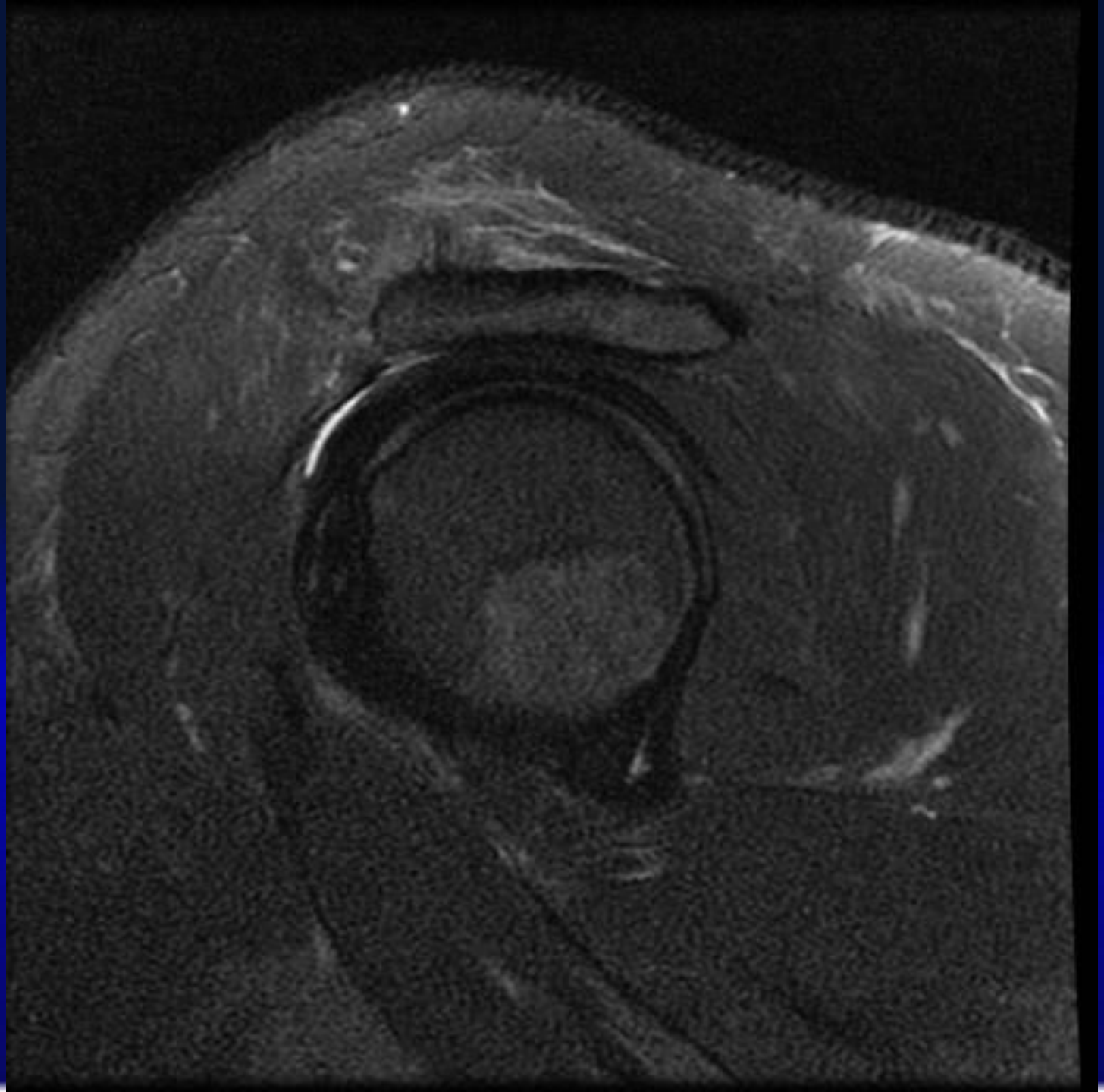


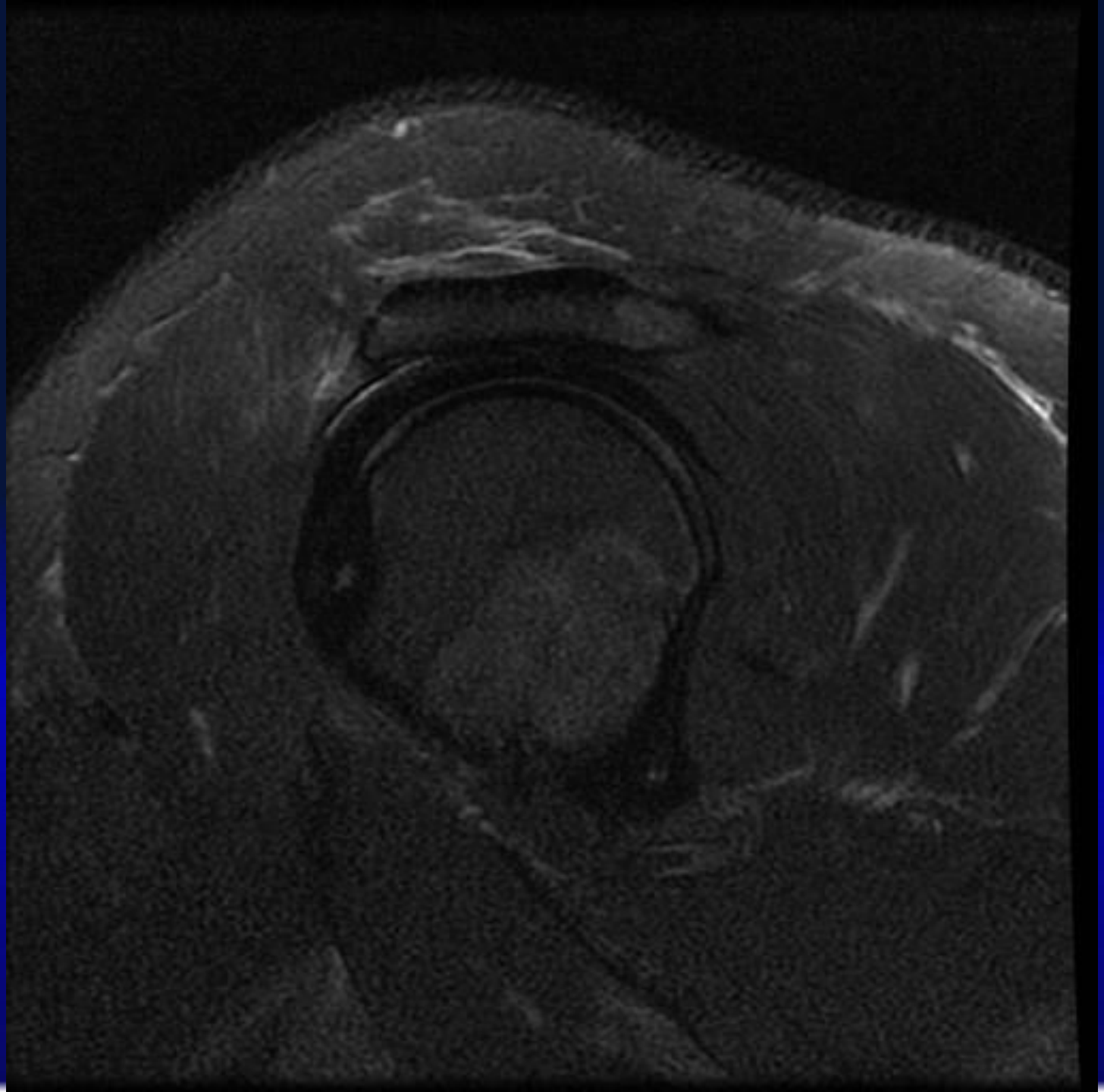


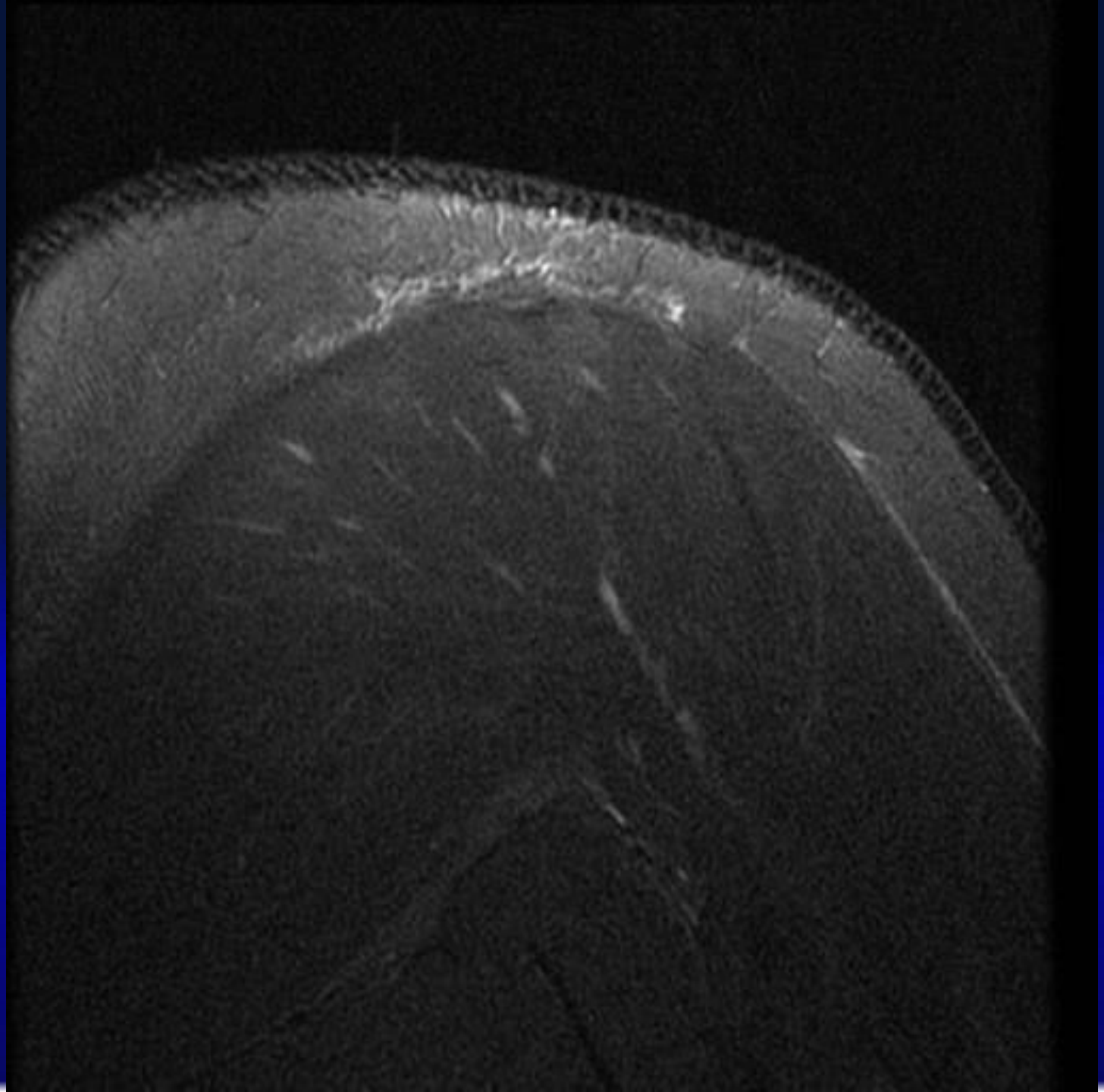


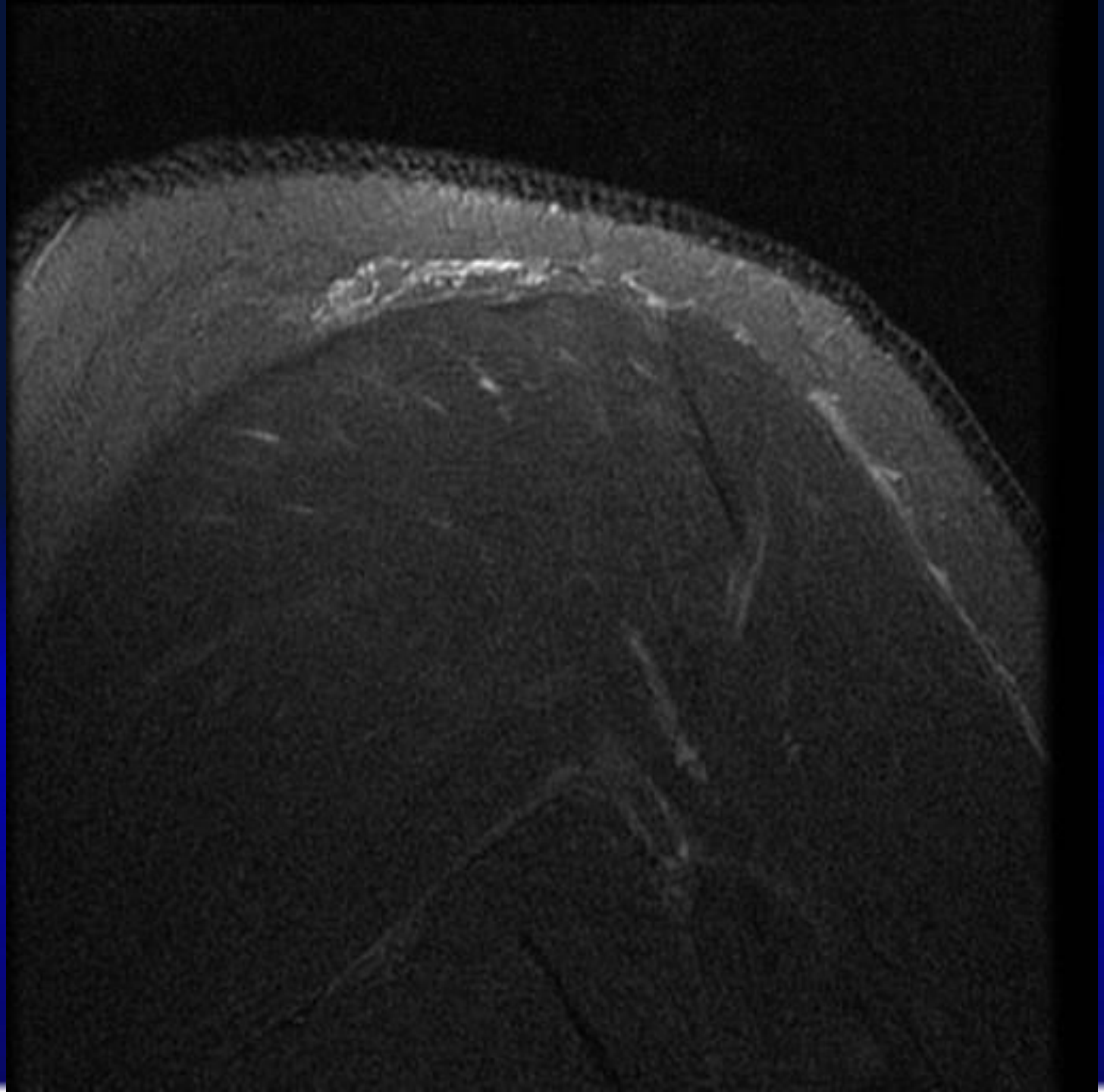


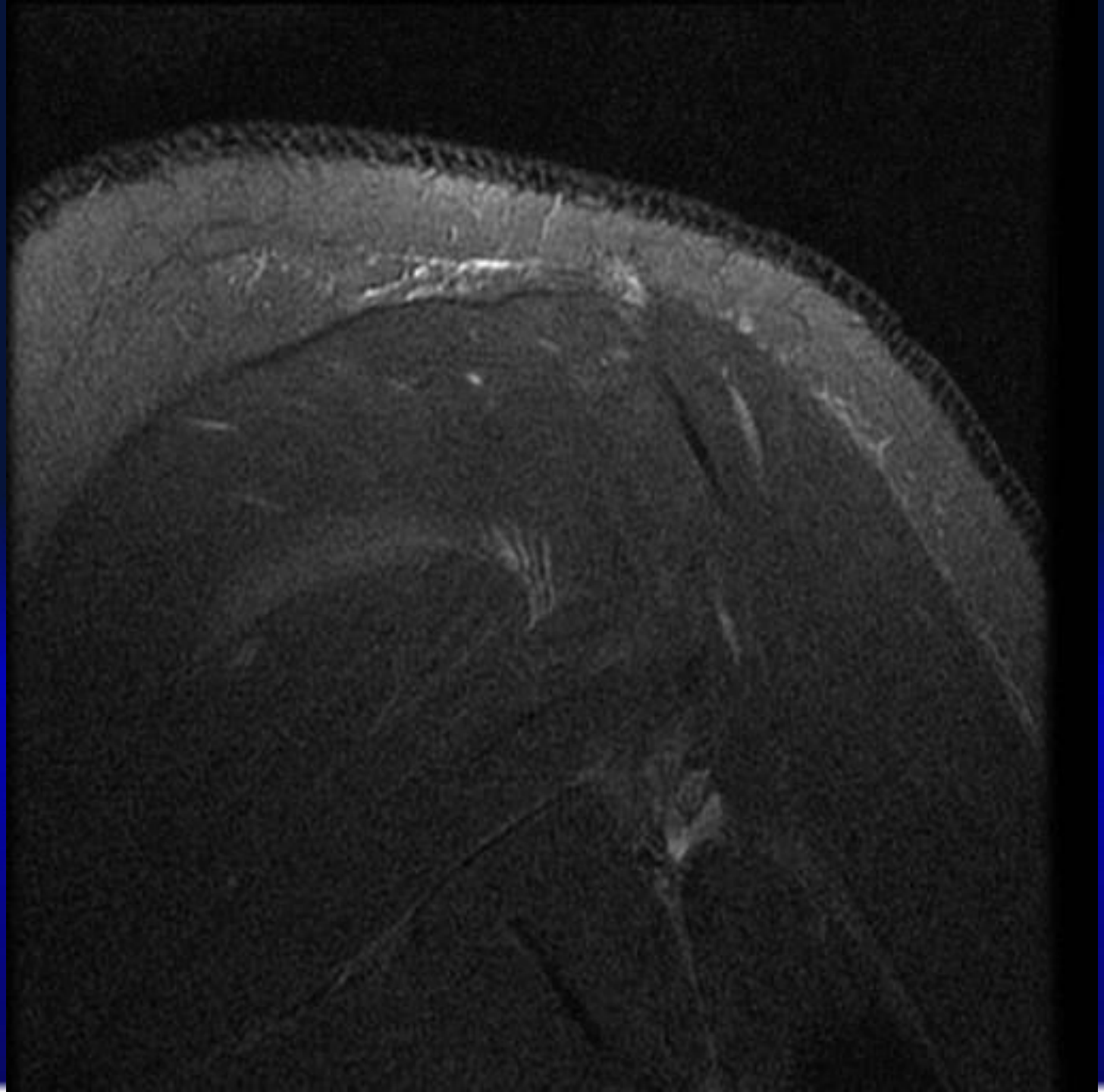


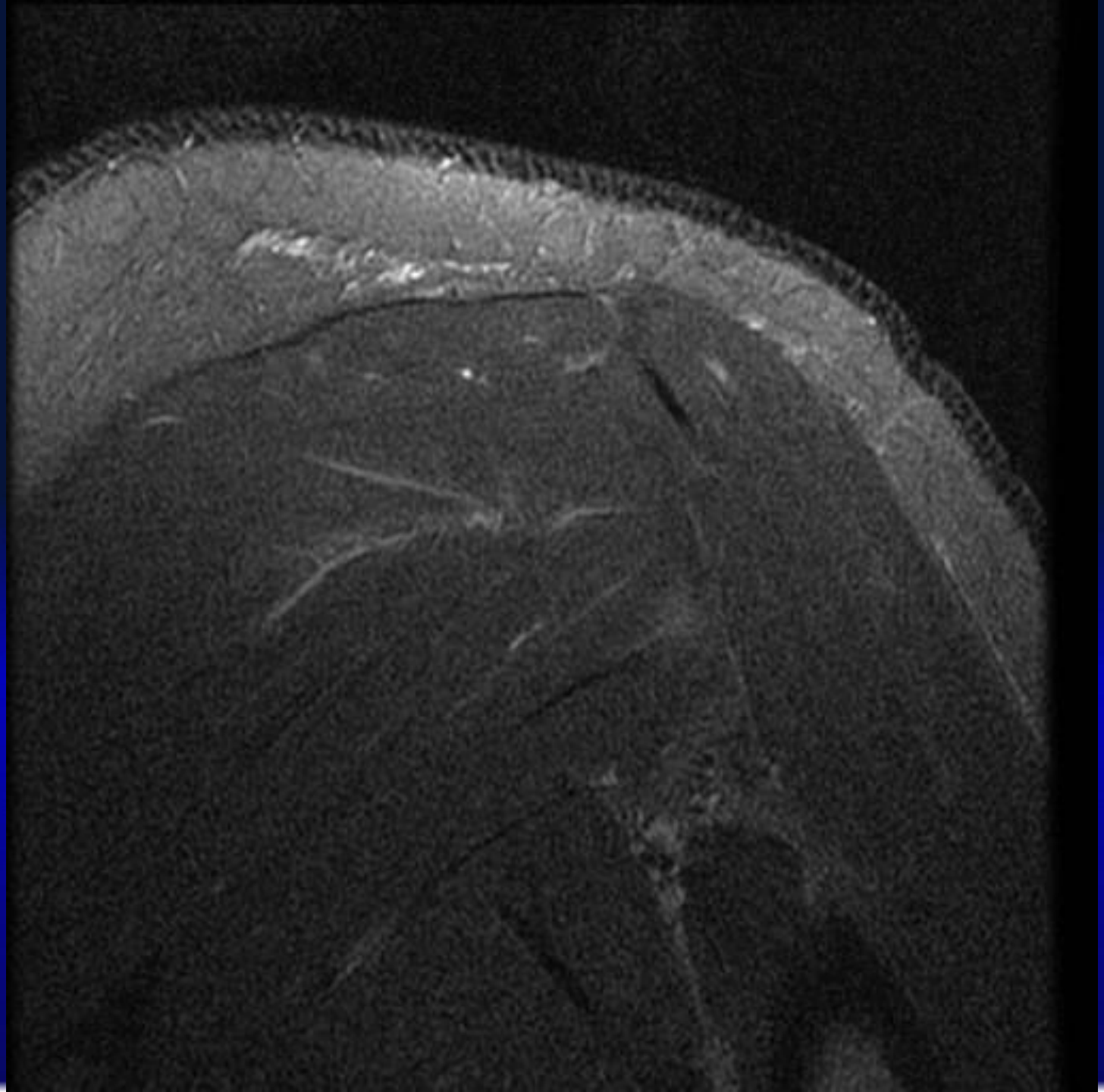


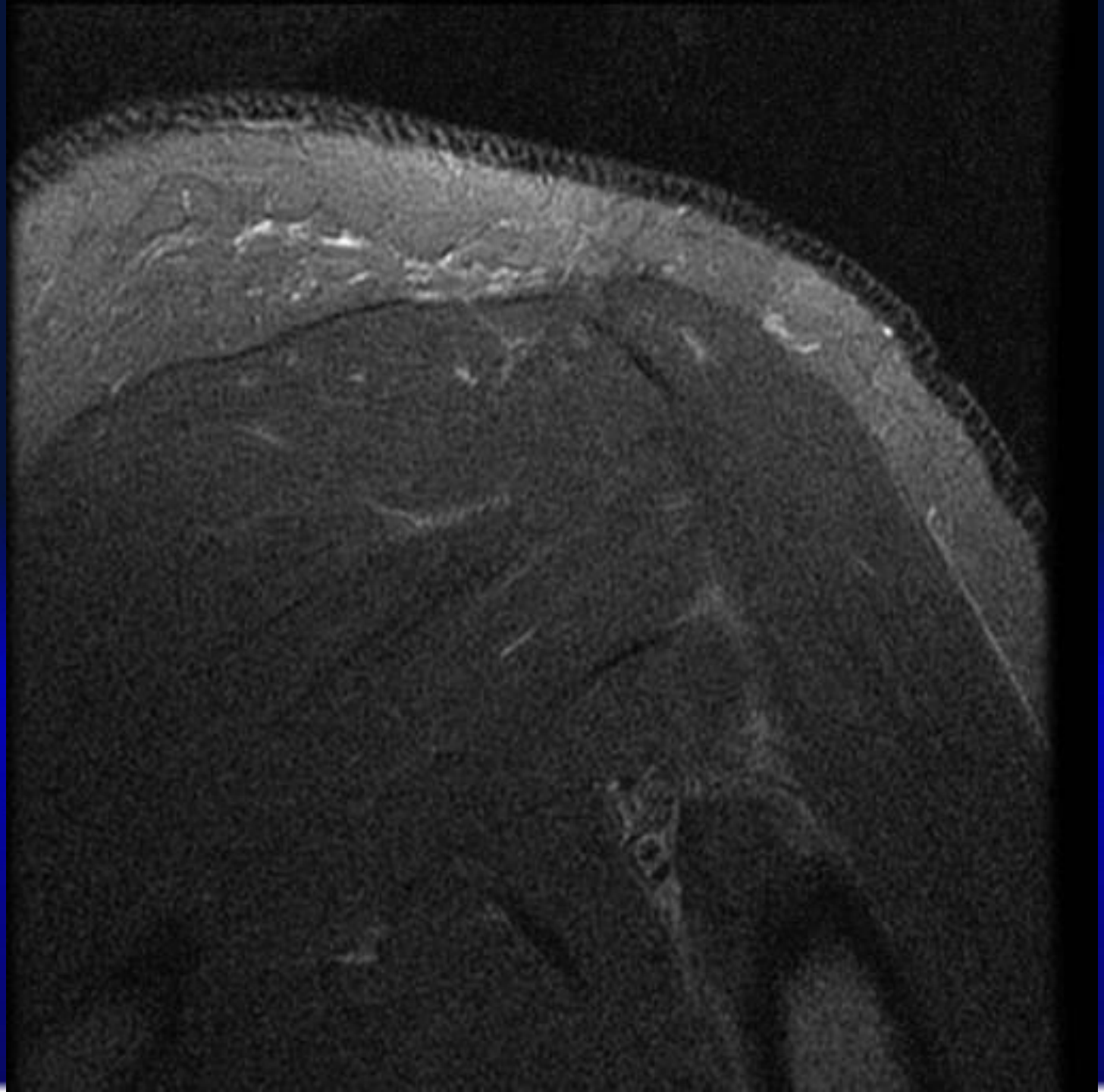


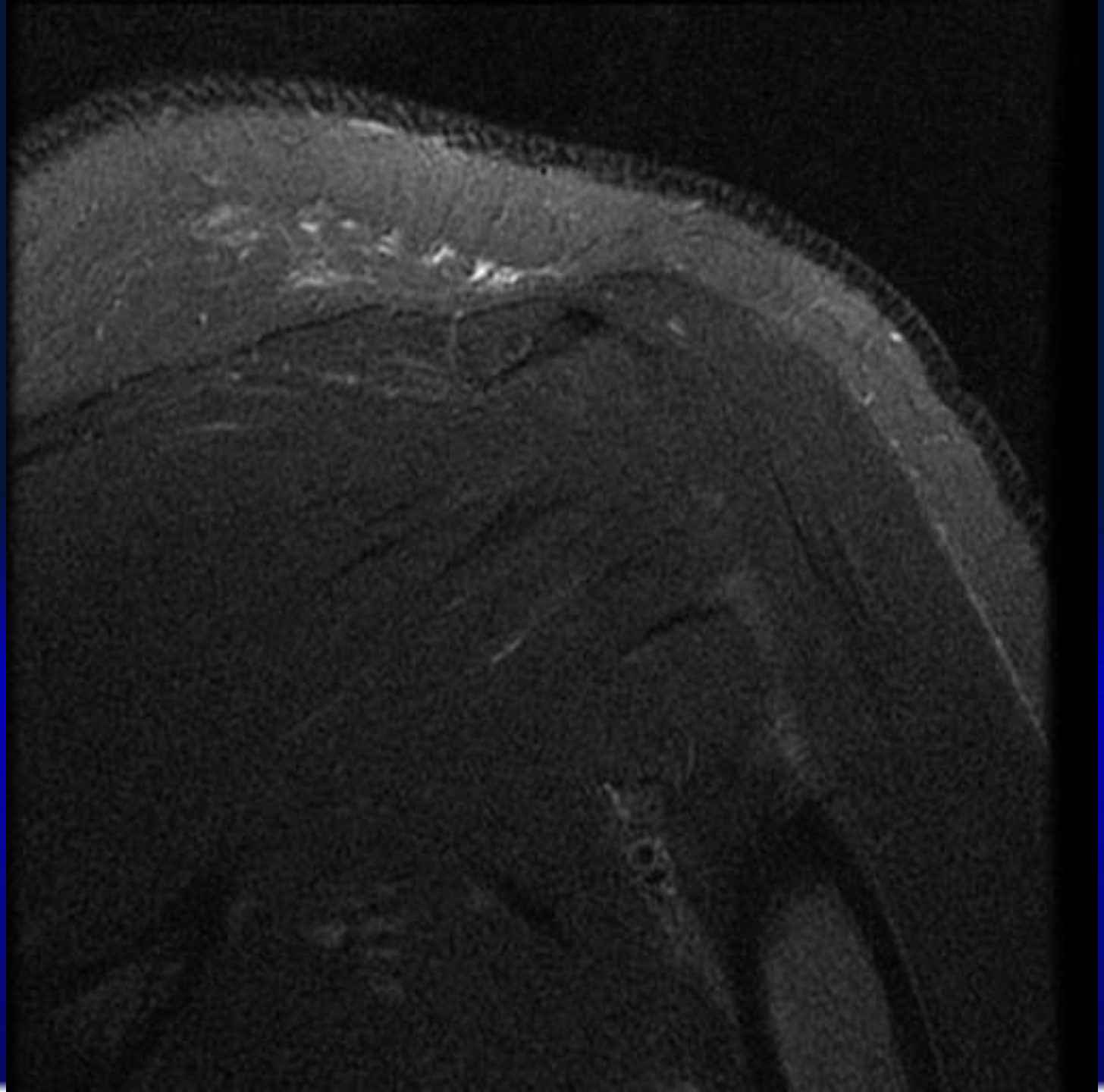


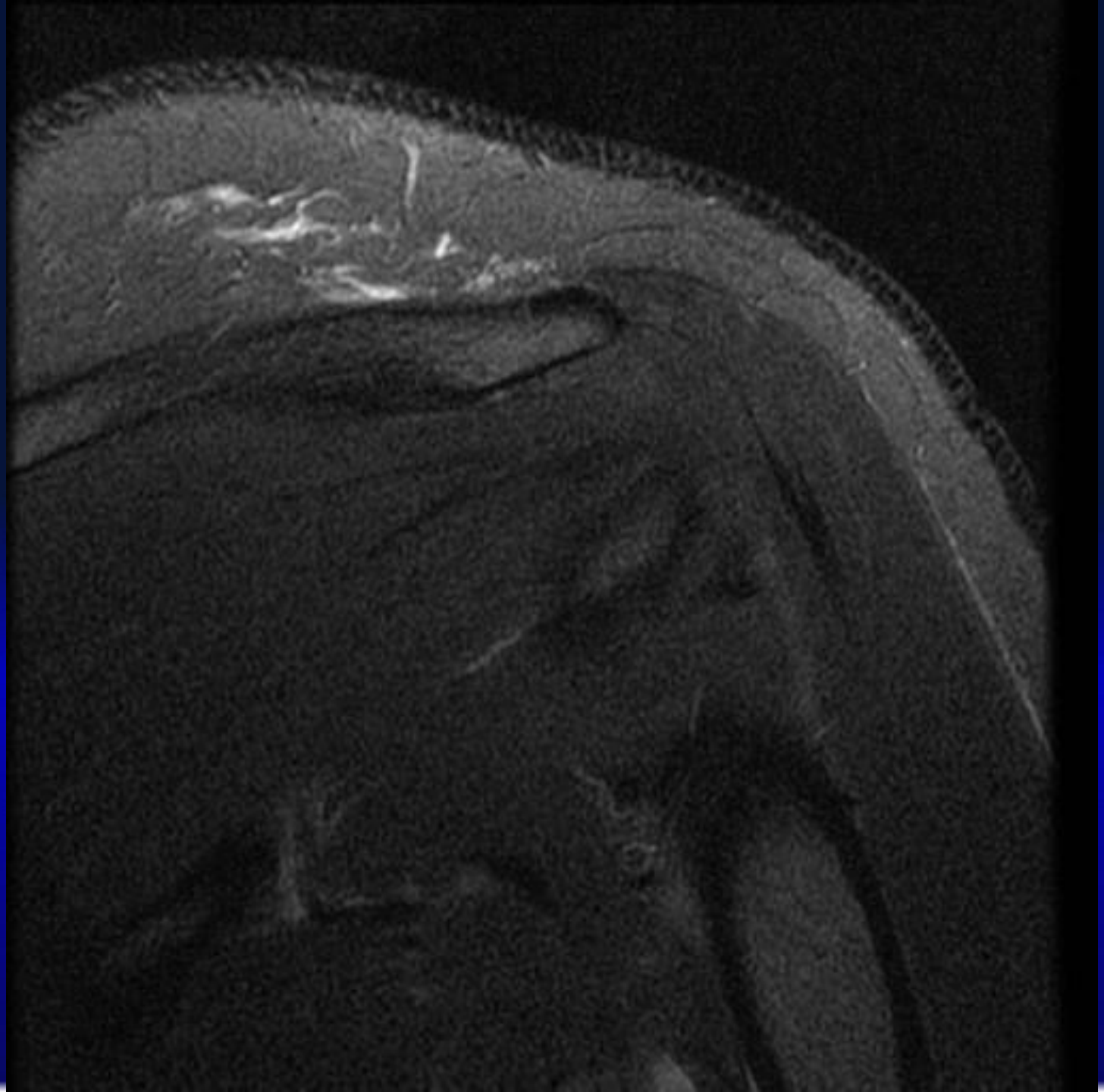


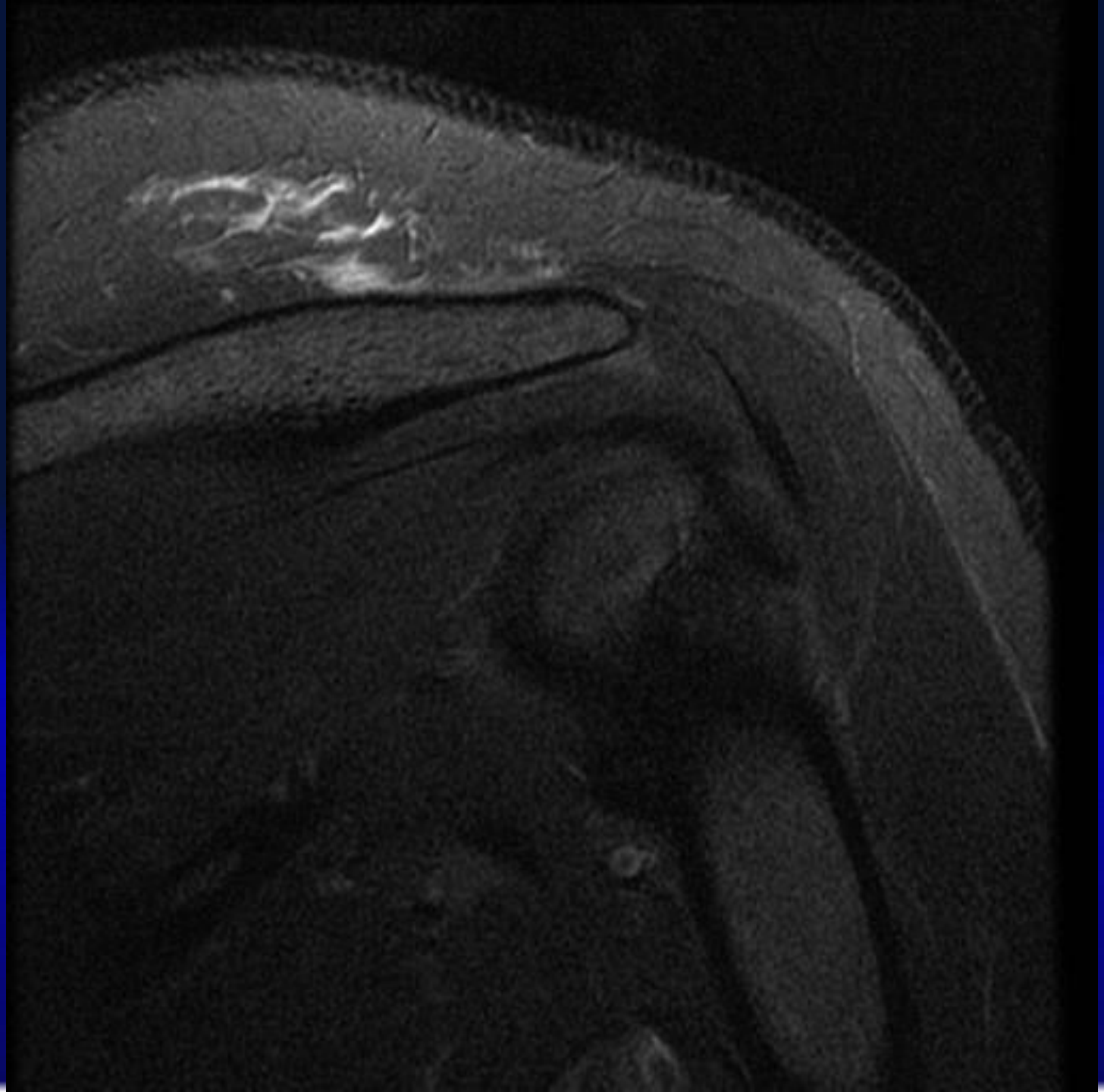


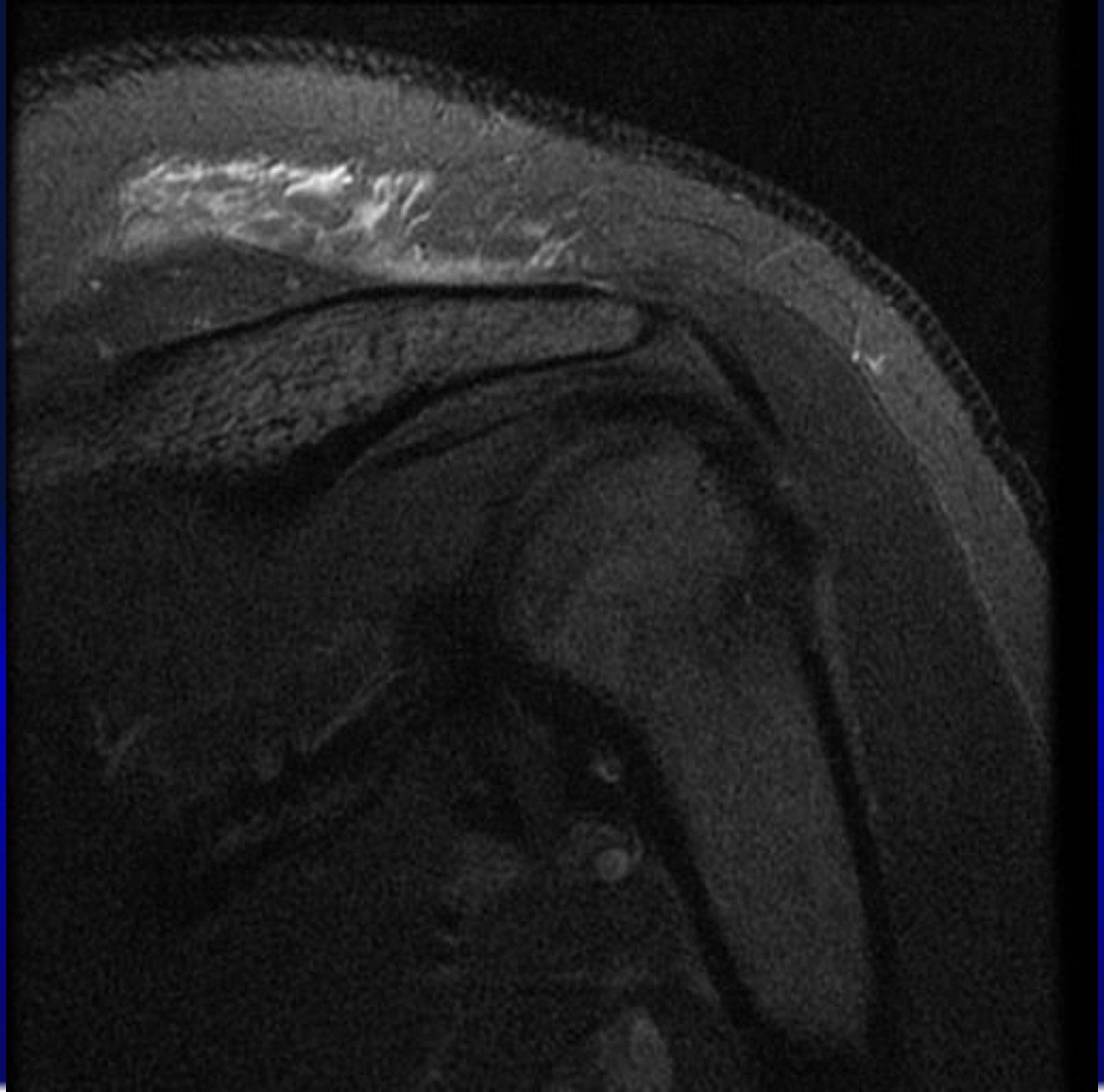


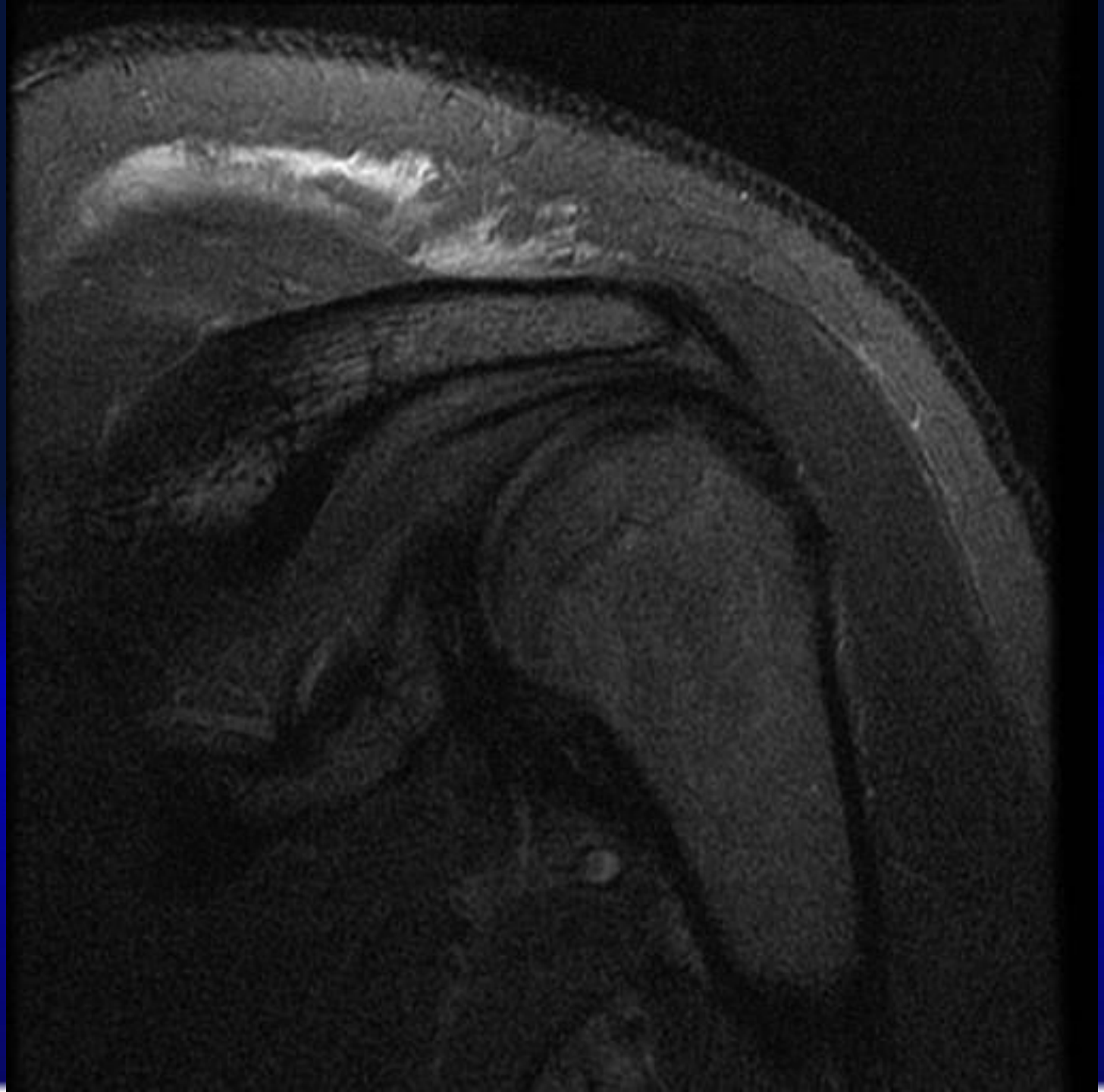


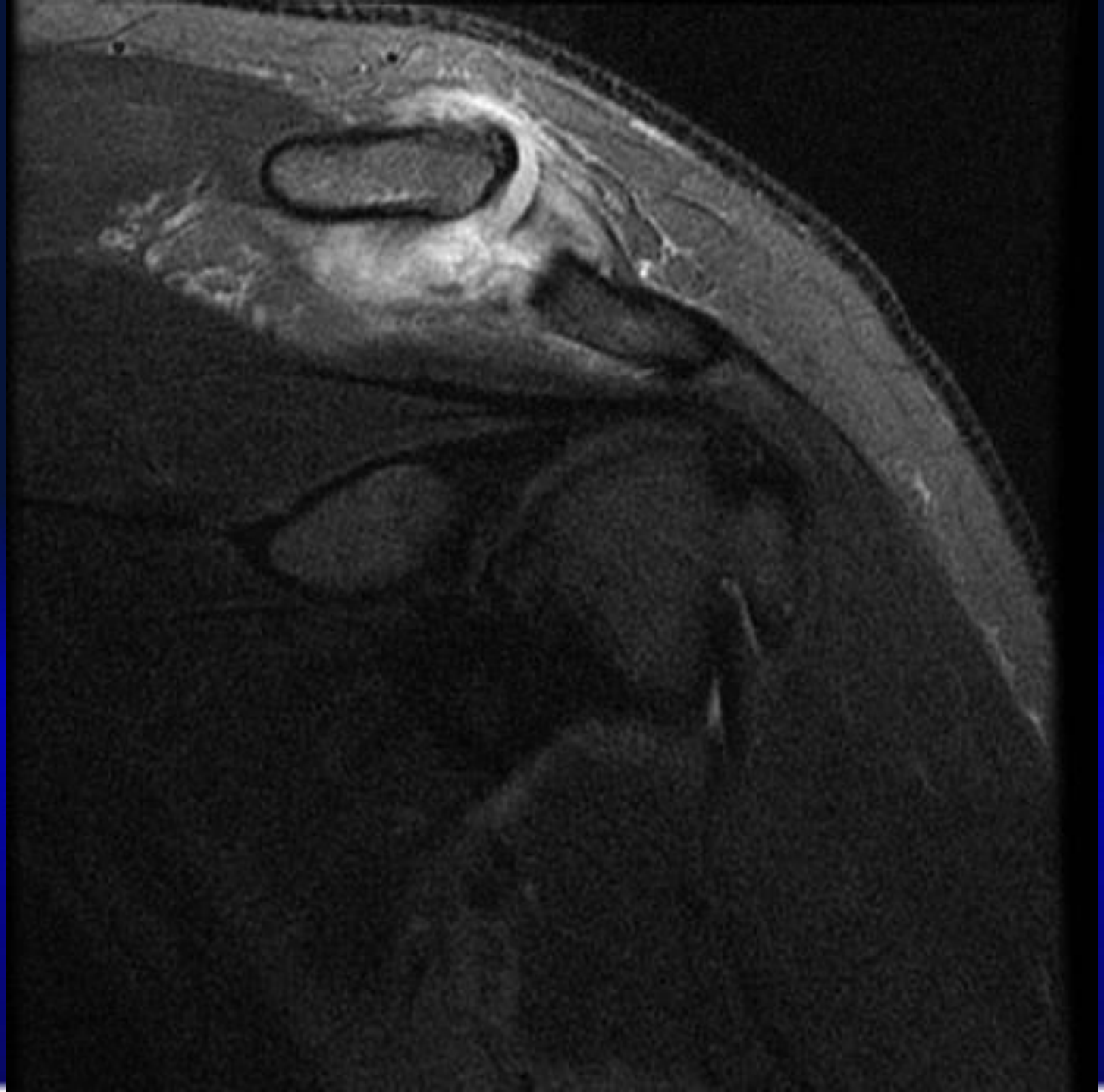


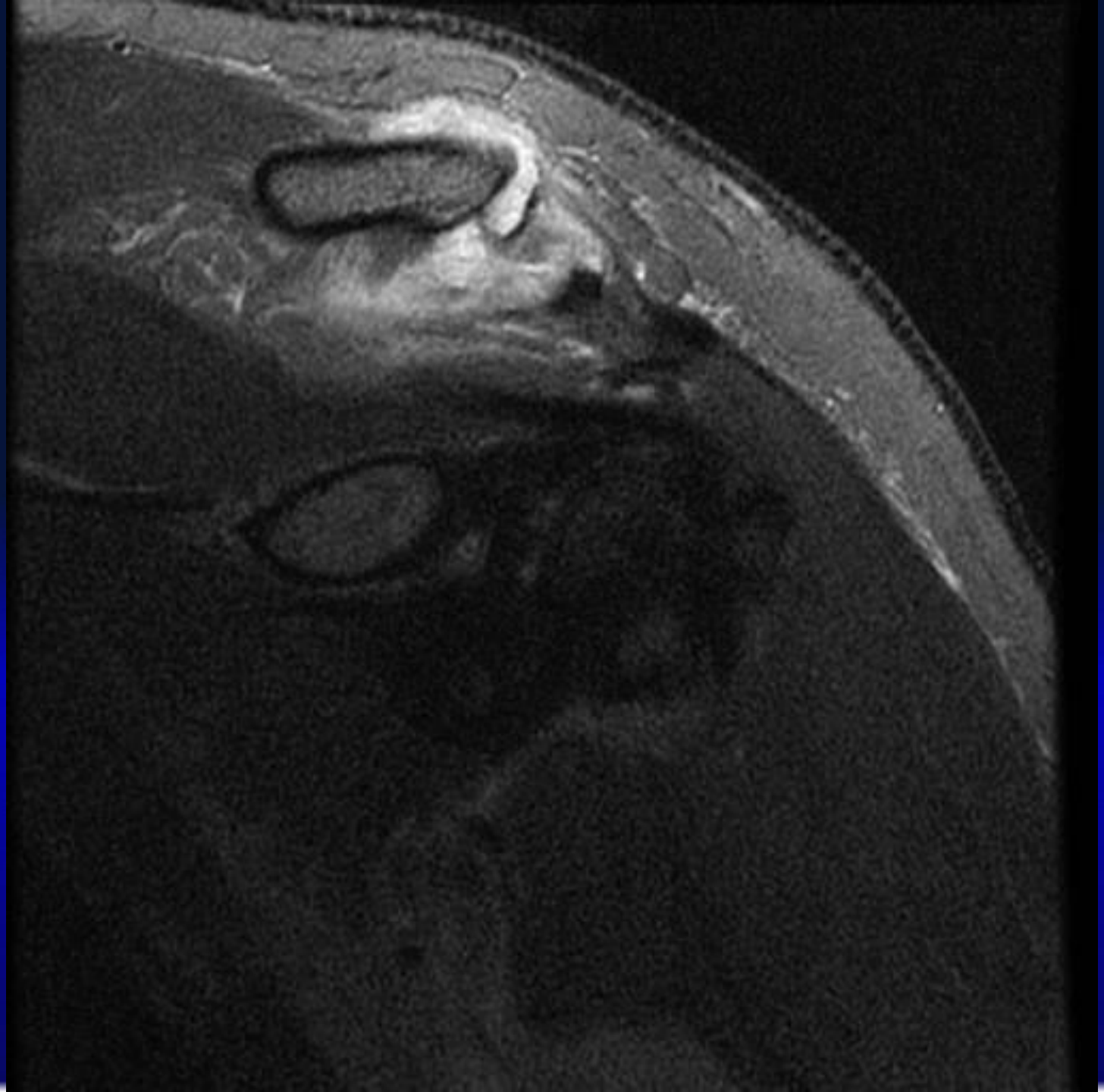


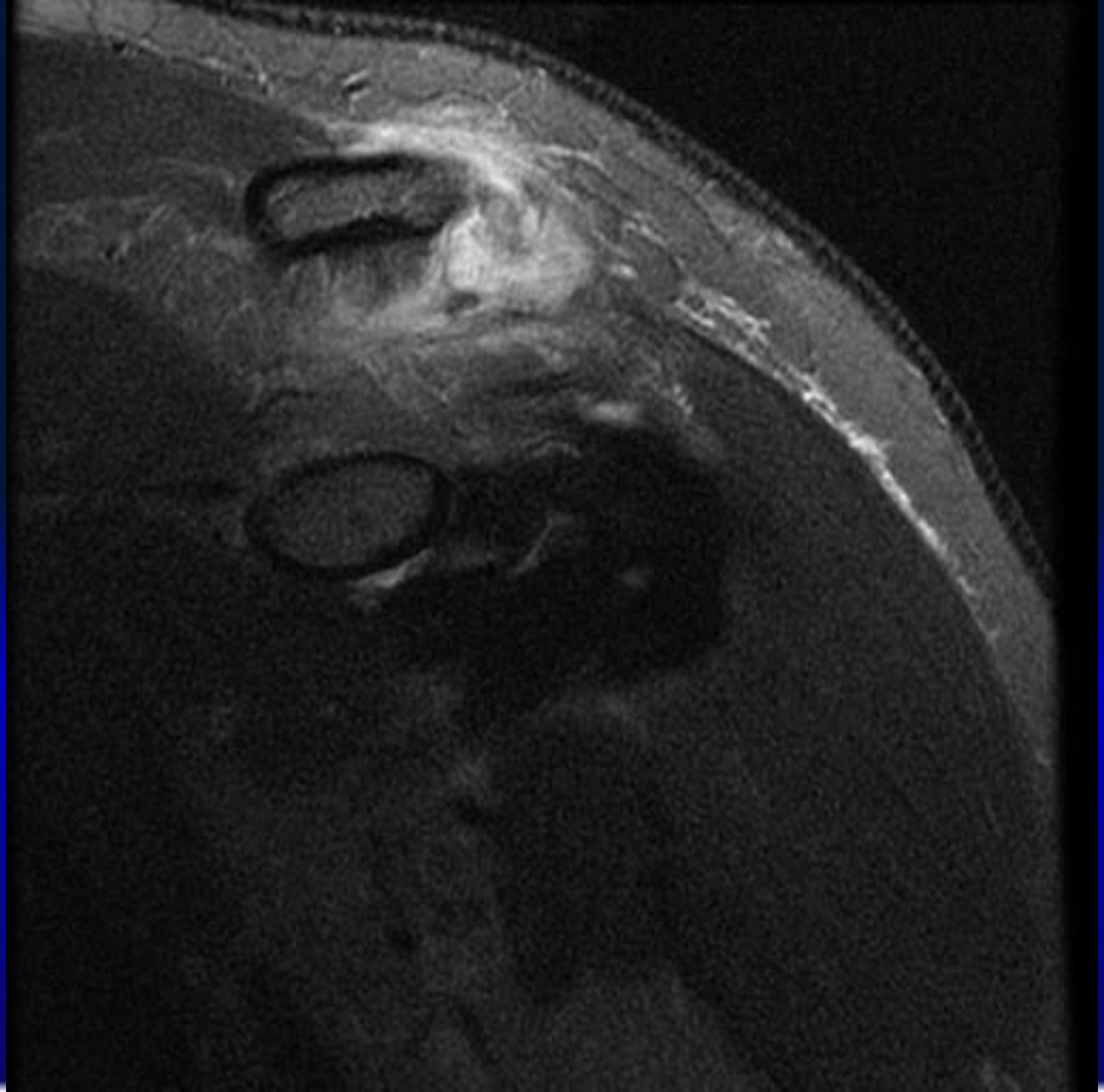










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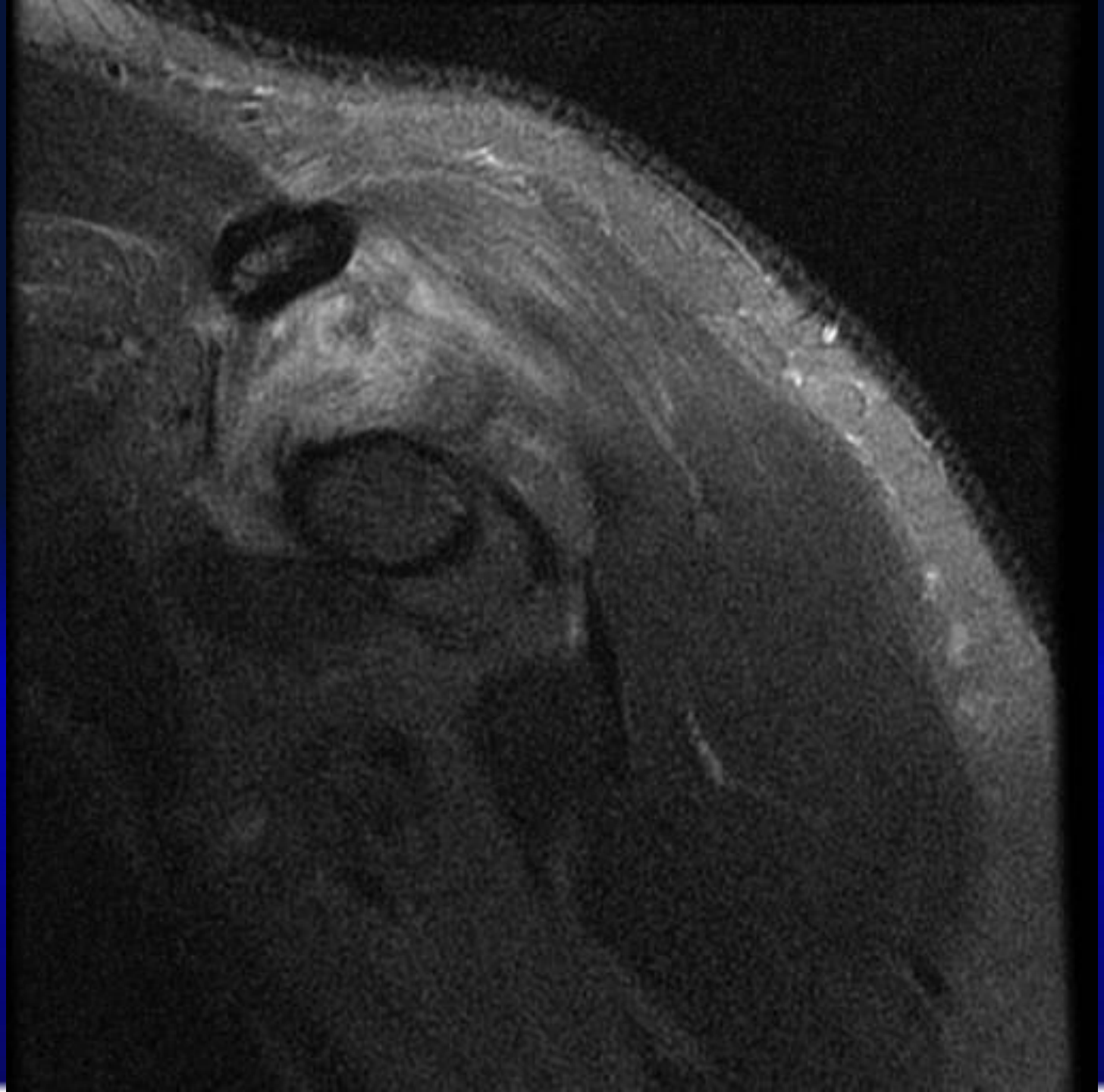
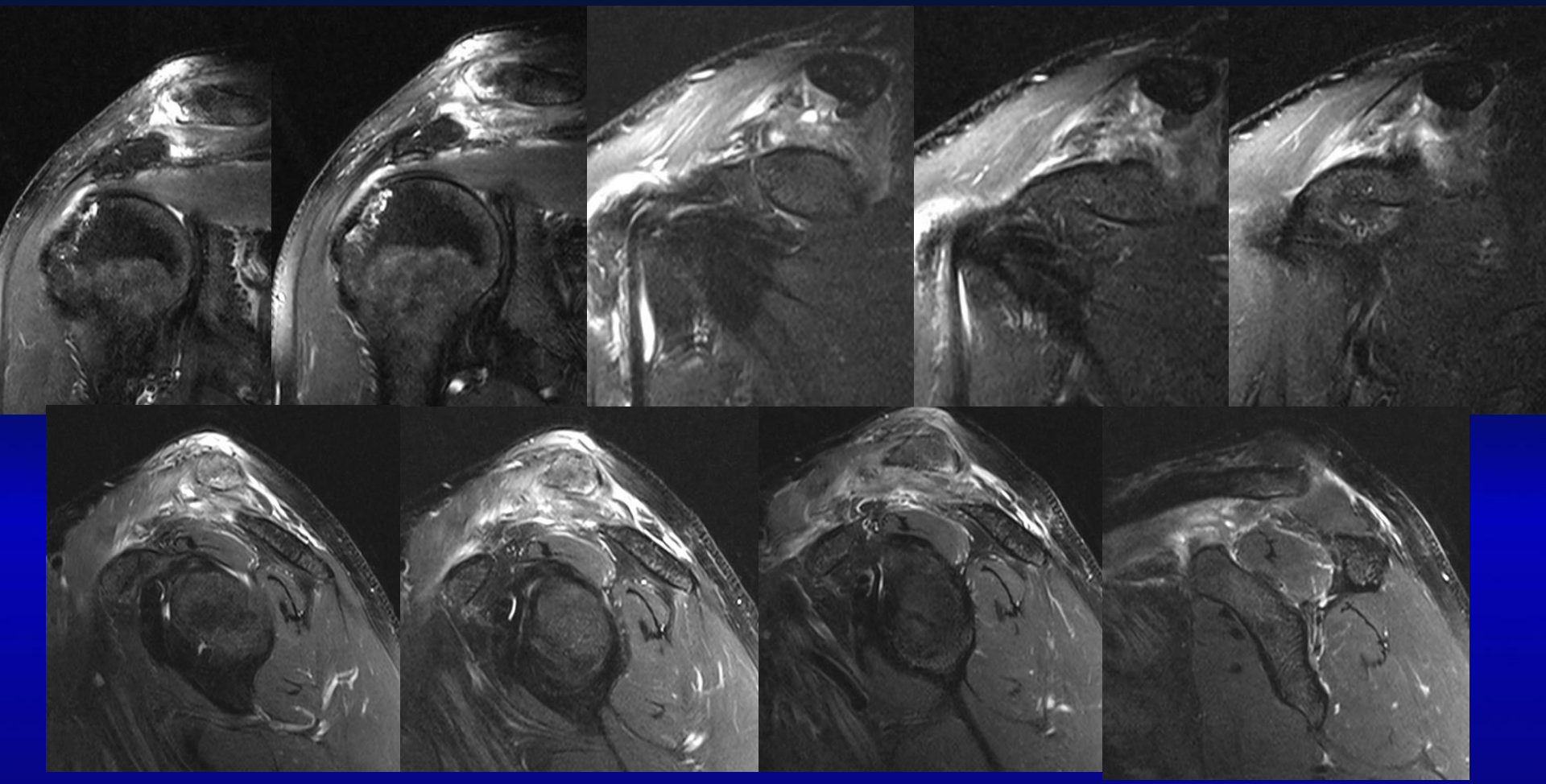
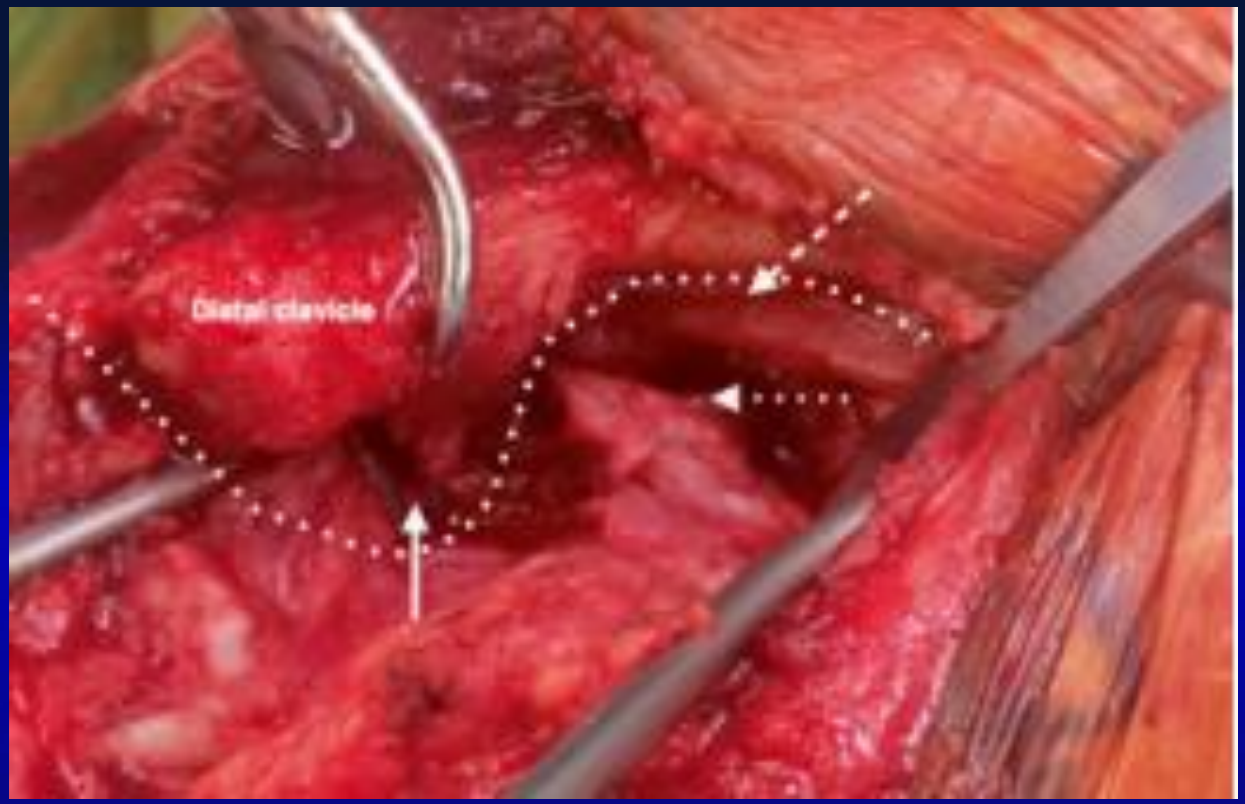


Rockwood: Grade V Injury



UCSD, Courtesy Brady Huang

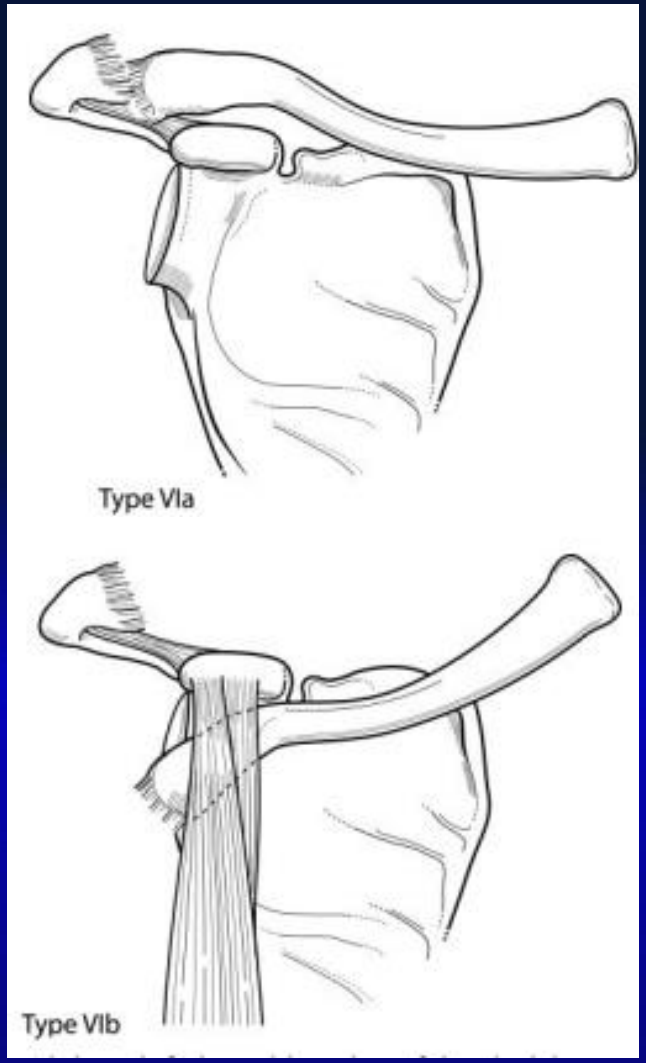


J. Phadnis, G.I Bain. Clavicle Anatomy. Normal Anatomy and Pathology of the Shoulder. 2015

Rockwood: Grade VI Injury

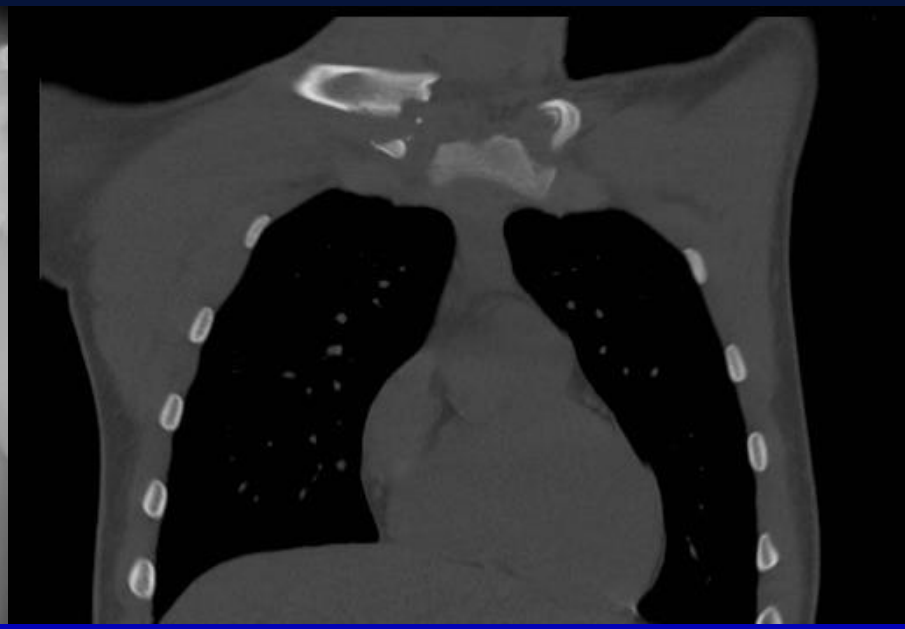
- Superior blow to distal clavicle with humeral hyperabduction and scapular retraction
- AC ligament/capsule – Complete disruption
- CC ligament –Complete disruption
- Deltoid + Trapezius – disrupted from clavicle
- Horizontal and vertical instability at ACJ

- PE
  - Shoulder flattened appearance, prominent acromion, superior coracoid easily palpable
- X-rays
  - Clavicle inferior to acromion(6A) or corocoid (6B), decreased CC distance
- MRI
  - Fluid signal and tear AC,CC ligaments, osseous edema, tearing of trapezius/deltoid from distal clavicle or periosteal sleeve, soft tissue edema or hemorrhage if acute



Alyas et al. Radiographis. 2008. 28(463-479

Rockwood: Grade VI Injury

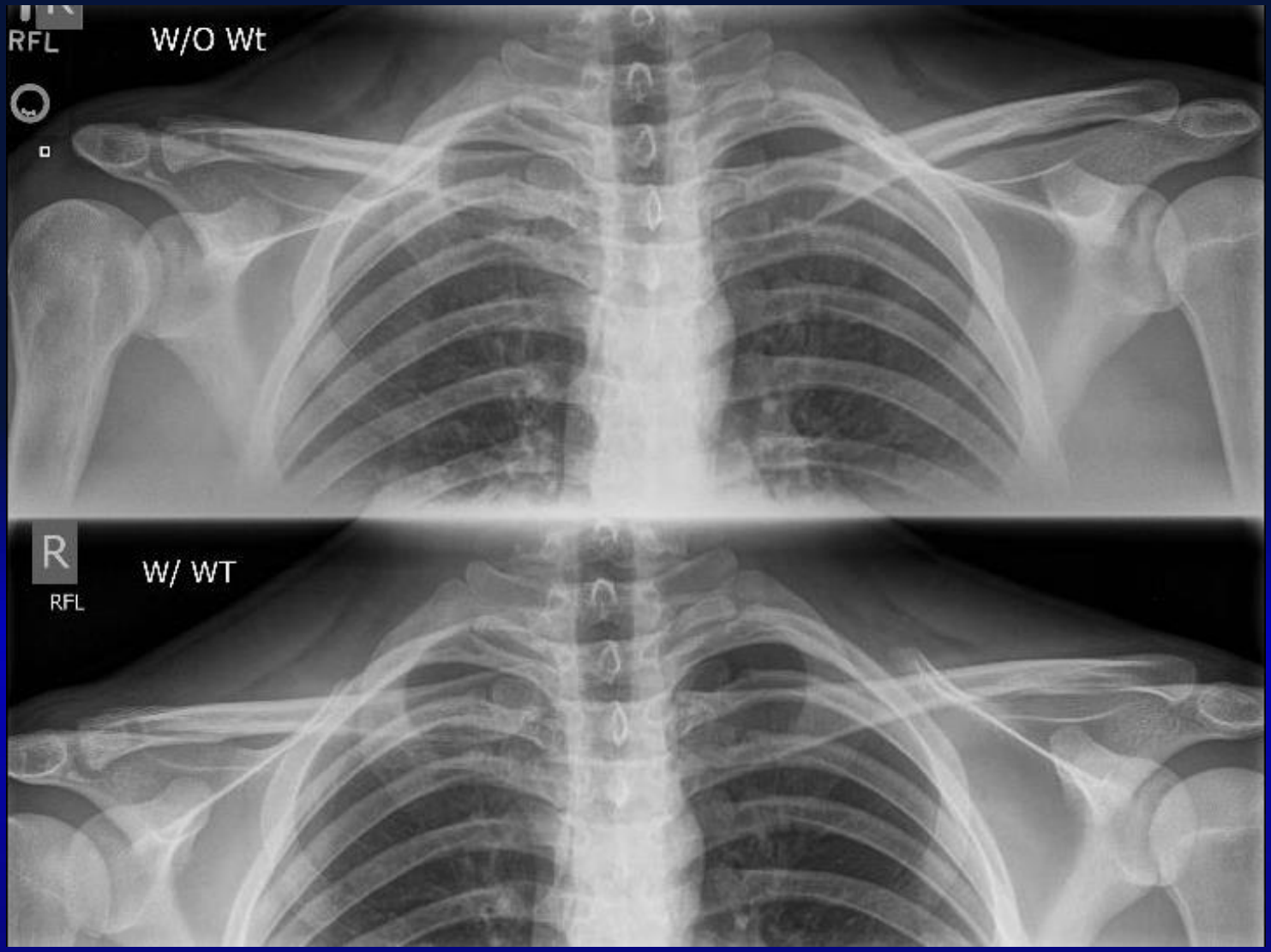


UCSD, Courtesy of Brady Huang

Rockwood: Grade VI Injury

UCSD, Courtesy of Brady Huang

Rockwood: Grade VI Injury



UCSD, Courtesy of Brady Huang


Almost there !!

ACJ: Treatment

- Hippocrates 460 B.C – stated “no significant injury” will result from the ACJ
- Non-operative vs. operative
- Non-operative
  - Grades I-II
    - Analgesia, sling(1-2 weeks)
    - Rehab – Passive ROM,isometric strengthening, progressive strengthening
    - Contact sports or heavy lifting should be avoided for 8-12 weeks
    - Complications
      - Many patients have long term pain,- residual instability, articular cartilage/disk degeneration, osteolysis.
        - Grade I: 36%
        - Grade II 48%
      - Skin tenting leading to local skin necrosis/infection
      - If persistent pain for 3 months – may consider surgery
        - » Mumford procedure +/- subacromial decompression – Success rate 75-90%

Mikek et al. Long-Term Shoulder Function after Type I and II Acromioclavicular Joint Disruption. Am J Sports Med. 2008; 36(11):2147-50

ACJ: Treatment

- Maybe not so benign
  - Mouhsine et al JSES 2003
  - 33 patients Grade I and II injuries treated conservatively
    - 27% required surgery within 36 months (6 distal clavicle excision, 3 Weaver-Dunn)
    - Only 16% patients with no radiographic degenerative changes or osteolysis evident at 6 year follow-up
  - Mikek AJSM 2008
  - 23 patients with Type I and II AC disruption with 10 year follow-up
    - 52% reported occasional symptoms
  - Constant score 70.5 injured vs 86.8 ($P < .001$)
  - UCLA score 24.1 vs 29.2 ($P < .001$)
  - Simple Shoulder Test 9.7 vs 10.9 ($P < .002$)

ACJ: Treatment

- Type III
  - Very controversial if should be nonoperative vs. operative
    - Multiple factors – athlete, dominant arm, time of year in season; manual laborer, level of pain, dysfunction
    - Current literature, should be treated nonsurgically
    - Surgery should only be considered for failed conservative, athletes, livelihood, young patients or higher grade injuries such as floating shoulder or neurovascular injury
  - MacFarland et al - 32 baseball players, relief of pain and nl function in 80% nonoperative, ROM tests – 90% nl ROM nonoperative vs. 92% operative
  - Schlegel et al, NFL Combine Experience 96'- 45 players had ACJ separation, 9 were Grade III
    - All treated non-operatively, 7/8 players were satisfied with outcome
    - No functional disabilities , 50% had loss of bench press/military press strength

A. M. Phillips, C. Smart,. "Acromioclavicular dislocation: conservative or surgical therapy," Clinical Orthopaedics and Related Research, no. 353, pp. 10–17, 1998

Clinical Orthopaedics & Related Research:
August 1998 - Volume 353 - Issue - pp 10-17
Symposium: Controversies in Skeletal Trauma

Acromioclavicular Dislocation: Conservative or Surgical Therapy.

Phillips, A. M. MA, MBBCh*; Smart, C. MBChB**; Groom, A.F.G. MA, MBBS†

Section Editor(s): Rodríguez-Merchán, E. Carlos MD, PhD

Abstract

A literature review was performed to clarify available information which influences decisions whether to advise a young adult patient to undergo surgery for a severely displaced acromioclavicular dislocation. Twenty-four papers were retrieved yielding 1172 patients of whom the mean followup for the 833 surgically treated patients was 43.7 months and not surgically treated was 60.4 months. Of the 24 papers, only five reported surgical and conservative outcomes; two of these papers used prospective randomized methodology and three used nonrandomized methodology. Fourteen papers reported surgical outcome only and five papers reported conservative outcome only. Overall, 88% of surgically treated patients and 87% of nonsurgically treated patients had a satisfactory outcome. Complications most commonly listed were (surgically treated versus nonsurgically treated): need for further surgery (59% versus 6%), infection (6% versus 1%), and deformity (3% versus 37%). Return to activity was no quicker with surgery. Pain was not any more common without surgery. Range of movement was more frequently normal or near normal without surgery (95% versus 86% if surgically treated) and so was strength (92% versus 87%). Meta-analysis of the four studies including data from surgical and conservative therapy showed no significant benefit from surgery. Power studies suggest that to show a statistically significant benefit from surgery, large studies would be required, which, given the relative incidence of these injuries, would probably be multicenter and therefore vulnerable to methodologic difficulties. There does not seem to be any reason to recommend an operative procedure to a patient with a Rockwood et al Type III injury based on the evidence currently available.

Results of Operative and Nonoperative Treatment of Rockwood Types III and V Acromioclavicular Joint Dislocation

A Prospective, Randomized Trial With an 18- to 20-Year Follow-up

Antti Joukainen,*† MD, PhD, Heikki Kröger,†‡ Prof., Lea Niemitukia,§ MD, E. Antero Mäkelä,‖ MD, PhD, and Urho Väätäinen,†¶ MD, PhD

Investigation performed at the Department of Orthopaedics, Traumatology and Hand Surgery, Kuopio University Hospital, Kuopio, Finland

Background: The optimal treatment of acute, complete dislocation of the acromioclavicular joint (ACJ) is still unresolved.

Purpose: To determine the difference between operative and nonoperative treatment in acute Rockwood types III and V ACJ dislocation.

Study Design: Randomized controlled trial; Level of evidence, 2.

Methods: In the operative treatment group, the ACJ was reduced and fixed with 2 transarticular Kirschner wires and ACJ ligament suturing. The Kirschner wires were extracted after 6 weeks. Nonoperatively treated patients received a reduction splint for 4 weeks. At the 18- to 20-year follow-up, the Constant, University of California at Los Angeles Shoulder Rating Scale (UCLA), Larsen, and Simple Shoulder Test (SST) scores were obtained, and clinical and radiographic examinations of both shoulders were performed.

Results: Twenty-five of 35 potential patients were examined at the 18- to 20-year follow-up. There were 11 patients with Rockwood type III and 14 with type V dislocations. Delayed surgical treatment for ACJ was used in 2 patients during follow-up: 1 in the operatively treated group and 1 in the nonoperatively treated group. Clinically, ACJs were statistically significantly less prominent or unstable in the operative group than in the nonoperative group (normal/prominent/unstable: 9/4/3 and 0/6/3, respectively; $P = .02$) and in the operative type III ($P = .03$) but not type V dislocation groups. In operatively and nonoperatively treated patients, the mean Constant scores were 83 and 85, UCLA scores 25 and 27, Larsen scores 11 and 11, and SST scores 11 and 12 at follow-up, respectively. There were no statistically significant differences in type III and type V dislocations. In the radiographic analysis, the ACJ was wider in the nonoperative than the operative group (8.3 vs 3.4 mm; $P = .004$), and in the type V dislocations (nonoperative vs operative: 8.5 vs 2.4 mm; $P = .007$). There was no statistically significant difference between study groups in the elevation of the lateral end of the clavicle. Both groups showed equal levels of radiologic signs of ACJ osteoarthritis and calcification of the coracoclavicular ligaments.

Conclusion: Nonoperative treatment was shown to produce more prominent or unstable and radiographically wider ACJs than was operative treatment, but clinical results were equally good in the study groups at 18- to 20-year follow-up. Both treatment methods showed statistically significant radiographic elevations of the lateral clavicle when compared with a noninjured ACJ.

Journal of Orthopaedic Trauma:
November 2015 - Volume 29 - Issue 11 - p 479–487
doi: 10.1097/BOT.0000000000000437
Original Article

Multicenter Randomized Clinical Trial of Nonoperative Versus Operative Treatment of Acute Acromio-Clavicular Joint Dislocation

The Canadian Orthopaedic Trauma Society

SDC

Abstract

Objective: To perform a randomized clinical trial of operative versus nonoperative treatment of acute acromio-clavicular (AC) joint dislocations using modern surgical fixation and both patient-based and surgeon-based outcome measures to determine which treatment method was superior.

Design: Prospective, randomized.

Setting: Multicenter.

Patients/Participants: Eight-three patients with acute (<28 days from the time of injury) complete (grade III, IV, and V) dislocations of the AC joint.

Intervention: Patients were randomized to operative repair with hook plate fixation versus nonoperative treatment (operative repair, 40; nonoperative treatment, 43).

Main Outcome Measurements: Disabilities of the Arm, Shoulder and Hand (DASH) score at 1 year after injury. Assessment also included a complete clinical assessment, evaluation of the constant score, and a radiographic evaluation at 6 weeks, and at 3, 6, 12, and 24 months.

Results: There were no demographic differences between the 2 groups, and the mechanisms of injury were similar between the 2 groups. The DASH scores (a disability score, lower score is better) were significantly better in the nonoperative group at 6 weeks (operative, 45; nonoperative, 31; $P = 0.014$) and 3 months (operative, 29; nonoperative, 16; $P = 0.005$). There were no significant differences between the groups at 6 months (operative, 14; nonoperative, 12; $P = 0.442$), 1 year (operative, 9; nonoperative, 9; $P = 0.997$), or 2 years (operative, 5; nonoperative, 6; $P = 0.439$) after injury. Constant scores were similar (better scores in the nonoperative group at 6 weeks, 3 months, and 6 months; $P = 0.0001$; and no difference thereafter). Although radiographic results were better in the operative group, the reoperation rate was significantly lower in the nonoperative group ($P < 0.05$).

Conclusions: Although hook plate fixation resulted in superior radiographic alignment, it was not clinically superior to nonoperative treatment of acute complete dislocations of the AC joint. The nonoperative group had better early scores, although both groups improved from a significant level of initial disability to a good or excellent result (mean DASH score, 5–6; mean constant score, 91–95) at 2 years. At present, there is no clear evidence that operative treatment with the currently available hook plate improves short-term outcome for complete AC joint dislocations.

Level of Evidence: Therapeutic Level I. See Instructions for Authors for a complete description of levels of evidence.

ACJ: Treatment

- Grade III-VI – operative management
- Goals
  - Accurate reduction of ACJ, by correcting inferior scapular sag, together with anteroposterior translation of ACJ
  - Ligamentous repair for joint stability
  - Reduction and ligament reconstruction/repair must have immediate stability to prevent acute re-displacement
  - Rigid implants used for temporary ligamentous stabilization must be removed once repair has consolidated, or they will eventually break, loosen or produce stiffness in the shoulder

ACJ: Treatment

- Acute or delayed repair ?
  - Reduction is more accurate in acute stages < 2 week post injury
  - > 2 weeks, native ligaments may be difficult to identify/repair

Orthopaedic Surgery
Archives of Orthopaedic and Trauma Surgery
October 2008, Volume 128, Issue 10, pp 1153-1157

First online: 22 November 2007

Acromioclavicular dislocation Rockwood III–V: results of early versus delayed surgical treatment

Olaf Rolf ✉ , Andreas Hann von Weyhern, Alexander Ewers, Thomas Dirk Boehm, Frank Gohlke

Results

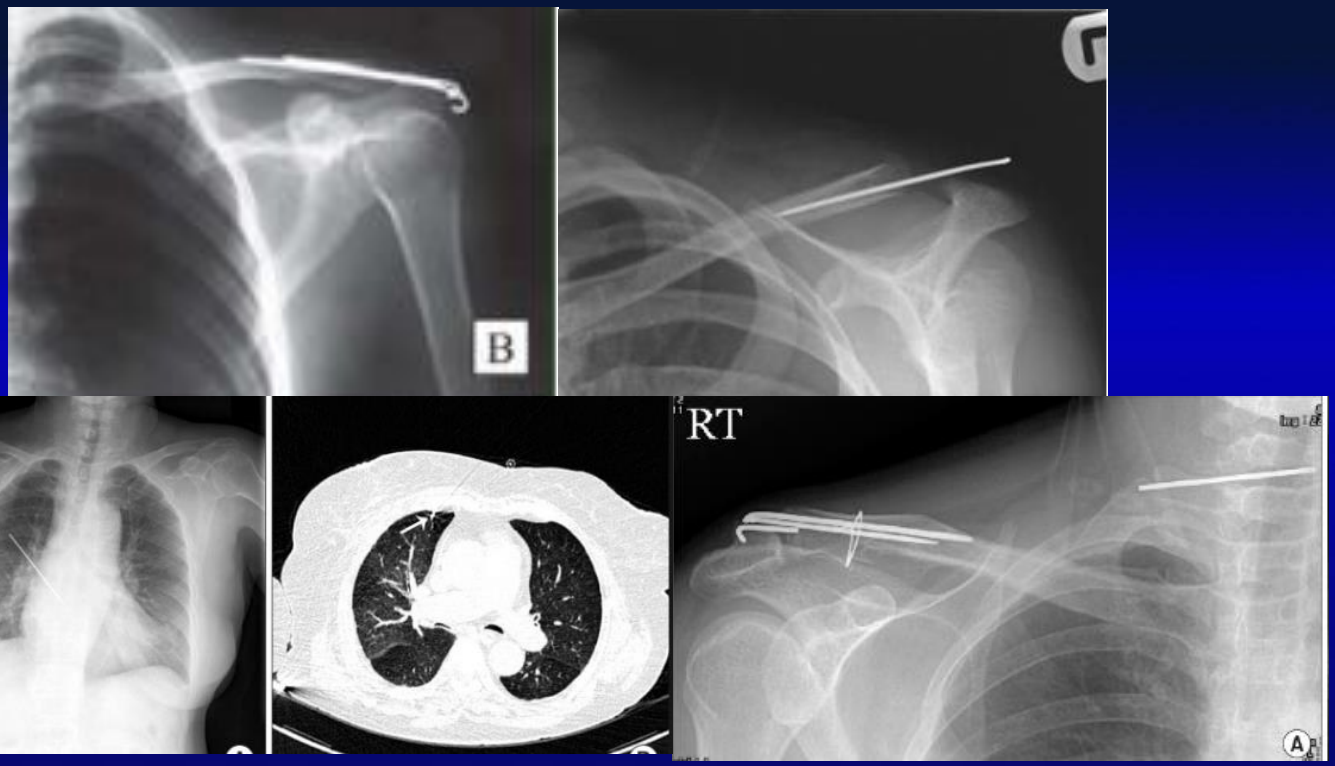
A comparison of the overall results revealed a statistically significant better outcome in the early repair group, regarding the Constant Score, the degree of acromioclavicularjoint-reduction, numbers of complications and patient`s satisfaction.

ACJ: Treatment

- 3 basic categories of surgical technique
  - 1) ACJ Fixation
  - 2) CC Fixation
  - 3) Ligament reconstruction

Historical Methods of fixation

- ACJ Fixation
  - Percutaneous pinning
    - Usually with limited arthrotomy
    - K-wires, Knowles pins, Simmons pins
    - Require 2nd surgery for removal
    - Complications- migration, construct fracture

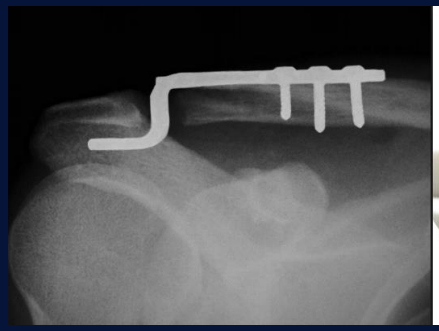


Gella S. J. Orthopaedics. 2008;5(1)e13

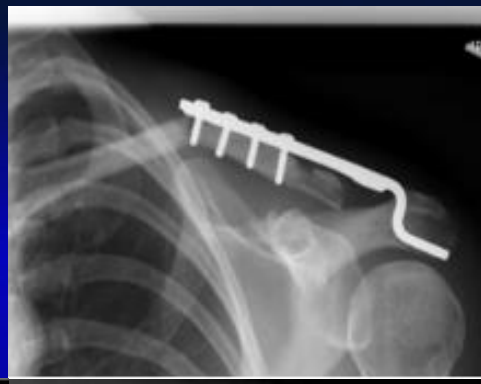
Treatment: Grade III-VI Injuries - Acute

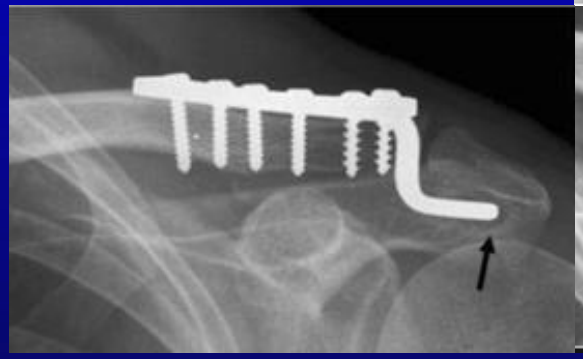
Hook plate

- - Maintains 3 plane articulation
- - Requires removal surgery
  - if not, eventual malreduction of ACJ
- -Complications -
  - plate bending, SA impingement, fracture, osteolysis/unhooking plate, infection, ? Long term OA

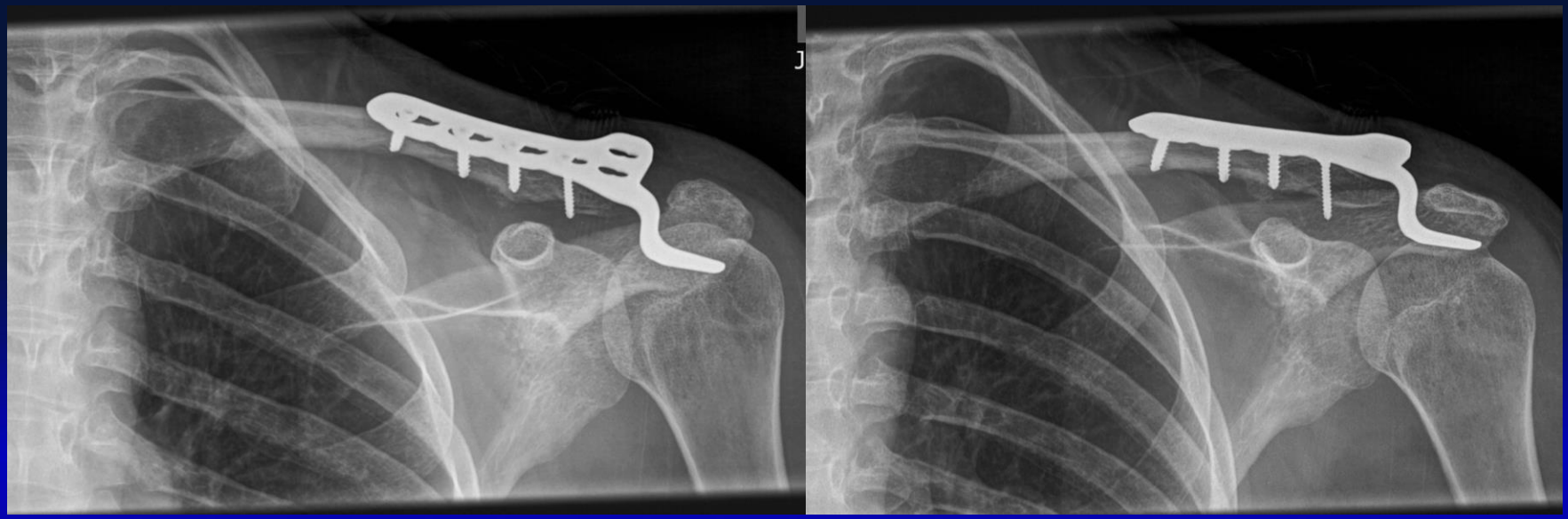


Synthes hook plate





Hsin-u- Lin et al. J. Orthopedic Surgery and Research. Feb 2014.



UCSD, Courtesy of Brady Huang

- Steinbacher et al – Retrospective review of 19 young athletes, with Grade III injuries s/p hook plate fixation and removed at 16 weeks w/o CC ligament reconstruction,mean f/u 4.2 years. Full ROM achieved by 5 weeks, sport resumed 6 months, no complications. Conclusion – Hook plates allow fast return to sport with good functional outcome.
- (*Clavicular hook plate for grade-III acromioclavicular dislocation. Journal of Orthopaedic Surgery 2014;22(3):329-32)*

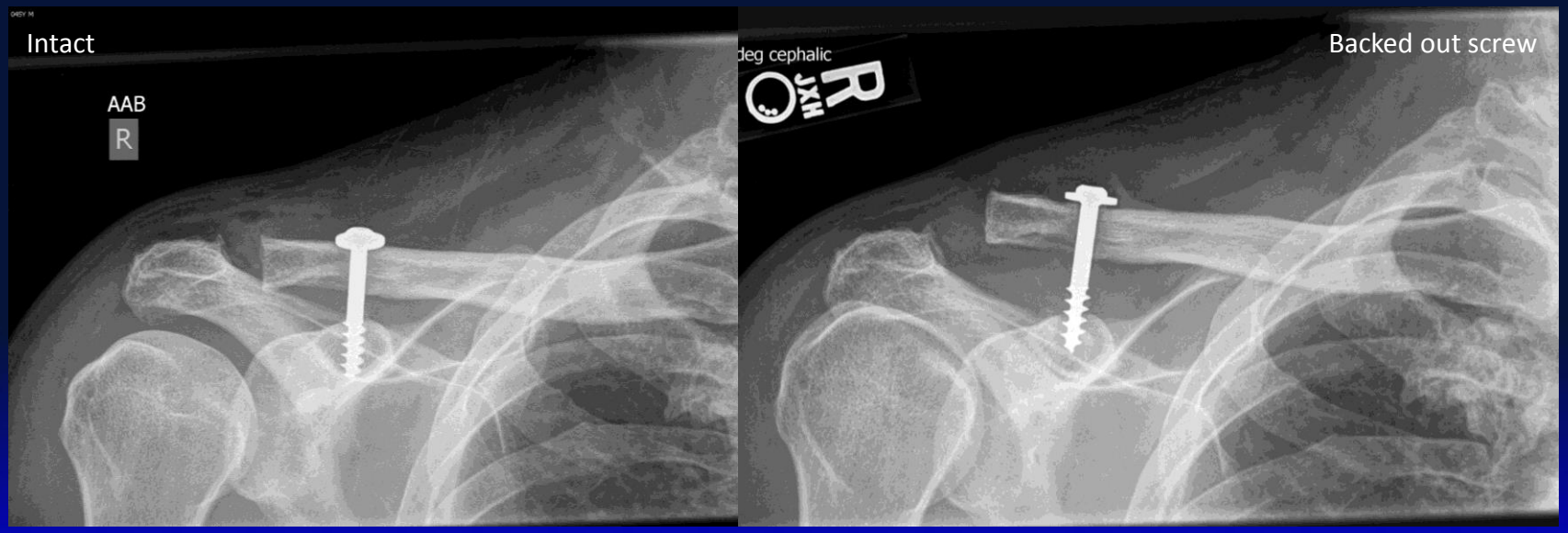
- Kumar et al – Prospective study 33 military soldiers w/ Grade 3 injuries s/p hook plate, w/o CC ligament reconstruction. Hook plate removed 14-22 weeks. All patients returned to pre-injury state, w/o complications. Conclusion – Hook plate provides good Grade 3 ACJ fixation w/o requiring ligamentous surgery and may provide beneficial for high functional patients, such as military personnel.
- (*Hook plate fixation for acute acromioclavicular dislocations without coracoclavicular ligament reconstruction: a functional outcome study in military personnel. Strategies in Trauma and Limb Reconstruction. August 2015, Volume 10, Issue 2, pp 79-85*

Treatment: Grade III-VI Injuries - Acute

Bosworth 1941

- Bosworth screw
- Percutaneously placed – single threaded screw between clavicle and coracoid , without CC ligament repair
  - Need for adequate bone purchase; needs removal after 8 wks
  - Complications – coracoid fracture, osteolysis or screw breakage
  - Skin infection and irritation

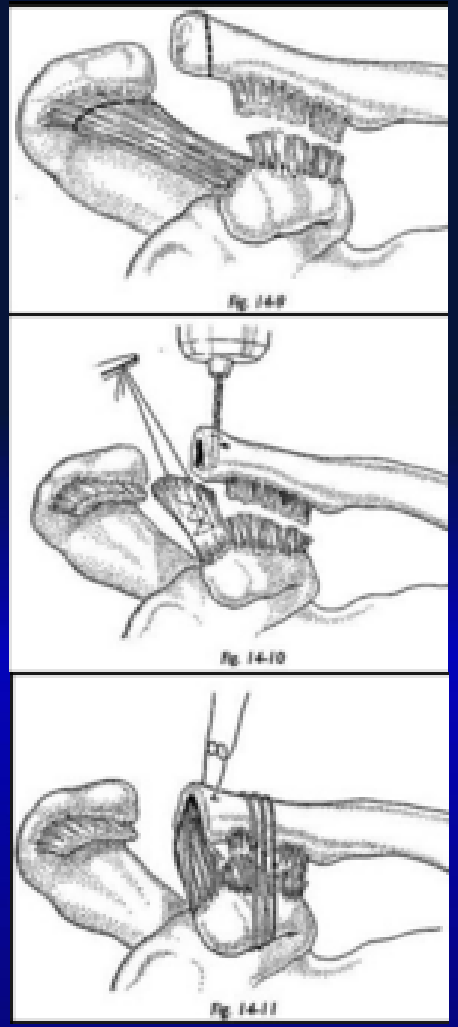
Cambridgeortho.com



UCSD, Courtesy of Brady Huang

CC Fixation: Grade III-VI Injuries – Acute/Chronic

- Weaver-Dunn Procedure - 1972
  - Acute & chronic Grade III-VI
  - Open or arthroscopic
  - Acromial attachment of Coracoacromial ligament(CA) is detached w/wo acromial bone chip
  - 1 cm of distal clavicle is resected
  - CA ligament with suture pulled into holes and intramedullary canal + sutured
  - 30% strength and 10% stiffness of native CC
  - Modifications - Suture/cerclage or gracilis/semitendinosis around clavicle + coracoid – further stabilization
  - Complications
    - Anterior instability(10-25%), loss of reduction(3-6%),

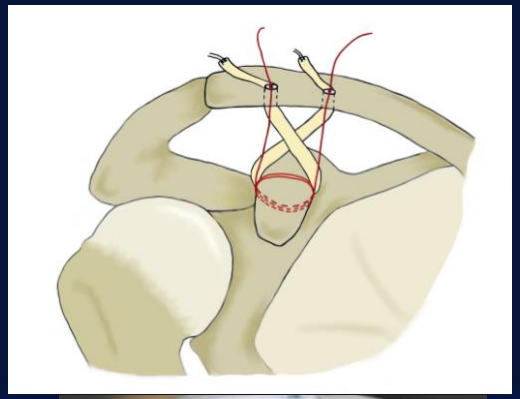


J.A. Fraser-Moodie, N.L Shortt, C.M Robinson. Injuries to the Acromioclavicular joint. JBJS. 2008; 90-B

UCSD

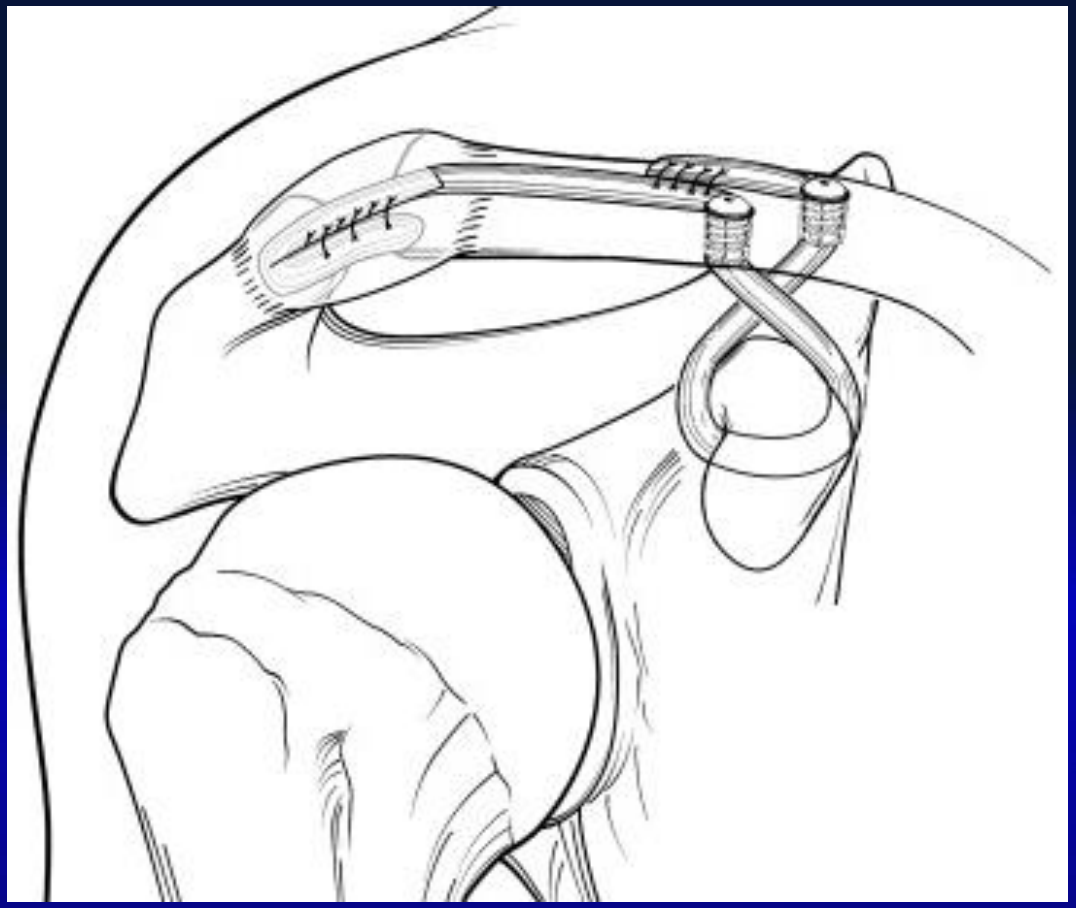
Anatomic Coracoclavicular Ligament Reconstruction (ACCR)

- Tendon auto/allograft of semitendinosis, gracilis or anterior tibial tendon
- Optional stablization with Dacron, Mersilene tape, suture, polydiaxonone bioabs suture
- 3 Techniques
  - Coracoid loop
  - Coracoid tunnel
  - Tendon loop-back
  - Surgery drawbacks – extensive soft tissue dissection
  - Complications
    - Mal-reduction, Erosions/stress fx of clavicle/coracoid, graft failure, vascular injury
    - Instability at AC joint



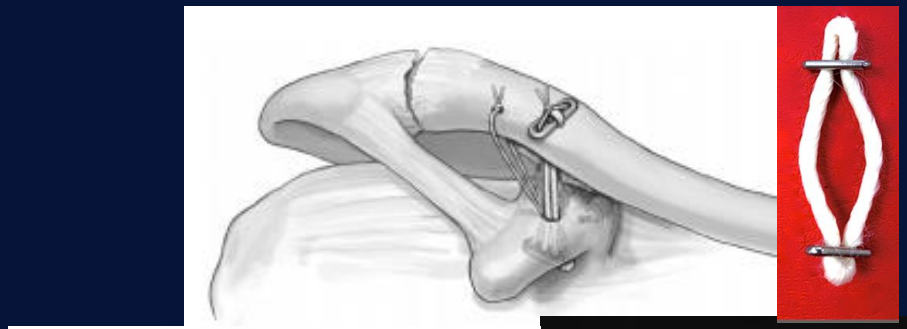
Arthrex.com

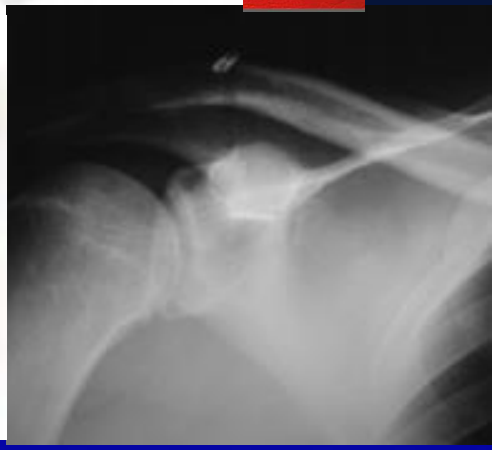
Anatomic Coracoclavicular + Acromioclavicular Ligament Reconstruction (ACCR)



Newer methods of ACJ fixation

- Endobutton technique
- Endobutton with graft
- Tightrope system
  - Advantages
    - Single suture
    - Strength/stiffness 40% > native CC lig
    - Emulate normal course of CC lig
    - Less invasive





Struhl et al. Techniques in Shoulder and Elbow surgery. 2007

The American Journal of Sports Medicine

A Biomechanical Evaluation of an Anatomical Coracoclavicular Ligament Reconstruction

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Methods: Forty-two fresh-frozen cadaveric shoulders (72.8 ± 13.4 years) were randomly assigned to 3 groups: arthroscopic reconstruction, anatomical coracoclavicular reconstruction, and a modified Weaver-Dunn procedure. Bone mineral density was obtained on all specimens. Specimens were tested to 70 N in 3 directions, anterior, posterior, and superior, comparing the intact to the reconstructed states. Superior cyclic loading at 70 N for 3000 cycles was then performed at a rate of 1 Hz, followed by a load to failure test (120 mm/min) to simulate physiologic states at the acromioclavicular joint.

Results: In comparison to the intact state, the modified Weaver-Dunn procedure had significantly ($P < .05$) greater laxity than the anatomical coracoclavicular reconstruction or the arthroscopic reconstruction. There were no significant differences in bone mineral density (g/cm^2), load to failure, superior migration over 3000 cycles, or superior displacement. The anatomical coracoclavicular reconstruction had significantly less ($P < .05$) anterior and posterior translation than the modified Weaver-Dunn procedure. The arthroscopic reconstruction yielded significantly less anterior displacement ($P < .05$) than the modified Weaver-Dunn procedure.

Conclusion: The anatomical coracoclavicular reconstruction has less anterior and posterior translation and more closely approximates the intact state, restoring function of the acromioclavicular and coracoclavicular ligaments.

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Semitendinosus Tendon Graft Versus a Modified Weaver-Dunn Procedure for Acromioclavicular Joint Reconstruction in Chronic Cases

A Prospective Comparative Study

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Results The mean American Shoulder and Elbow Surgeons shoulder score improved from 74 ± 7 points preoperatively to 86 ± 8 points postoperatively in the Weaver-Dunn group, and from 74 ± 4 points to 96 ± 5 points in the semitendinosus tendon group ($P < .001$ for both techniques). The mean Constant score improved from 70 ± 8 points to 81 ± 8 points in the Weaver-Dunn group, and from 71 ± 5 points to 93 ± 7 points in the semitendinosus tendon group ($P < .001$). The results in the semitendinosus tendon group were significantly better than in the Weaver-Dunn group ($P < .001$). The radiologic measurements showed a mean coracoclavicular distance of 12.3 ± 4 mm in the Weaver-Dunn group increasing to 14.9 ± 6 mm under stress loading, compared with 11.4 ± 3 mm increasing to 11.8 ± 3 mm under stress in the semitendinosus tendon group. The difference during stress loading was statistically significant ($P = .027$). In the semitendinosus tendon group, horizontal displacement of the lateral clavicle end could be reduced in all cases with type IV dislocation.

Conclusion Semitendinosus tendon graft for coracoclavicular ligament reconstruction resulted in significantly superior clinical and radiologic outcomes compared to the modified Weaver-Dunn procedure.

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SHOULDER

Simultaneous anatomic reconstruction of the acromioclavicular and coracoclavicular ligaments using a single tendon graft

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Results Following coracoid cerclage reconstruction, total anterior–posterior translation was significantly greater than intact (10.0 ± 5.7 mm; $p = 0.008$). Following single tendon acromioclavicular–coracoclavicular reconstruction, there was no significant difference in anterior–posterior translation compared to intact (−1.6 ± 2.2 mm; n.s.). The coracoid cerclage technique demonstrated significantly greater anterior–posterior translation than the single tendon acromioclavicular–coracoclavicular technique ($p = 0.007$). Both techniques restored superior–inferior translation to the intact condition (n.s.). Ultimate load, deformation at ultimate load, and energy absorbed at ultimate load were significantly greater after acromioclavicular–coracoclavicular reconstruction than after coracoid cerclage reconstruction ($p < 0.05$).

Conclusions This novel single tendon anatomic acromioclavicular–coracoclavicular reconstruction provided greater stability and stronger load to failure characteristics than the isolated coracoid cerclage reconstruction. A simultaneous acromioclavicular–coracoclavicular reconstruction technique using a single free tendon graft provided anatomic reconstruction of the conoid, trapezoid, and superior and inferior acromioclavicular ligaments and may reduce postoperative subluxation.

Summary

- ACJ injuries are common, especially in contact sports such as football, rugby and hockey
- As radiologists, our primary role is to describe imaging findings to aid clinicians in classifying ACJ injuries under the Rockwood classification.
- Grade I and II ACJ injuries should be treated conservatively and can be expected to have good functional outcomes.
- Type III ACJ injury– toss up ? Initially, nonoperative; surgical if young, athlete, overhead worker, significant instability/pain
- Grade IV-VI – uncommon, but should be treated surgically, though newer evidence showing conservative treatment may be an option
- The optimal surgical approach has not been established, but anatomical ACL/CCL repair have shown signs of superiority.

Thank You

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