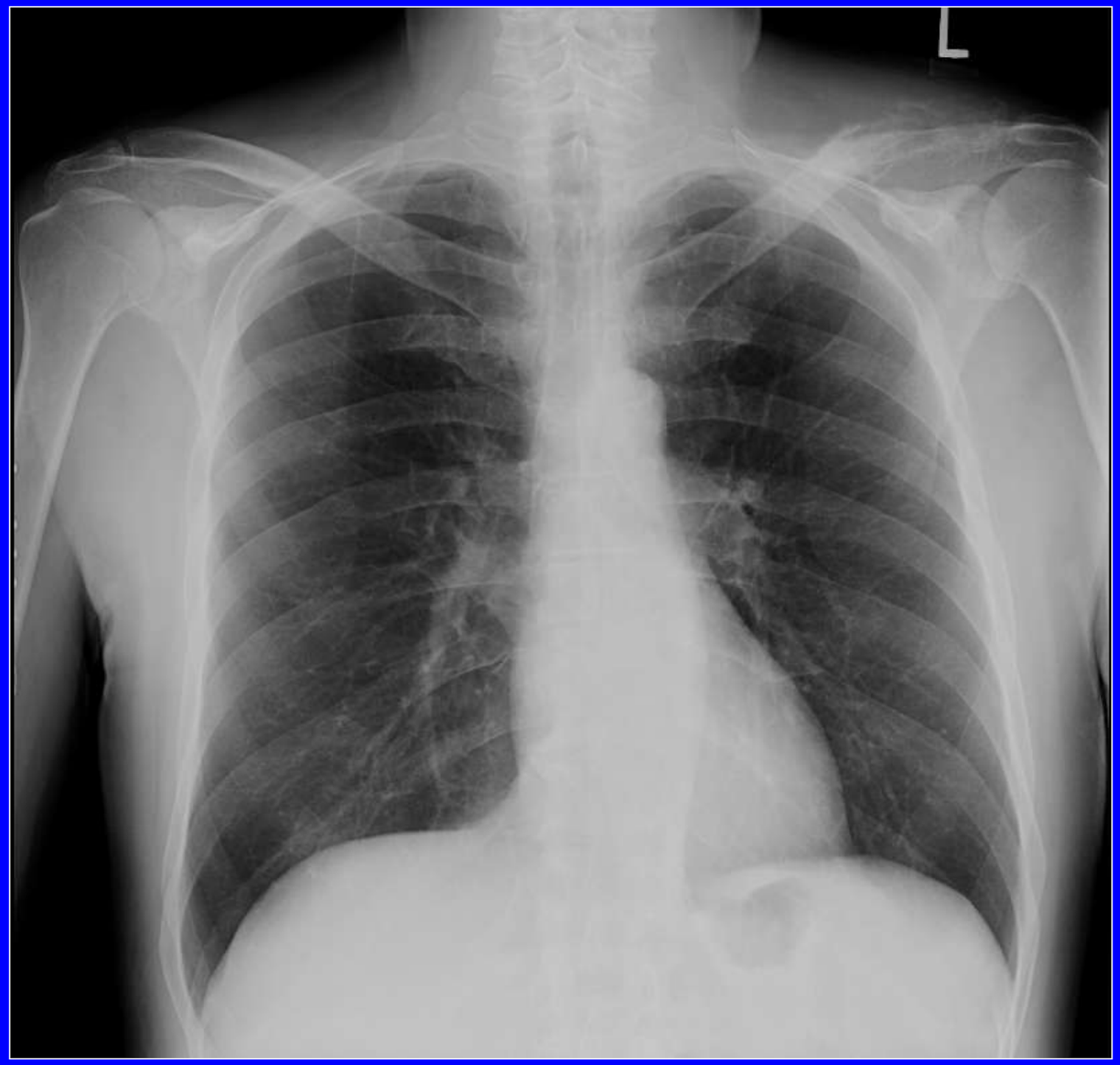
Acromioclavicular Joint: Anatomy, Biomechanics and Pathology

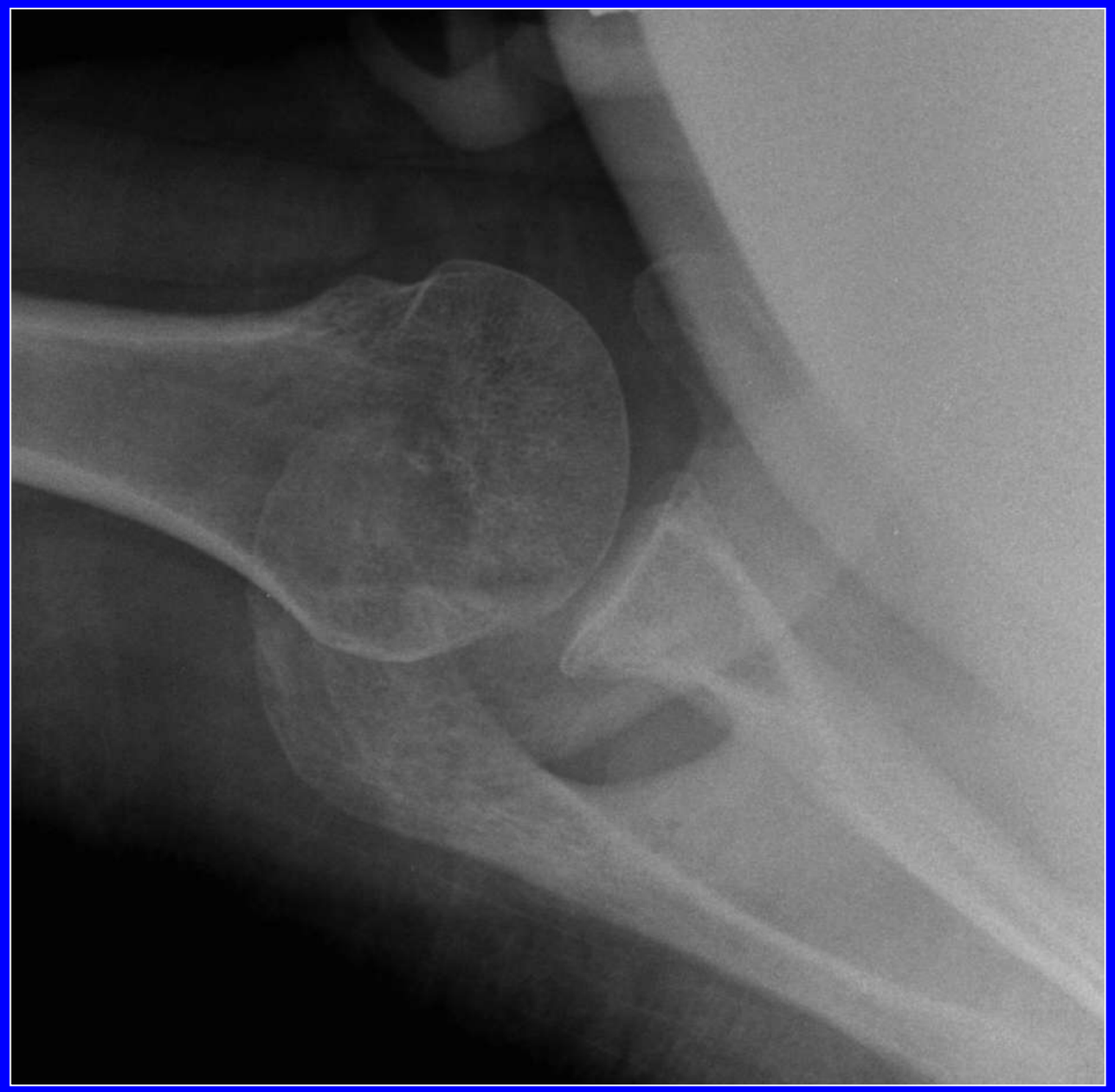
Kamran Ahmed
7/29/10

Unknowns

Cough



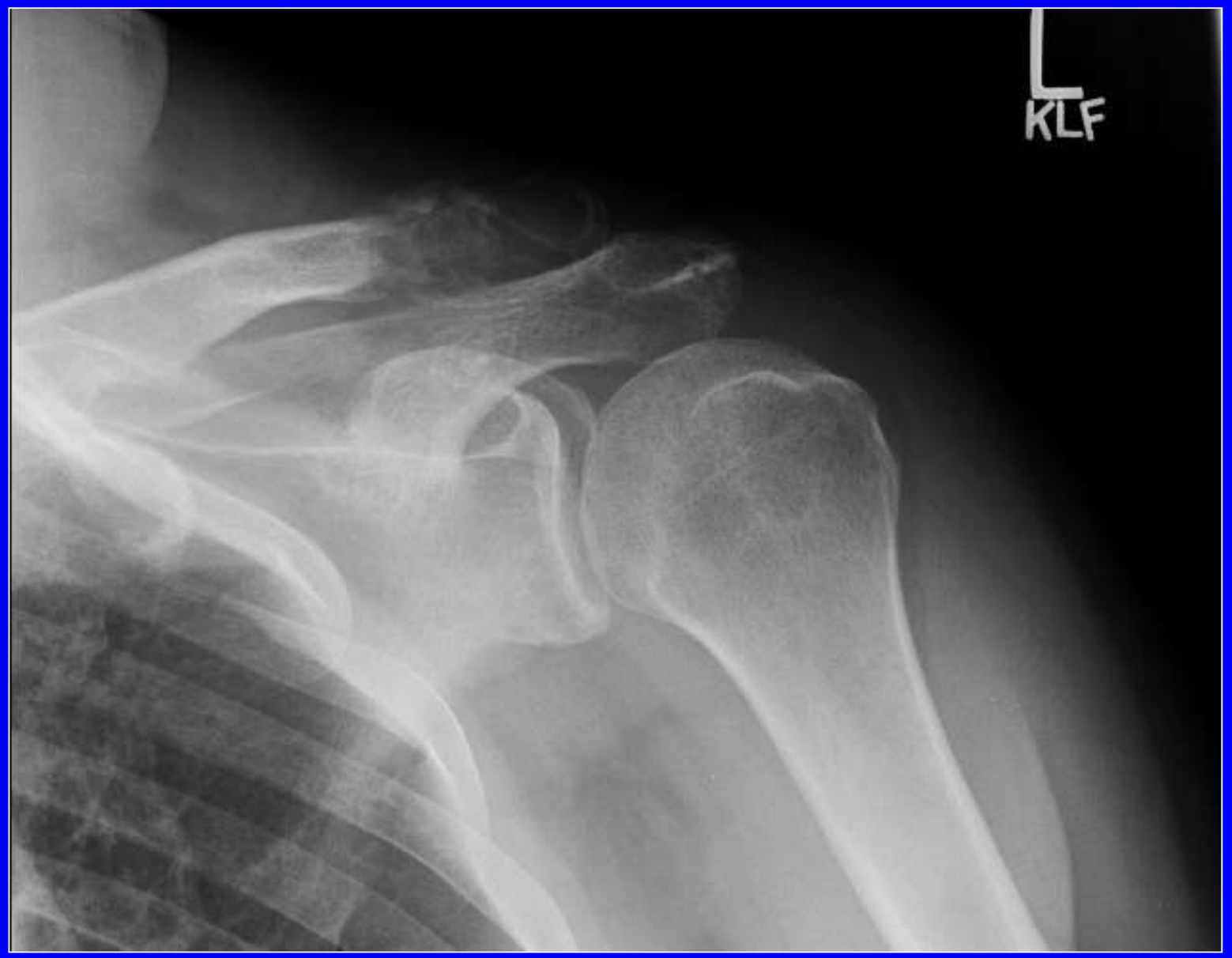
Pain



Pain

Routine

Decreased range of motion



ALOC

Learning Objectives

- ✓ Review the clinical features and significance of AC joint injury
- ✓ Review normal AC Joint anatomy
- ✓ Become familiar with basic AC joint biomechanics
- ✓ Be able to classify AC joint injuries based upon modified Rockwood Classification
- ✓ List common causes of extrinsic subacromial impingement
- ✓ Review common AC joint arthritides
- ✓ Bonus round

9

AC Joint: Clinical Significance

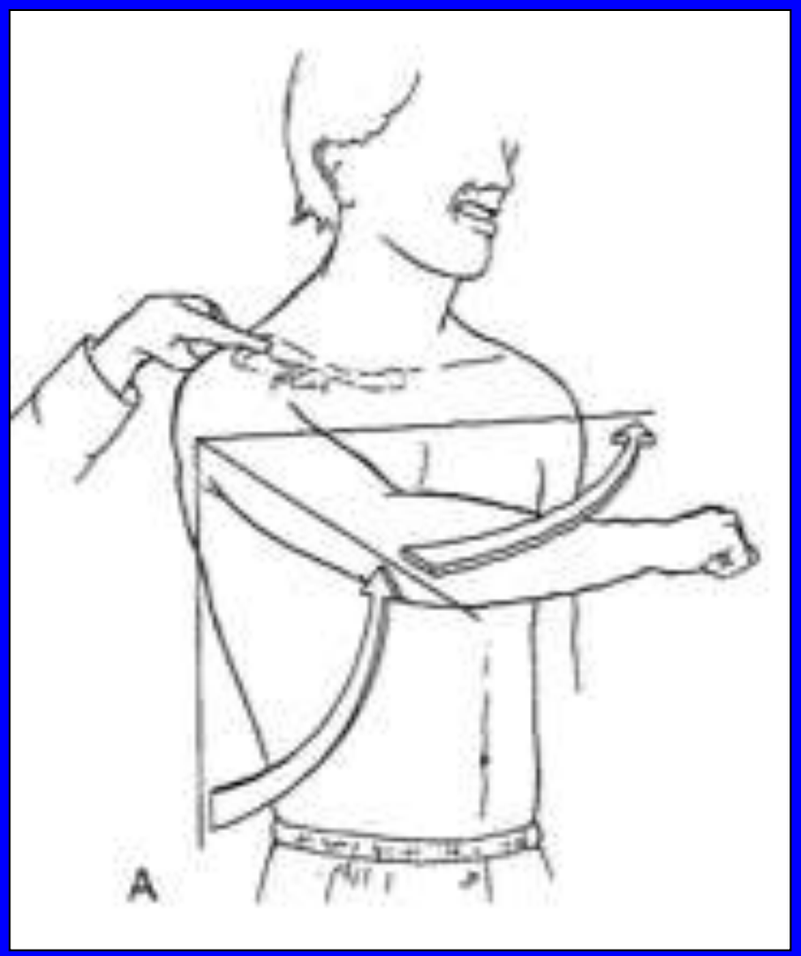
I. Trauma and degenerative pathology commonly involve the AC joint
II. May contribute to clinical entity of impingement
III. Represent up to 10% of all shoulder injuries
IV. Clinically may masquerade as other common shoulder pathology including RTC tears
V. Need clinical history/exam findings as advanced OA have imaging appearance similar to acute capsular injury (MRI in particular)
VI. AC jt injury represent up to 50% of at injuries
VII. Most significant stresses and degene the weight lifting population

AC Joint clinical evaluation

I. **<u>Point tenderness</u>**
II. Positive cross arm adduction
III. Relief of symptoms with intrarticular local anesthetic

Maarten Hendrik Moen, Robert-Jan de Vos, Todd S Ellenbecker, et al. **Clinical tests in shoulder examination: how to perform them.** *Br J Sports Med 2010 44: 370-375*

AC Joint clinical evaluation: Cross body adduction test



I. Specific to AC joint
II. Place finger on AC jt
III. Pt Arm flexed 90 degrees
IV. Adduct arm across the body
V. Pain must be localized to AC joint only

Mazzoca et al: Injuries to the acromiooclavicular joint in children, in Delee JC, Drez D (eds): Orthopedic Sports Medicine (ed 2) Philadelphia, PA. Saunders 2003 (pp 912-934)

AC Joint clinical evaluation

Strobel, K. et al. Am. J. Roentgenol. 2003;181:755-760

I. Point tenderness
II. Positive cross arm adduction
III. **Relief of symptoms with intrarticular local anesthetic**

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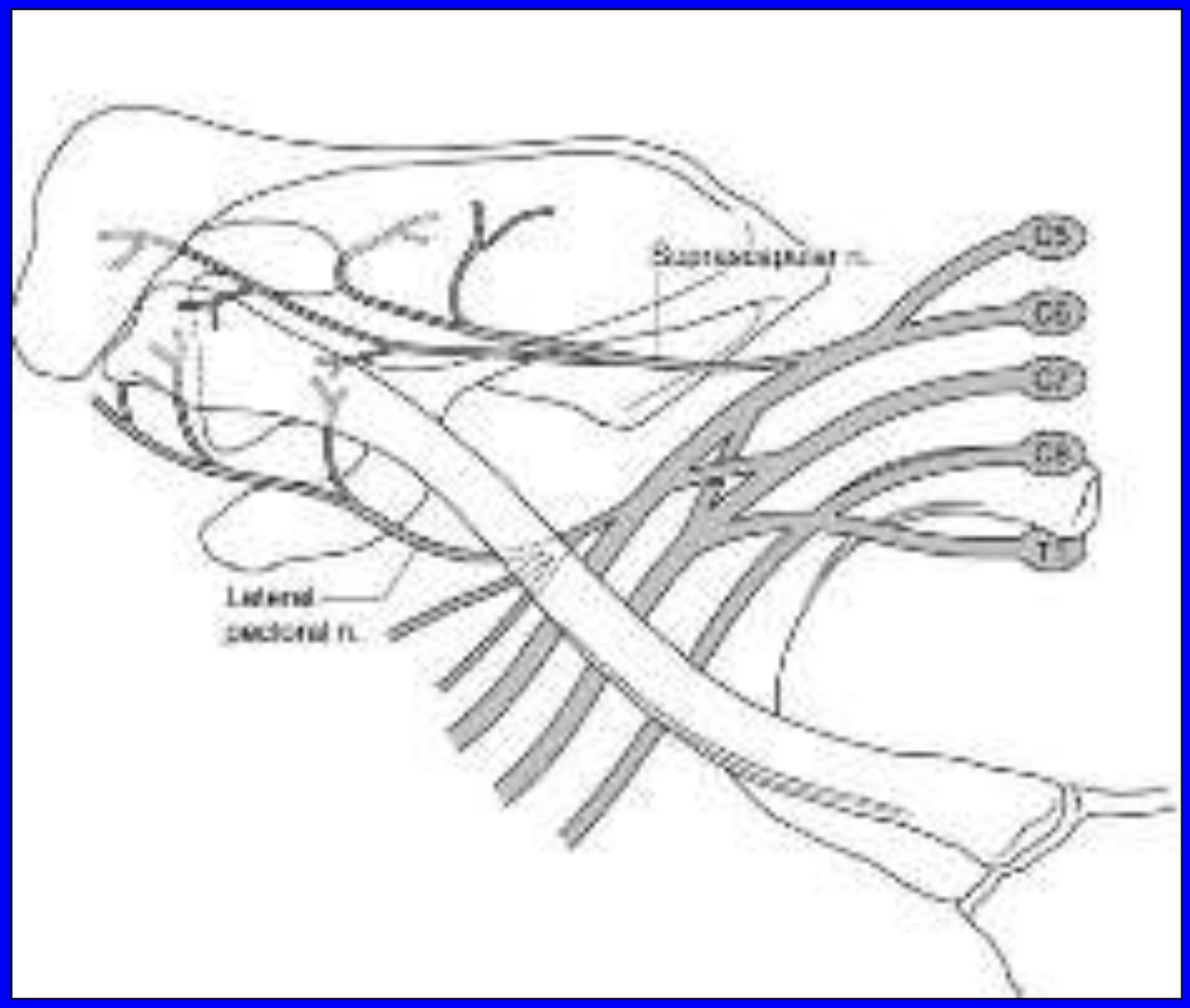
AJR

AC Joint clinical evaluation: not always easy

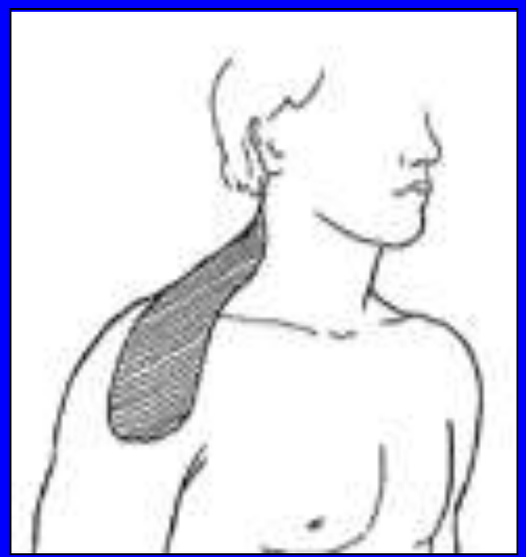


I. Pain in anterosuperior shoulder may be challenging to localize

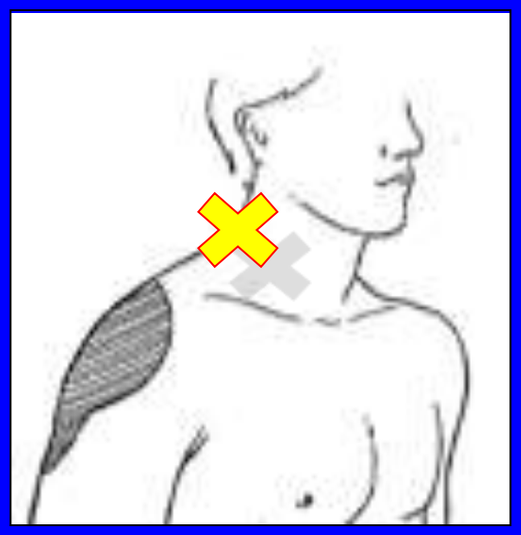
II. Lateral pectoral and suprascapular nerves innervate AC jt and superior aspect glenohumeral jt

Mazzoca et al: Injuries to the acromiooclavicular joint in children, in Delee JC, Drez D (eds): Orthopedic Sports Medicine (ed 2) Philadelphia, PA. Saunders 2003 (pp 912-934)

AC Joint clinical evaluation: not always easy



I. Irritation of AC joint
   - Pain arising from joint proper
   - Pain anterolateral neck
   - Pain anterolateral deltoid



II. Irritation of Subacromial space
   - Pain near lateral acromion
   - Pain near lateral deltoid
   - No pain in neck/trapezius region

Mazzoca et al: Injuries to the acromiooclavicular joint in children, in Delee JC, Drez D (eds): Orthopedic Sports Medicine (ed 2) Philadelphia, PA. Saunders 2003 (pp 912-934)

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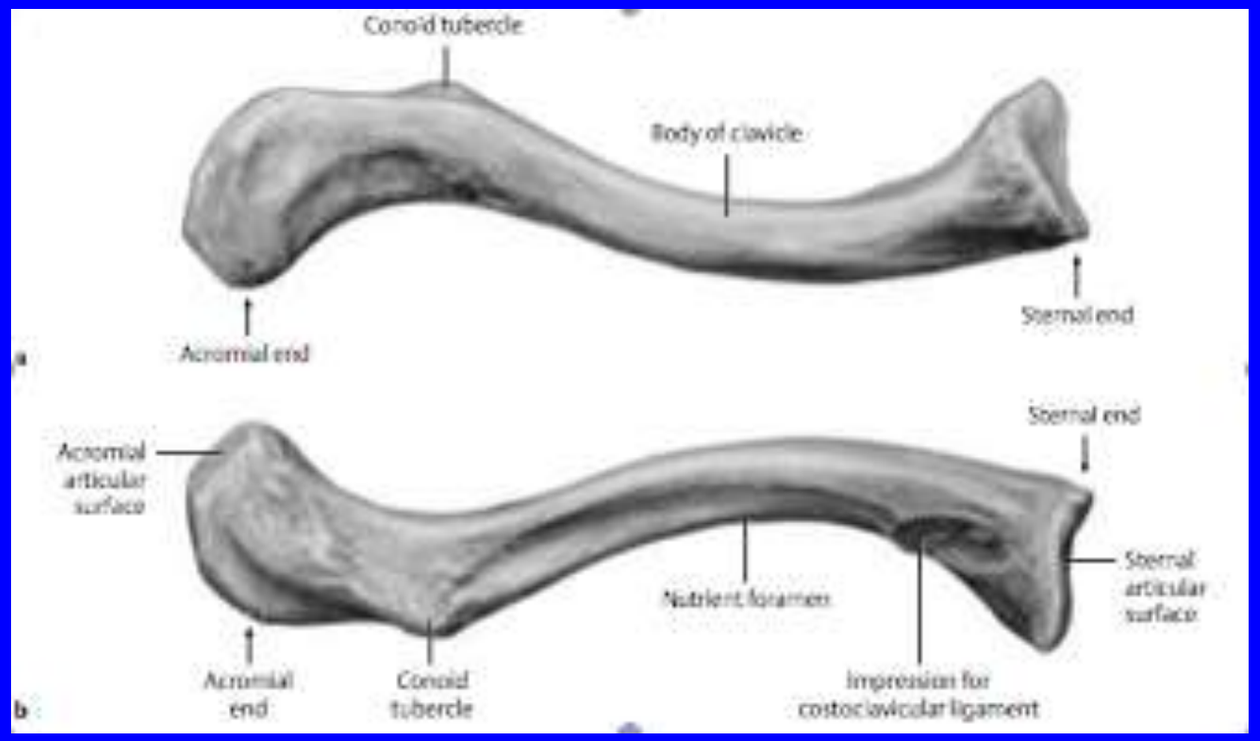
Developmental Anatomy: Clavicle

I. Clavicle mainly a membranous bone
II. Clavicle first bone to begin to ossify (week 5)
III. Ossifies from two primary centers (medial and lateral)
IV. Enchondral (epiphyseal) ossification sternal, acromial ends
V. Membranous ossification main contributor to longitudinal growth diaphyseal (body of clavicle)
VI. Fetal clavicular length (mm) roughly approximates EGA (weeks) via sonography

Developmental Anatomy: Acromion

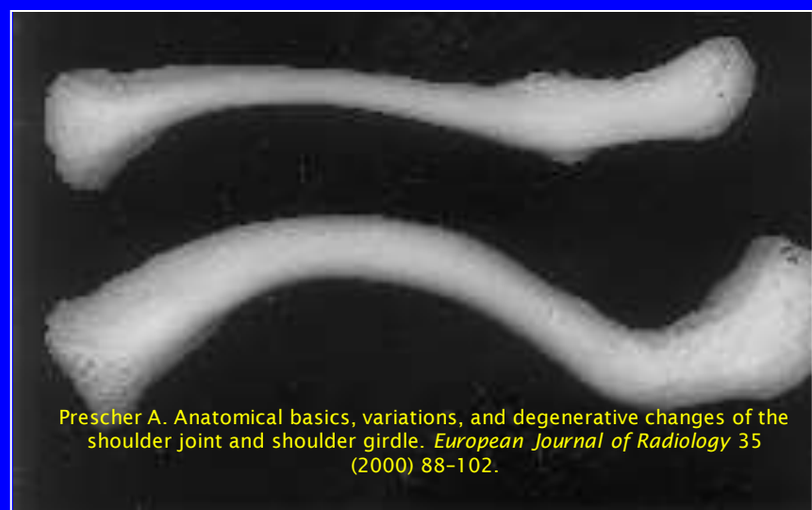
I. Starts as mesenchyme condensation 2nd month gestastion-remains cartilagenous until birth
II. Two Secondary ossification centers first appear 8-10 yrs
III. Should fuse by 20-25 yrs
IV. Fibrocartilaginous bridge (<2yrs) between acromion and clavicle
V. Joint cavity first visible yrs 3-5
VI. AC Joint articular surfaces start as hyaline then become fibrocartilage with age (Clavicle 17, acromion 23)

Osseous Anatomy: Clavicle



I. S shaped tubular bone
II. Medial 2/3 Convex anterior
III. Lateral 1/3 concave
   - Inferior surface
   - posterior conoid tubercle
   - Anterior trapezial ridge

Freyschmidt J et al. Clavicle and Sternoclavicular joints. Koehler/Zimmer's Borderlands of Normal and Early Pathological Findings in Skeletal Radiography (ed 5) Thieme Publishing 2002 (p. 306)



Prescher A. Anatomical basics, variations, and degenerative changes of the shoulder joint and shoulder girdle. *European Journal of Radiology* 35 (2000) 88-102.

Osseous Anatomy: Acromion

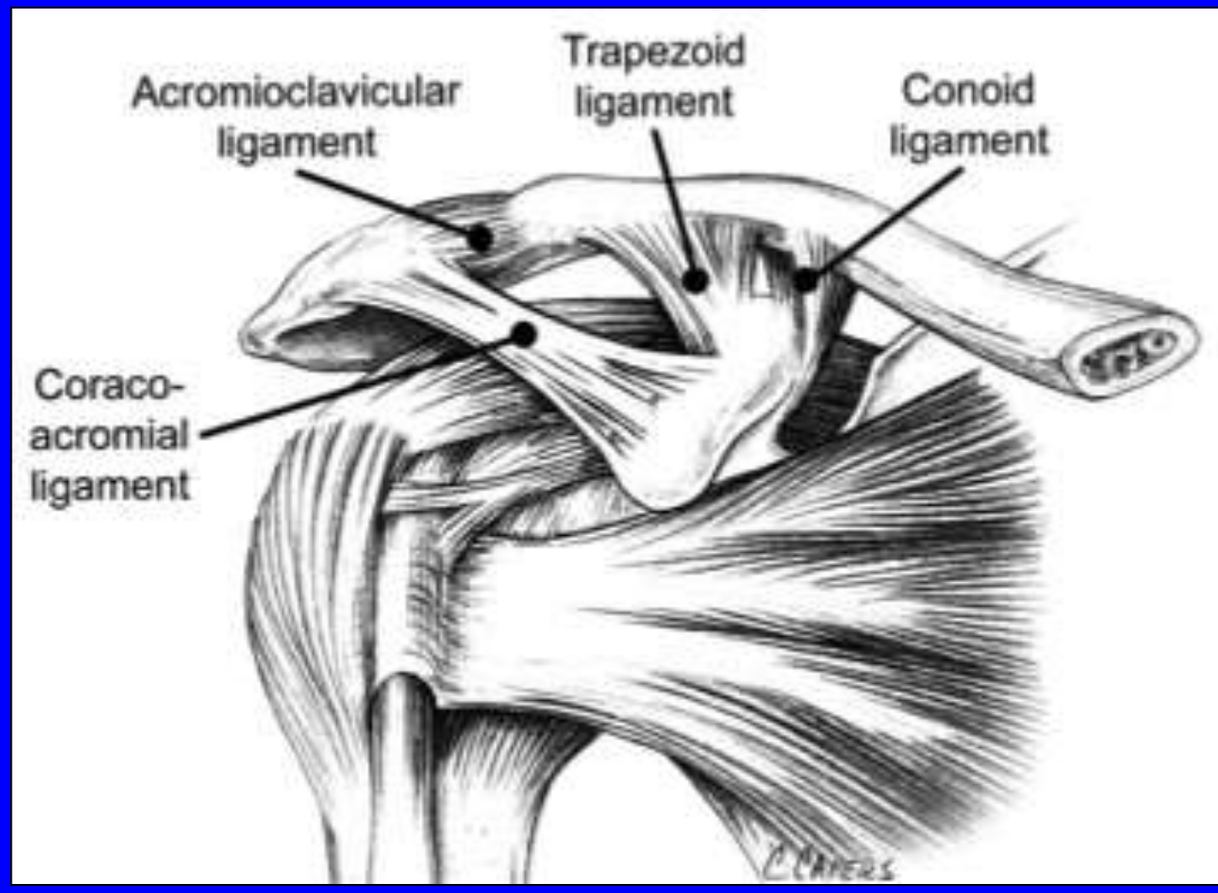
I. Projects anteriorly, arising from the superolateral aspect of the scapula
II. Acromial facet is along the medial aspect of acromial tip

http://homes.bio.psu.edu/people/faculty/strauss/anatomy/skel/pics/scapula1.jpg

Anatomy Overview

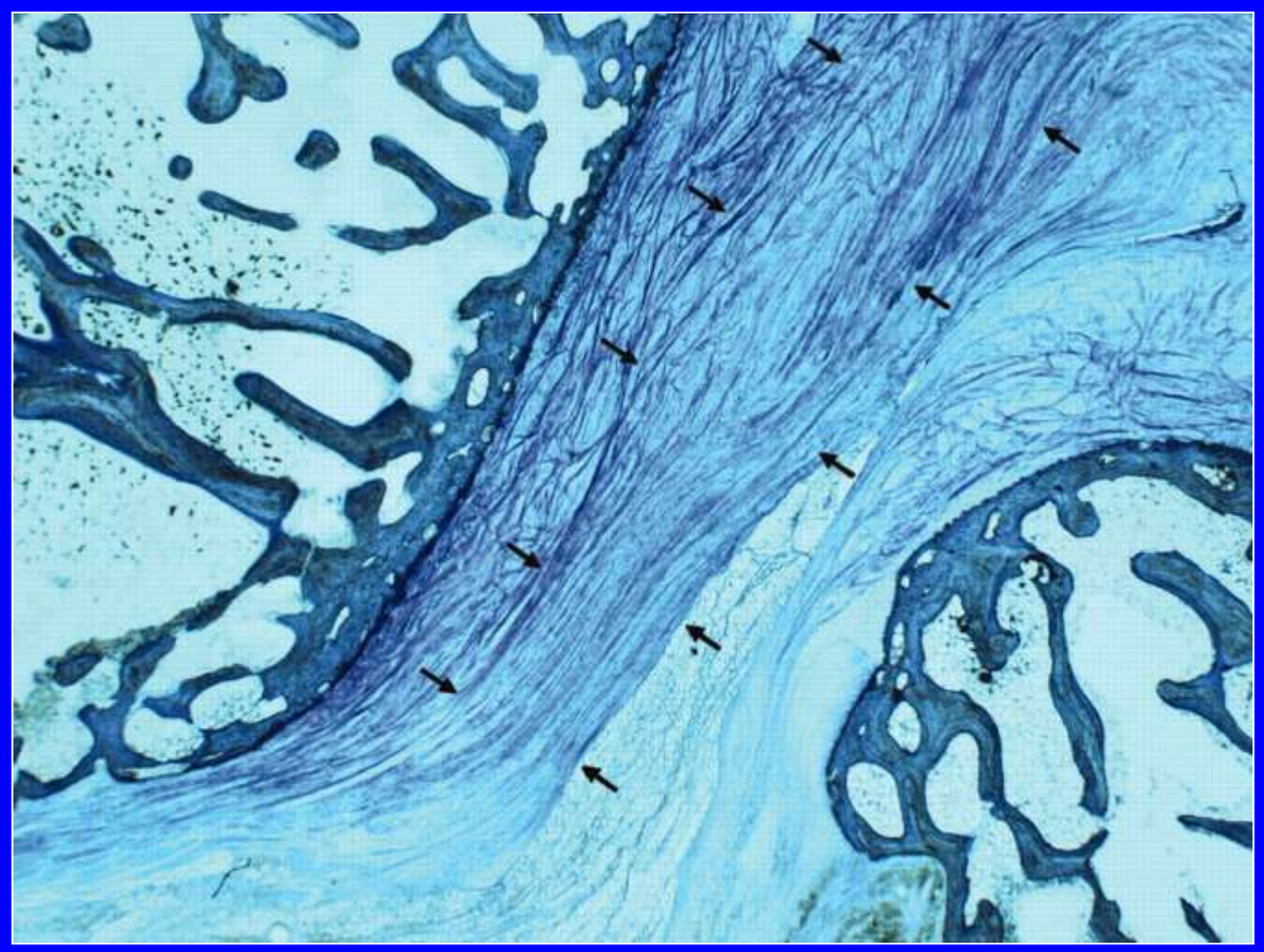
I. Synovial joint
- Lined by articular cartilage
- Rudimentary fibro cartilaginous articular disk
- Thin fibrous capsule
- Reinforced by AC ligaments

II. Stabilizers
- Dynamic
  - Deltoid and trapezius muscles
- Static
  - AP: AC ligaments/capsule
  - Sup-inf: Coracoclavicular ligaments
  - CoracoAcromial Ligament



Beim GM. **Acromioclavicular Joint Injuries.** *Journal of Athletic Training 2000;35(3):261–267*

AC Jt: Fibrocartilaginous disk



I. Articular disk usually present
II. Negligible function
III. Variable size and shape
IV. Starts degenerating 2nd decade
V. Significant destruction by 4th decade

Fialka, C. et al. Visualization of Intraarticular Structures of the Acromioclavicular Joint in an Ex Vivo Model Using a Dedicated MRI Protocol. *AJR*. 2005;185:1126-1131

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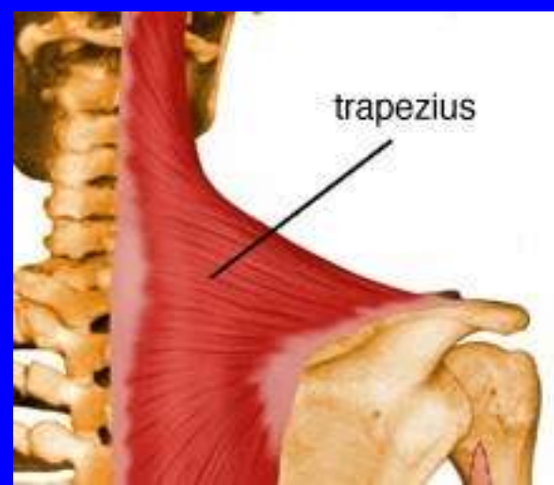
AJR

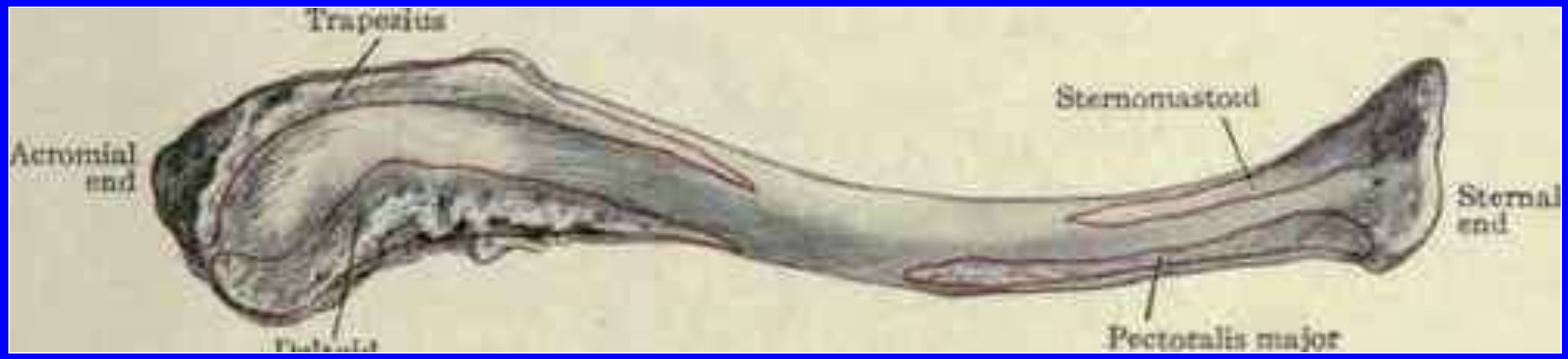
AC Jt Dynamic stabilizers: Deltoid and Trapezius muscles

I. Deltoid and trapezius muscle fibers blend with superior AC ligament and capsule
II. Deltoid muscle has fibers originating from the inferolateral aspect of the scapular spine and acromion with anterior deltoid fibers that insert medial to AC joint upon the distal clavicle
III. The trapezius muscle inserts on the superior aspect of the scapular spine and acromion
IV. Superior trapezius fascial attachment is confluent with posterosuperior AC jt capsule and dorsal clavicle
V. Add strength and stability to the joint when they contract or stretch
    - Exact contribution unknown
    - Cadaveric studies do not accurately assess deltotrapezial contribution

http://www.rad.washington.edu/academics/academic-sections/msk/muscle-atlas/upper-body/



Superior view clavicle



Post

Lat + Med

Ant

http://chestofbooks.com/health/anatomy/Human-Body-Construction/The-Bones-Of-The-Shoulder.html

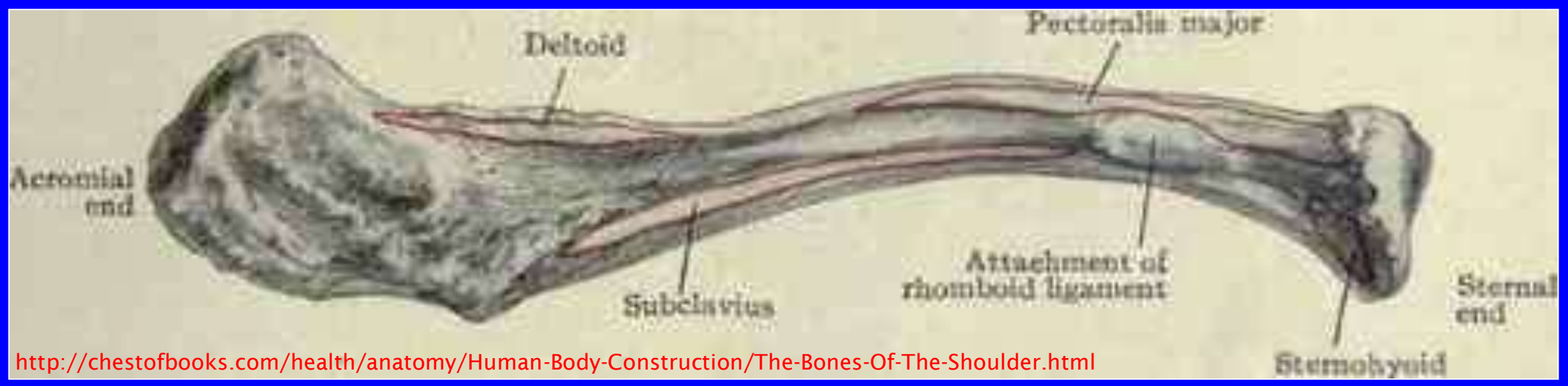
Deltoid tubercle

Anterior

Lateral

Medial

Prescher A. Anatomical basics, variations, and degenerative changes of the shoulder joint and shoulder girdle. *European Journal of Radiology* 35 (2000) 88–102.



http://chestofbooks.com/health/anatomy/Human-Body-Construction/The-Bones-Of-The-Shoulder.html

AC Jt Static Stabilizer: AC Ligaments and Capsule

I. Anterior, posterior, superior, inferior Lig
II. Cannot separate ligaments from capsule on standard MR sequences
III. Primary constraint for posterior displacement (~90%)
IV. Provide anteroposteror (horizontal) stability
    - Urist sectioned CC ligaments, kept AC lig intact and found no AC joint instability
V. After AC capsule transected get 100% increase in AP translation
VI. Also get increased force placed upon coracoclavicular ligaments

AC Jt Static Stabilizer: AC Ligaments and Capsule

I. S… more r…

II. S… th a…

III. R… L… bility

IV. R… I…

V. I… isible i…

Salter Jr EG, Nasca RJ, Shelley BS. Anatomical observations on the acromioclavicular joint in supporting ligaments. Am J Sports Med 1987;15:199-206

Inferior AC Ligament and capsule

Inferior AC Jt Lig/capsule

CAL

Salter Jr EG, Nasca RJ, Shelley BS. Anatomical observations on the acromioclavicular joint in supporting ligaments. Am J Sports Med 1987;15:199-206

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Salter Jr EG, Nasca RJ, Shelley BS. Anatomical observations on the acromioclavicular joint in supporting ligaments. Am J Sports Med 1987;15:199-206

AC Capsular Anatomy (Sag view)

Stine IA, Vangsness CT. Analysis of the capsule and ligament insertions about the Acromioclavicular Joint: A Cadaveric study. *Arthroscopy*. Vol 25 No 9 (September). 2009 pp 968-974

AC Capsular Anatomy (Sag view)

Superior*

Trapezius fascia Inserting on posterosuperior capsule

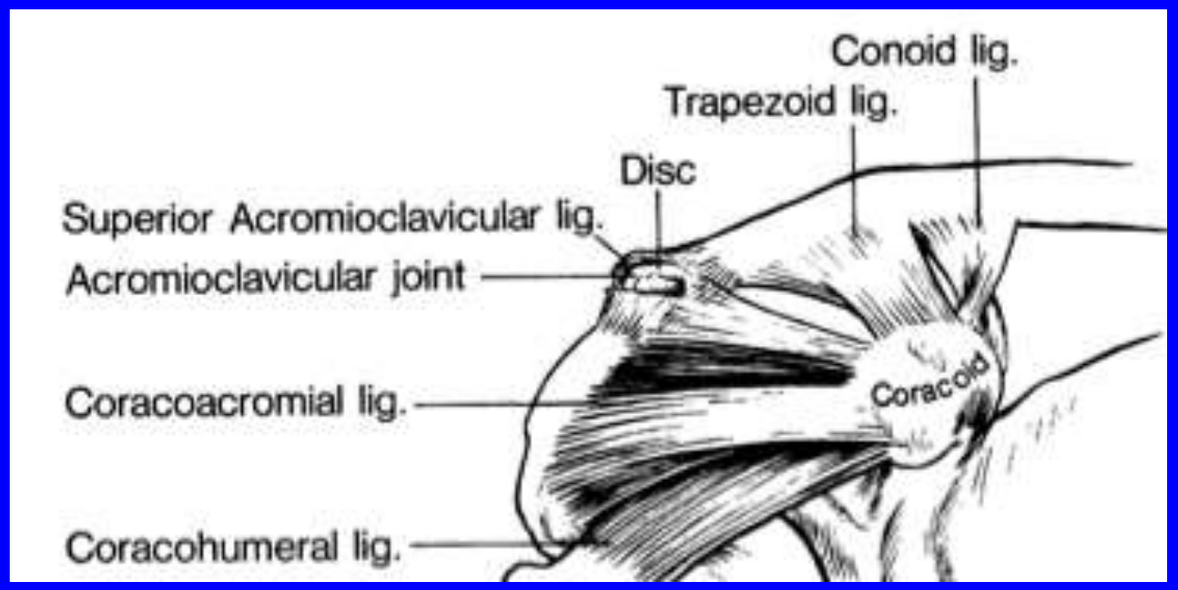
Anterior

Posterior*

Inferior

Stine IA, Vangsness CT. Analysis of the capsule and ligament insertions about the Acromioclavicular Joint: A Cadaveric study. *Arthroscopy*. Vol 25 No 9 (September). 2009 pp 968-974

AC Jt Static Stabilizer: Coracoclavicular Ligamentous complex



I. Mainly contribute to vertical stability AC jt

II. **Conoid ligament**
- Medial
- Conical or triangular in shape
- Posteromedial aspect of coracoid
- Runs superiorly, attaches to conoid tubercle (posterior)

III. **Trapezoid ligament**
- Lateral
- Quadrilateral shape
- Shaft of coracoid
- Runs oblique and superolaterally
- Inserts on trapezoid ridge (anterolateral)

Salter Jr EG, Nasca RJ, Shelley BS. Anatomical observations on the acromioclavicular joint in supporting ligaments. Am J Sports Med 1987;15:199-206

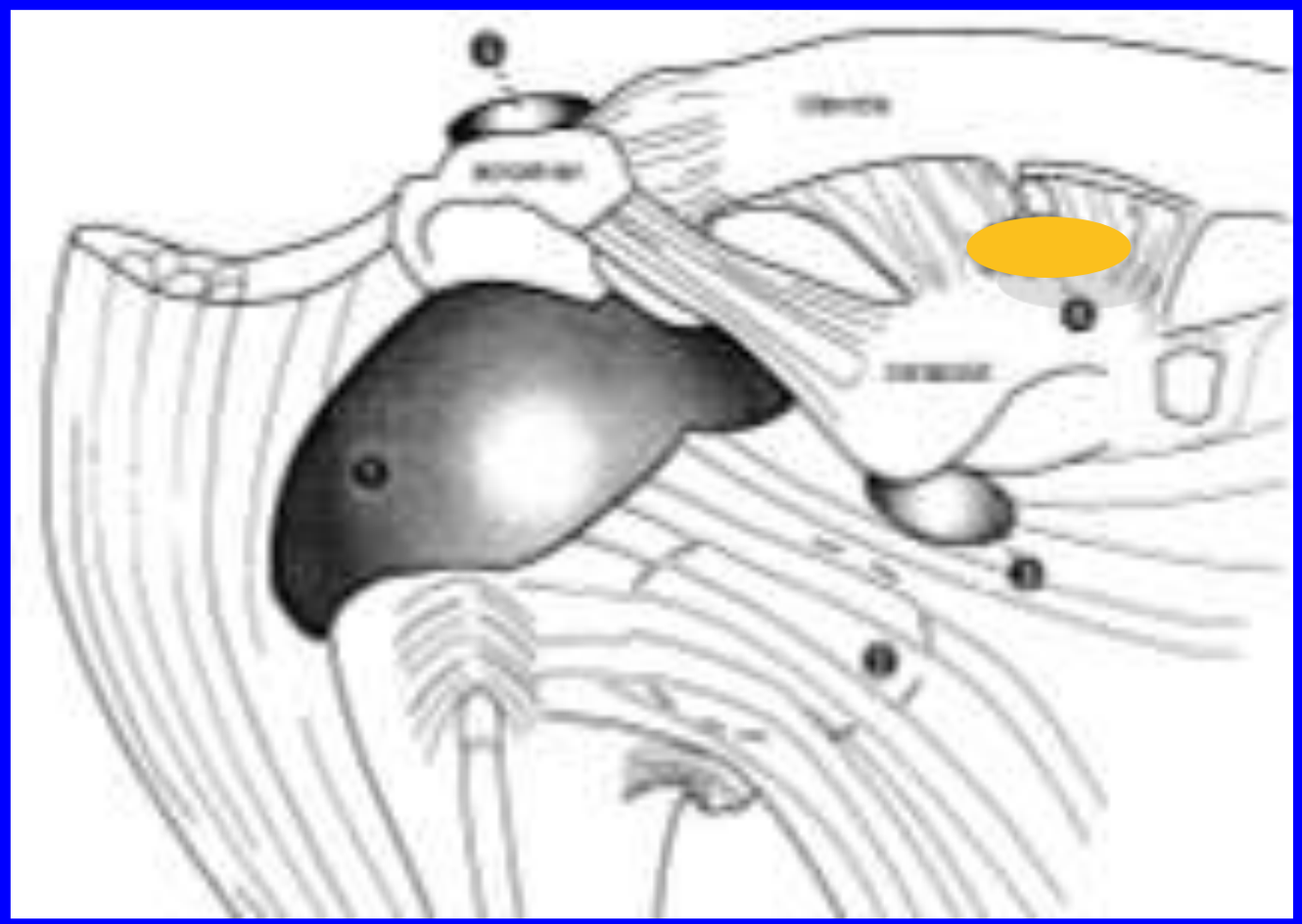
AC Jt Static Stabilizer: Coracoclavicular Ligamentous complex

Fat is our friend for identifying normal anatomy of CC ligaments (use T1 non FS)

I. Corocoid attachments of CC Ligs may be confluent
II. Clavicular attachments distinctly separate
III. Intervening **bursa** may exist between conoid and trapezoid ligaments

http://www.radsource.us/_images/0410_6.jpg

Coracoclavicular Bursa



I. Rare cause of shoulder pain

II. Must differentiate between HADD bursitis and post-traumatic ossification

Bureau NJ et al. Imaging of bursae around the shoulder joint. *Skeletal Radiol* (1996) 25:513–517

CC Ligament attachment: Inferior surface distal clavicle

Anterior

Posterior

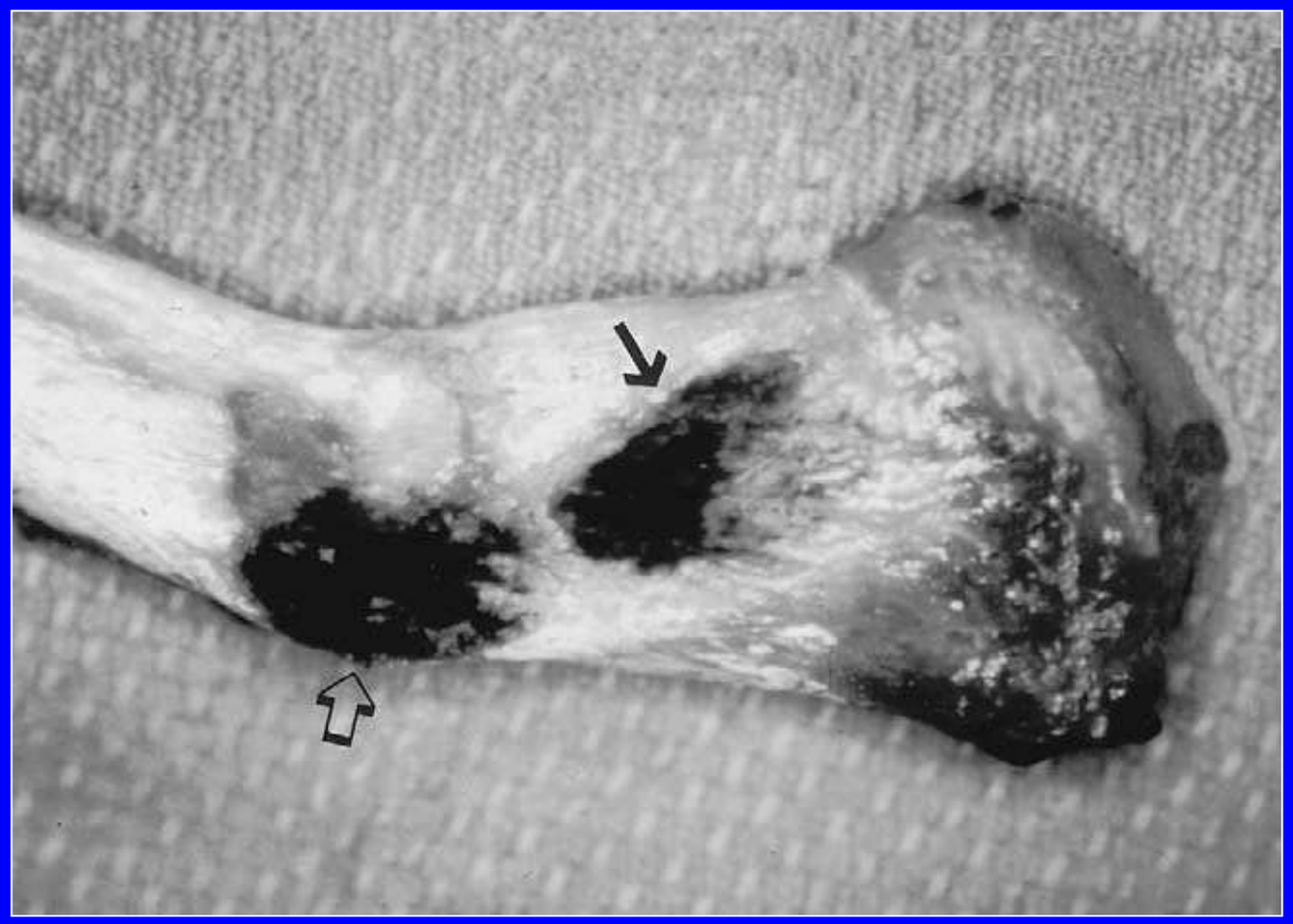
I. Trapezoid ridge (Anterior)

II. Conoid tubercle(Posterior)

Renfree KJ, Wright TW. Anatomy and biomechanics of the acromioclavicular and sternoclavicular joints. *Clin Sports Med* 22 (2003) 219-237.

Methylene blue stain sharpeys fibers of conoid and trapezoid ligament insertions

Anterior



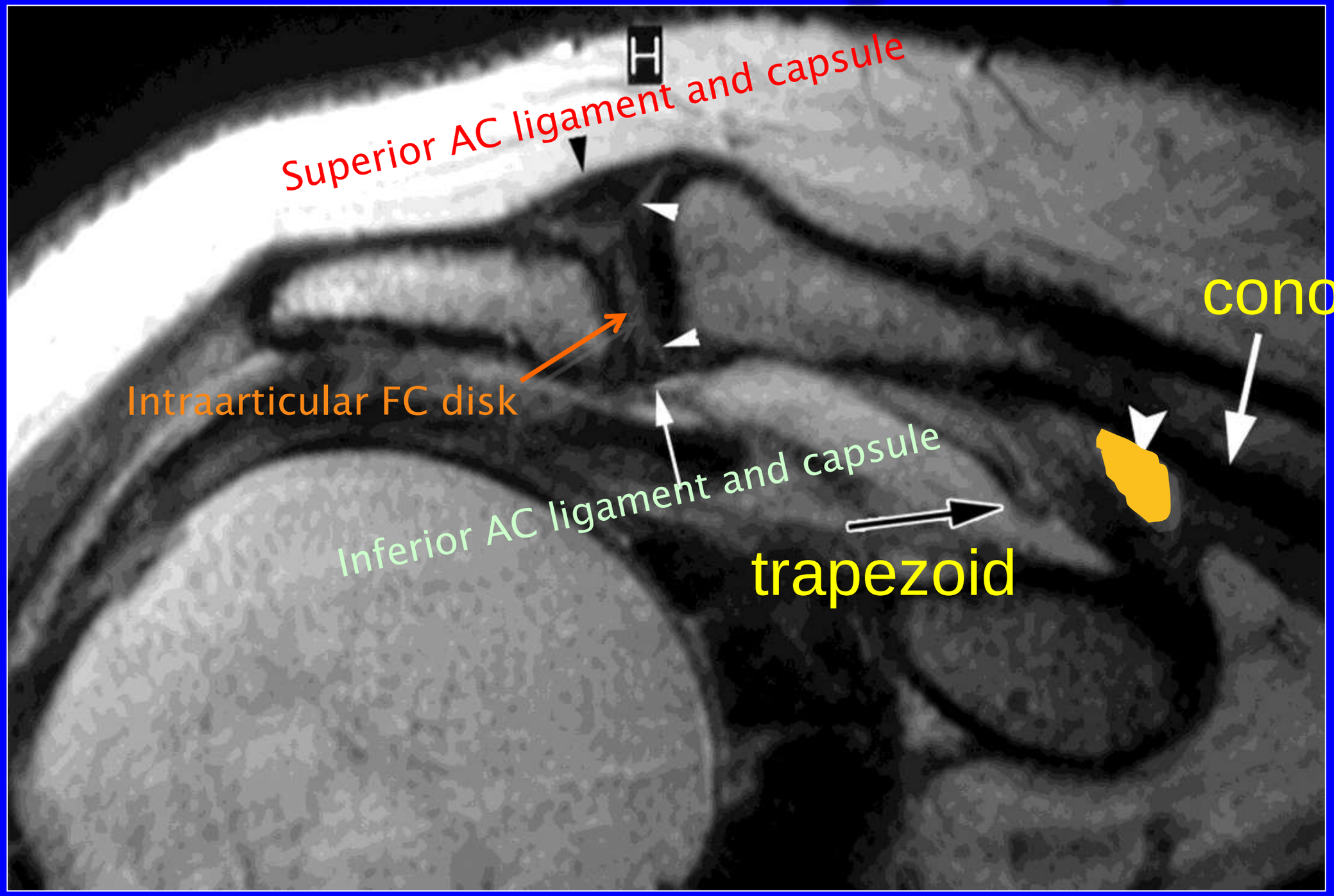
Posterior

I. Trapezoid ridge (Anterior)

II. Conoid tubercle(Posterior)

Renfree KJ, Wright TW. Anatomy and biomechanics of the acromioclavicular and sternoclavicular joints. *Clin Sports Med* 22 (2003) 219-237.

AC Ligaments, capsule, coracoclavicular Lig complex



Alyas F et al. Radiographics 2008;28:463-479

RadioGraphics

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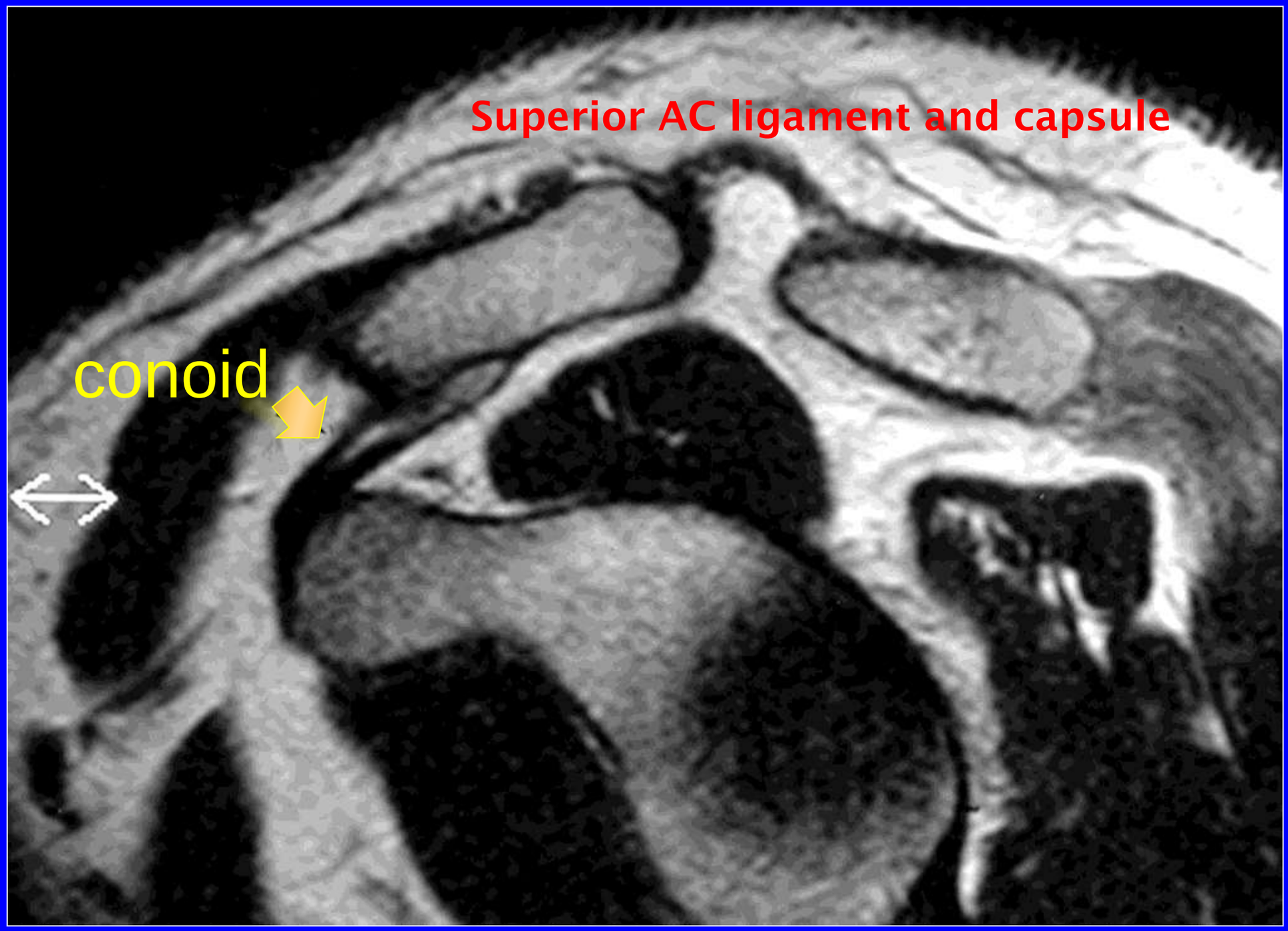
Coracoclavicular Ligaments: Conoid component



Alyas F et al. Radiographics 2008;28:463-479

RadioGraphics

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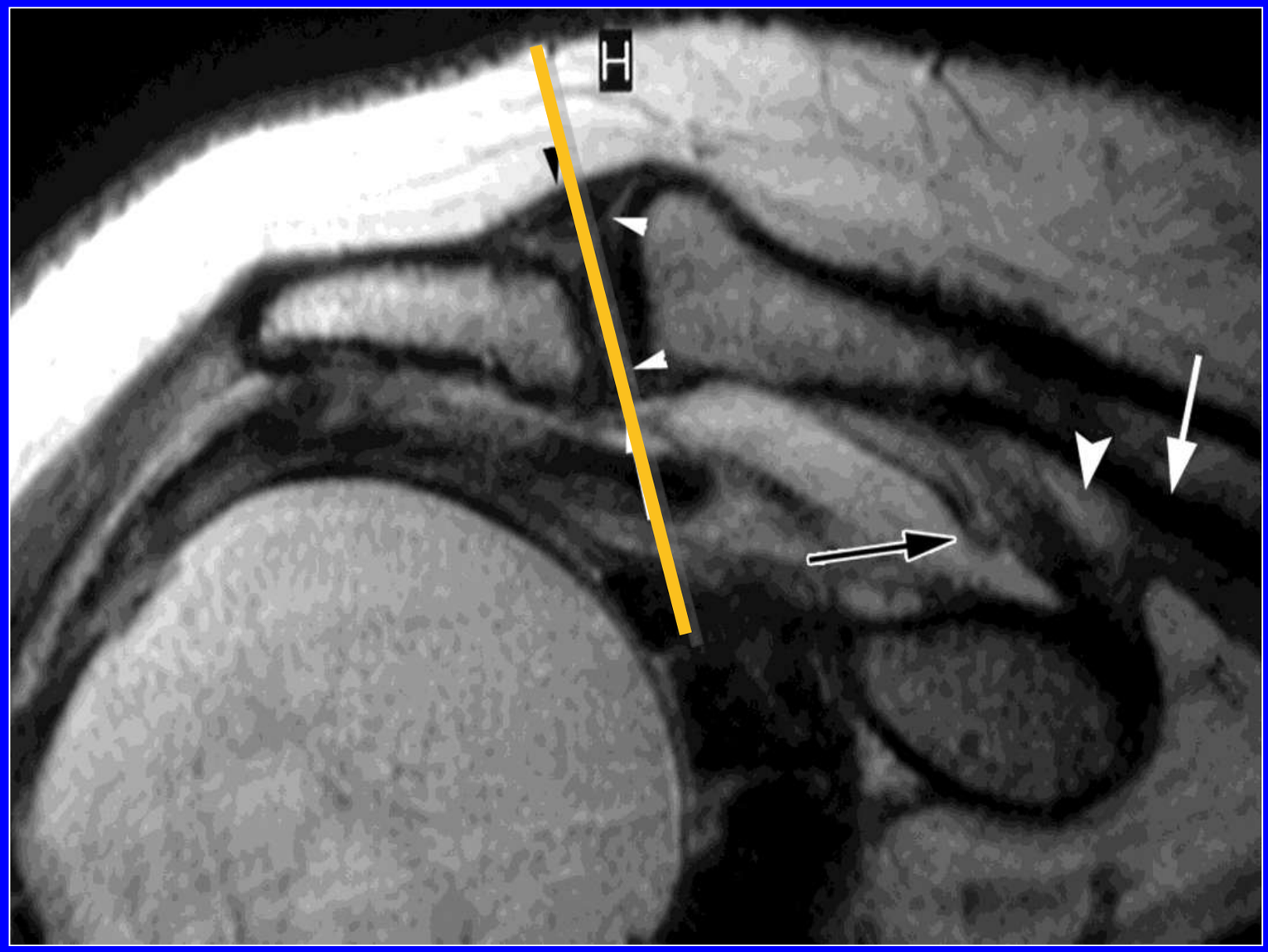
AC Jt capsule



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RadioGraphics

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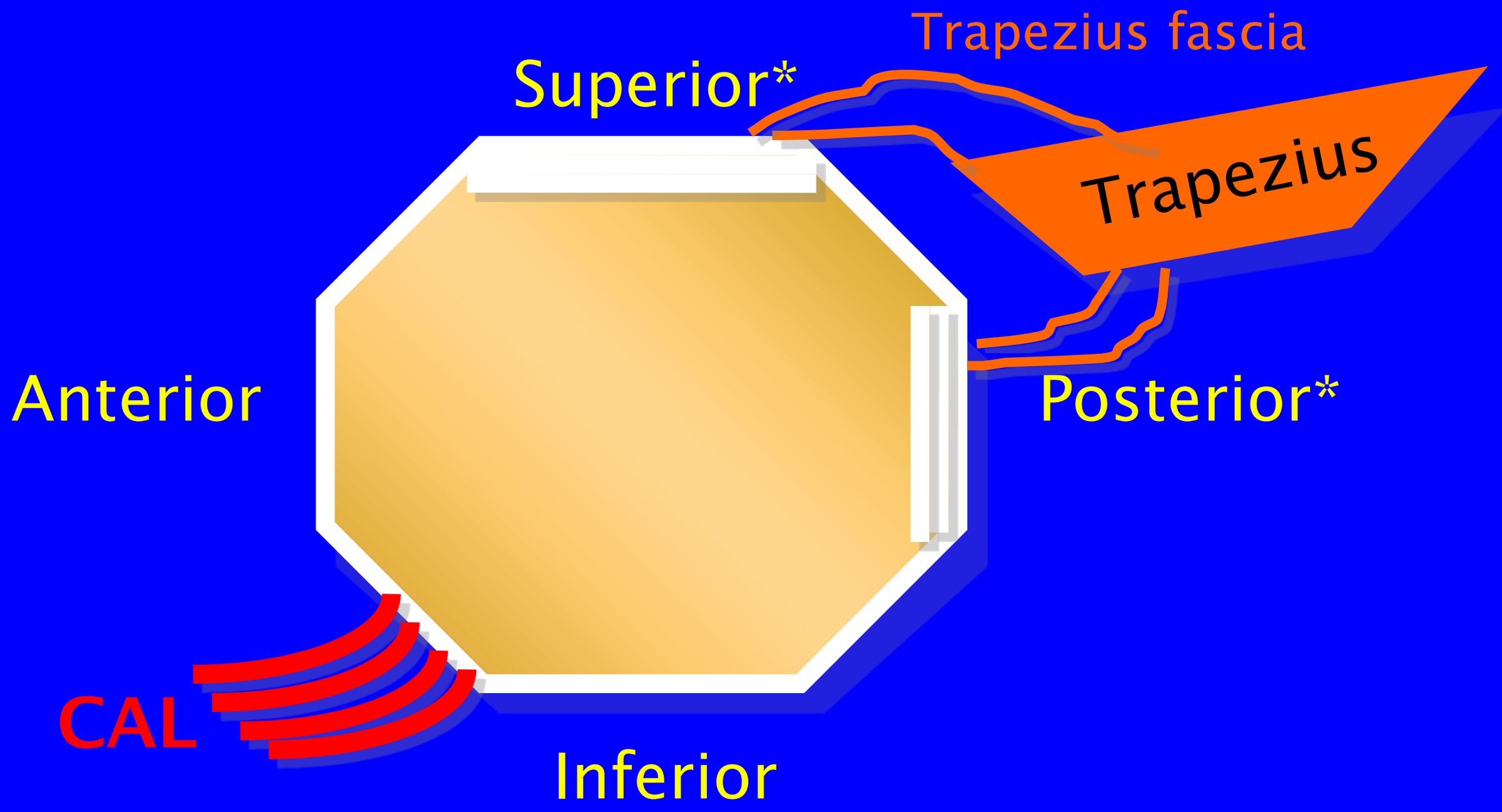
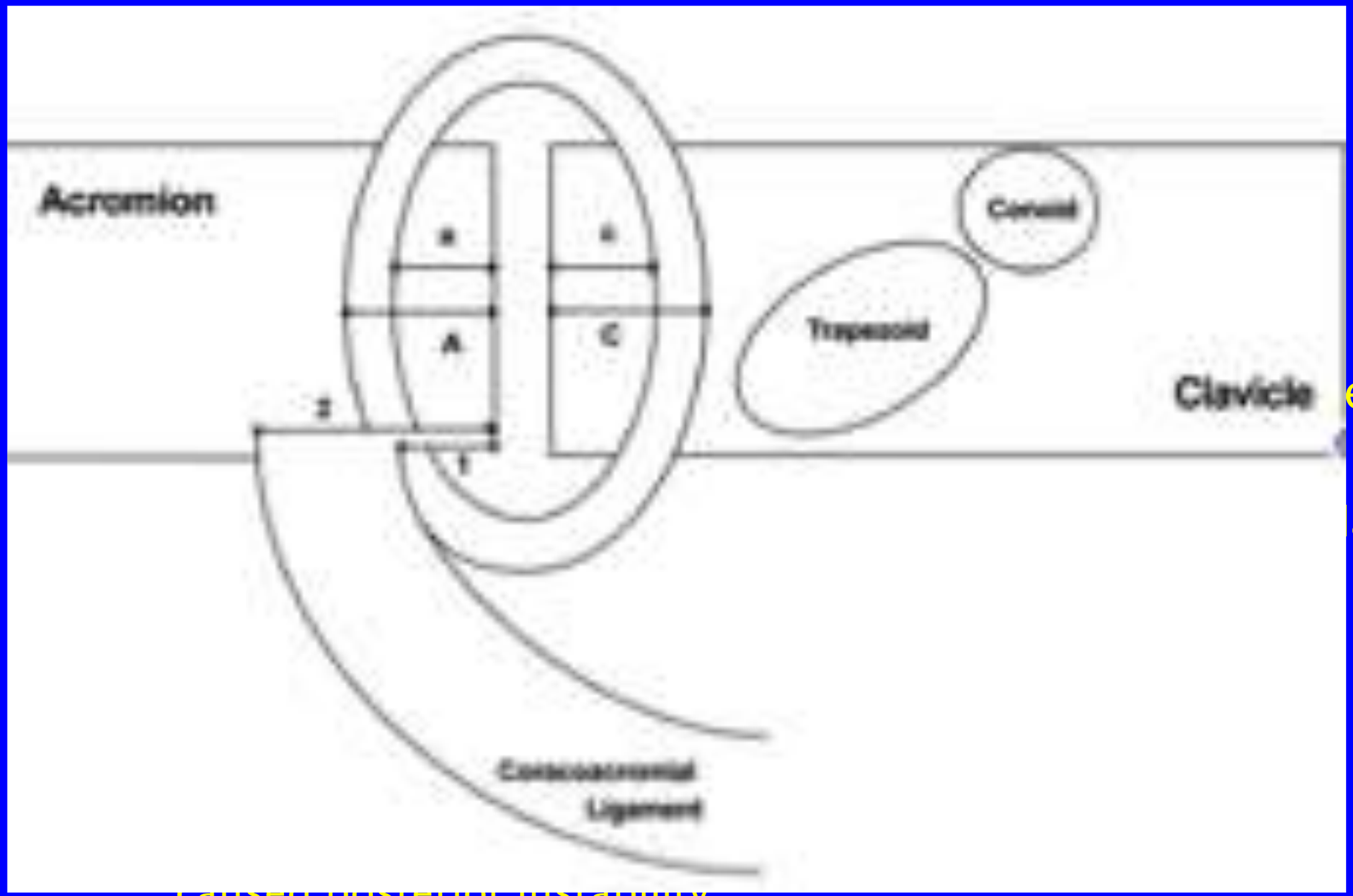
AC Capsular Anatomy (Sag view)



Capsule anatomy review



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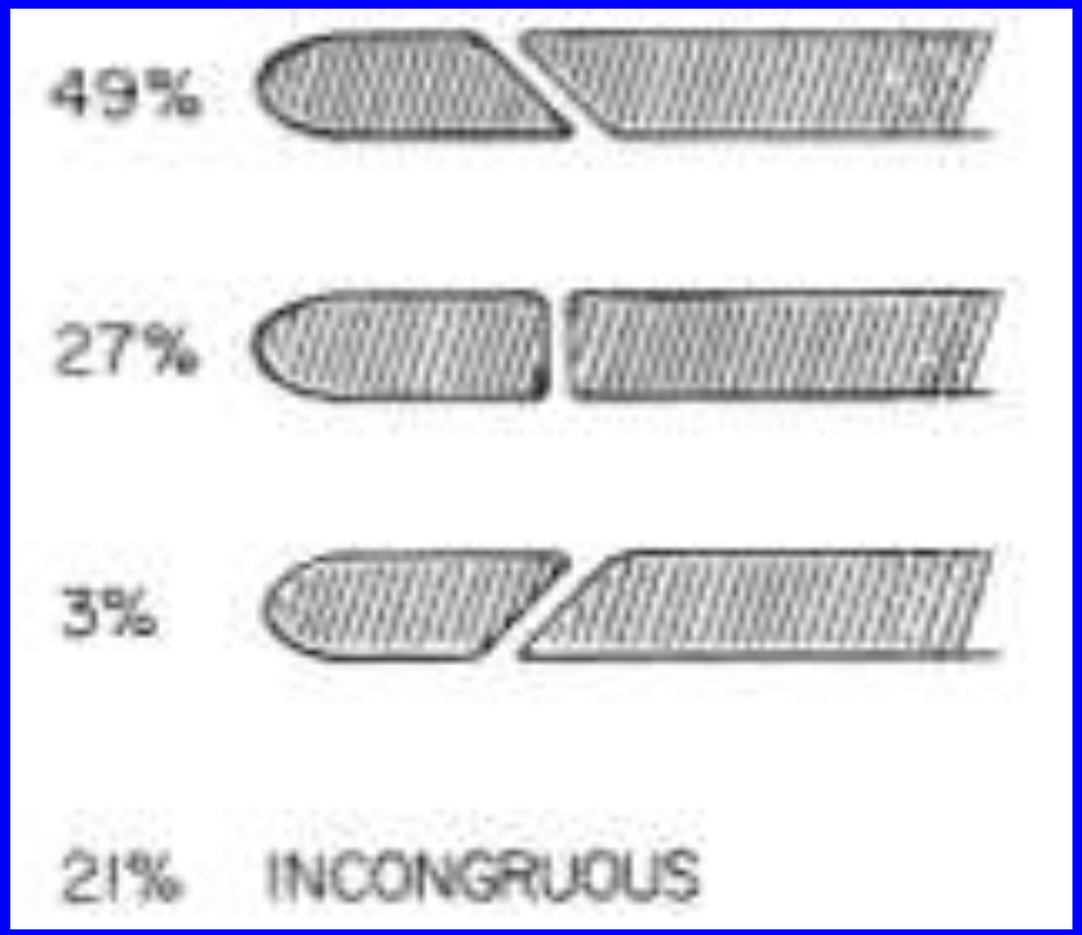
caused posterior instability

Stine IA, Vangsness CT. Analysis of the capsule and ligament insertions about the Acromioclavicular Joint: A Cadaveric study. *Arthroscopy*. Vol 25 No 9 (September). 2009 pp 968-974

AC Joint: Variable Inclination



Berkowitz MM, Warren RF, Altchek DW, et al. Arthroscpic acromioclavicular resection. Oper Tech Sports Med 1997;5(2):60-4;

I. Avg joint surface
   - 9 mm (SI) x 19 mm (AP)

II. Vertical inclination
   - theorized to be more suscetible to degeneration due to high
   - conc
   - dista

Urist MR. COMPLETE DISLOCATIONS OF THE ACROMIOCLAVICULAR JOINT: The Nature of the Traumatic Lesion and Effective Methods of Treatment with an Analysis of Forty-One Cases.*J Bone Joint Surg Am.* 1946;28:p. 824

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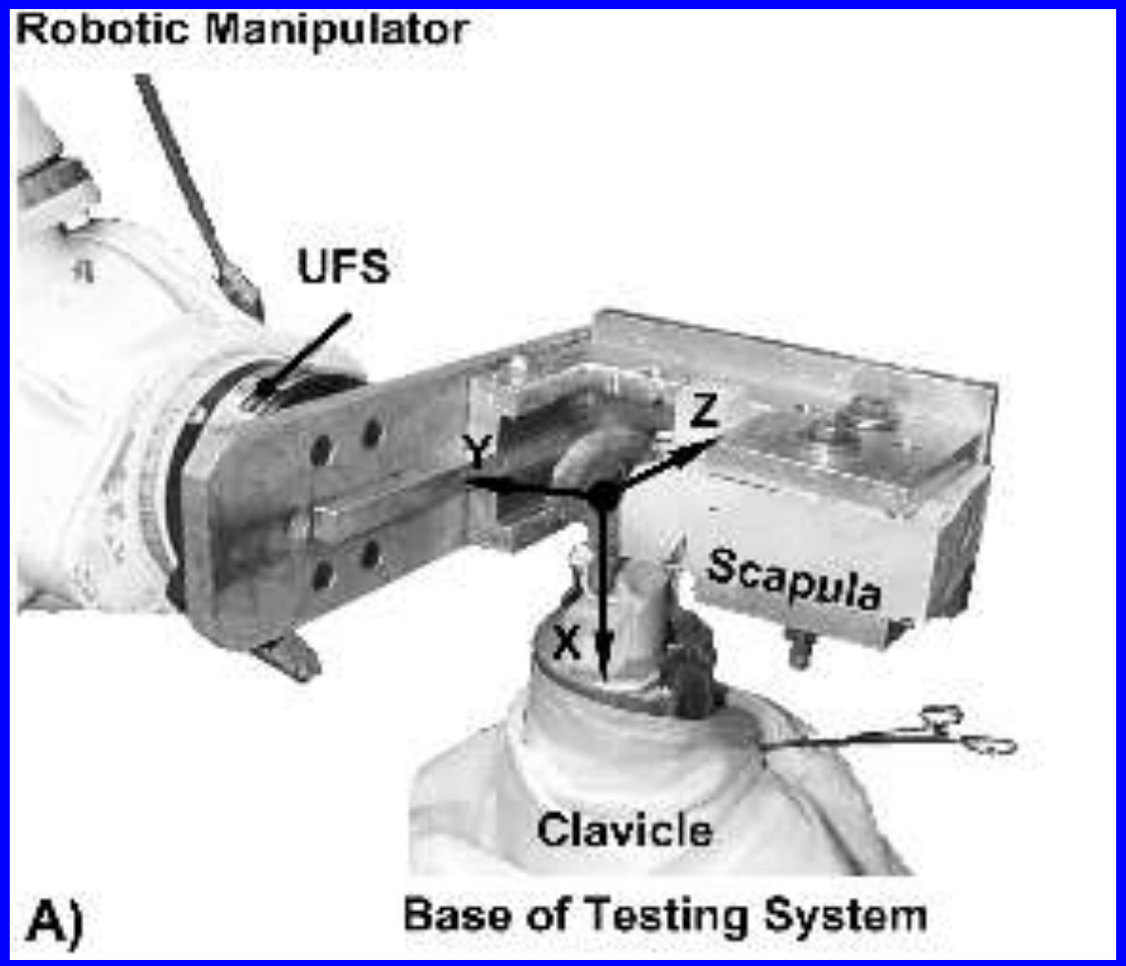
Biomechanics 101



Debski RE et al. Effect of Capsular Injury on Acromioclavicular Joint Mechanics. *J Bone Joint Surg Am.* 2001;83:1344-1351

Biomechanics 101

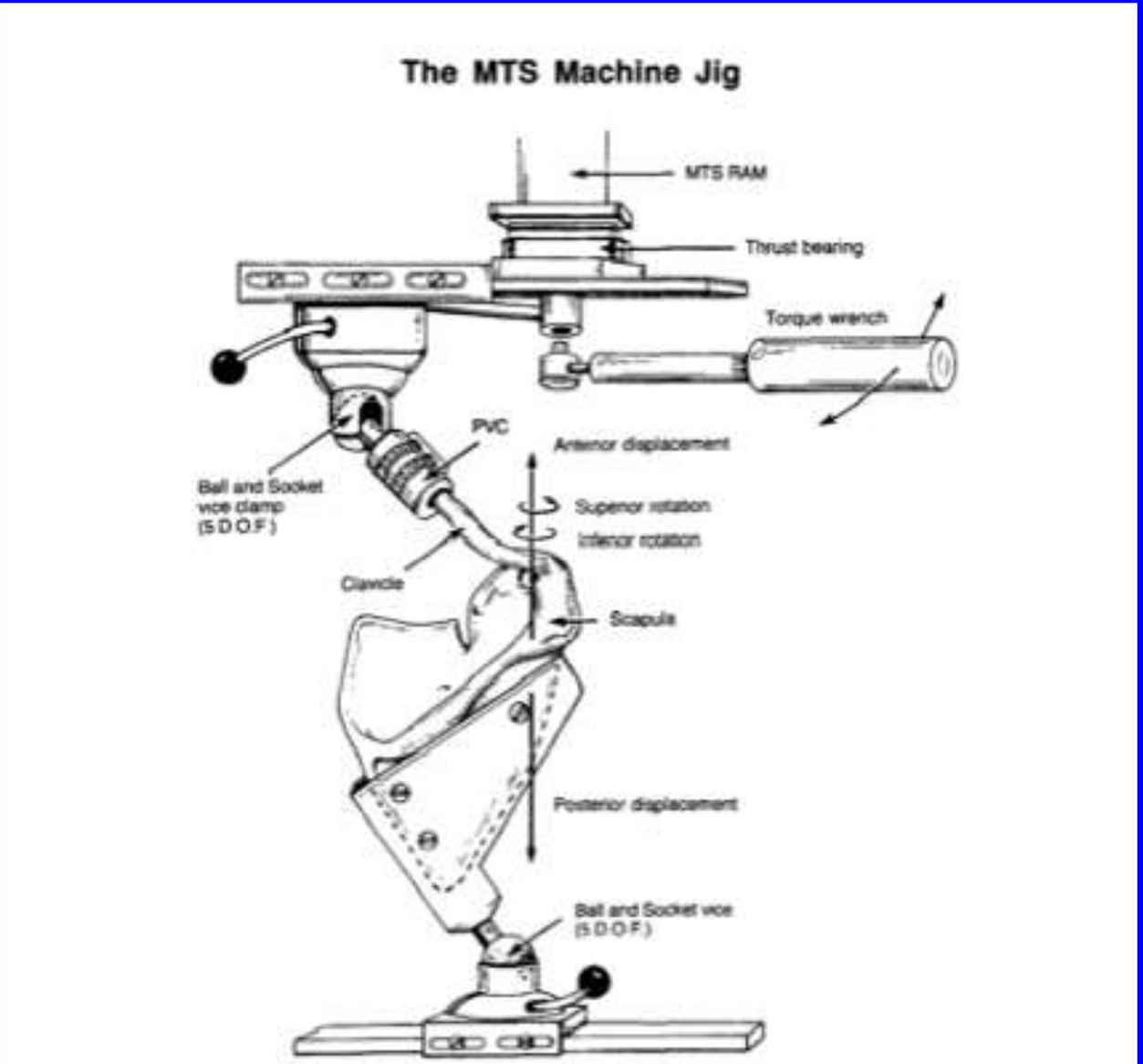


Figure 1 Schematic drawing of testing apparatus. Clavicular portion of specimen remained fixed throughout testing conditions as scapular base was translated posteriorly through actuator displacement and pulley system.

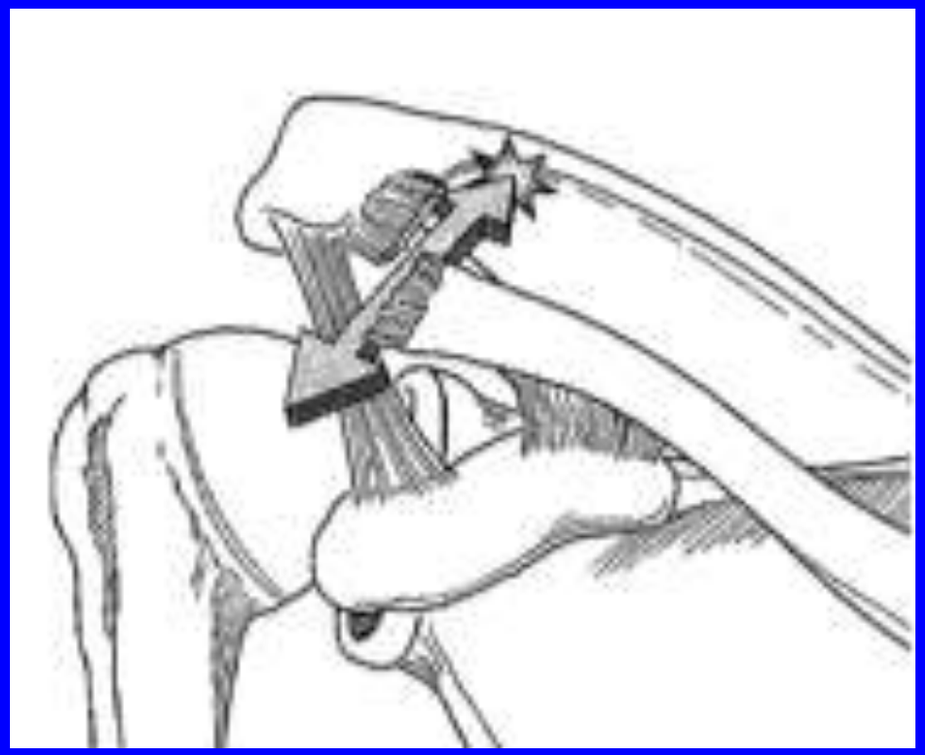
Klimkiewicz JJ et al. The acromioclavicular capsule as a restraint to posterior translation of the clavicle: A biomechanical analysis. J Shoulder Elbow Surg 1999;8: I 19-24)


Nikon

Biomechanics: AC Joint Motion

Mazzoca et al: Injuries to the acromiooclavicular joint in children, in Delee JC, Drez D (eds): Orthopedic Sports Medicine (ed 2) Philadelphia, PA. Saunders 2003 (pp 912-934)

Biomechanics



I. Motion at AC jt is clinically relevant

II. When AC jt fused or clavicle fixed to scapula via coracoclavicular screw, these still allow forward elevation in abduction

III. This persistent motion allows hardware to migrate and break over time

IV. Posterior horizontal instability of the distal clavicle can cause painful abutment of the distal clavicle upon scapular spine

Mazzoca et al: Injuries to the acromiooclavicular joint in children, in Delee JC, Drez D (eds): Orthopedic Sports Medicine (ed 2) Philadelphia, PA. Saunders 2003 (pp 912-934)

Biomechanics

I. Fukuda et al
   - Small AC jt displacements (physiologic load)
     - AC ligaments/capsule are primary restraints to both posterior (89%) and superior (65%) translation of the clavicle
   - Large AC jt displacements (simulate injury)
     - Conoid ligament becomes primary restraint to superior (60%) and anterior translation of clavicle
     - Conoid ligament resists ant and posterior rotation of clavicle upon its longitudinal axis
     - Trapezoid resisted axial compression of AC jt

http://needle-exchange.ca/images/boring_lecture.jpg

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AC Jt dislocation

I. 10% of all shoulder injuries
II. M>F 5:1
III. MC 2nd decade
IV. Mechanism

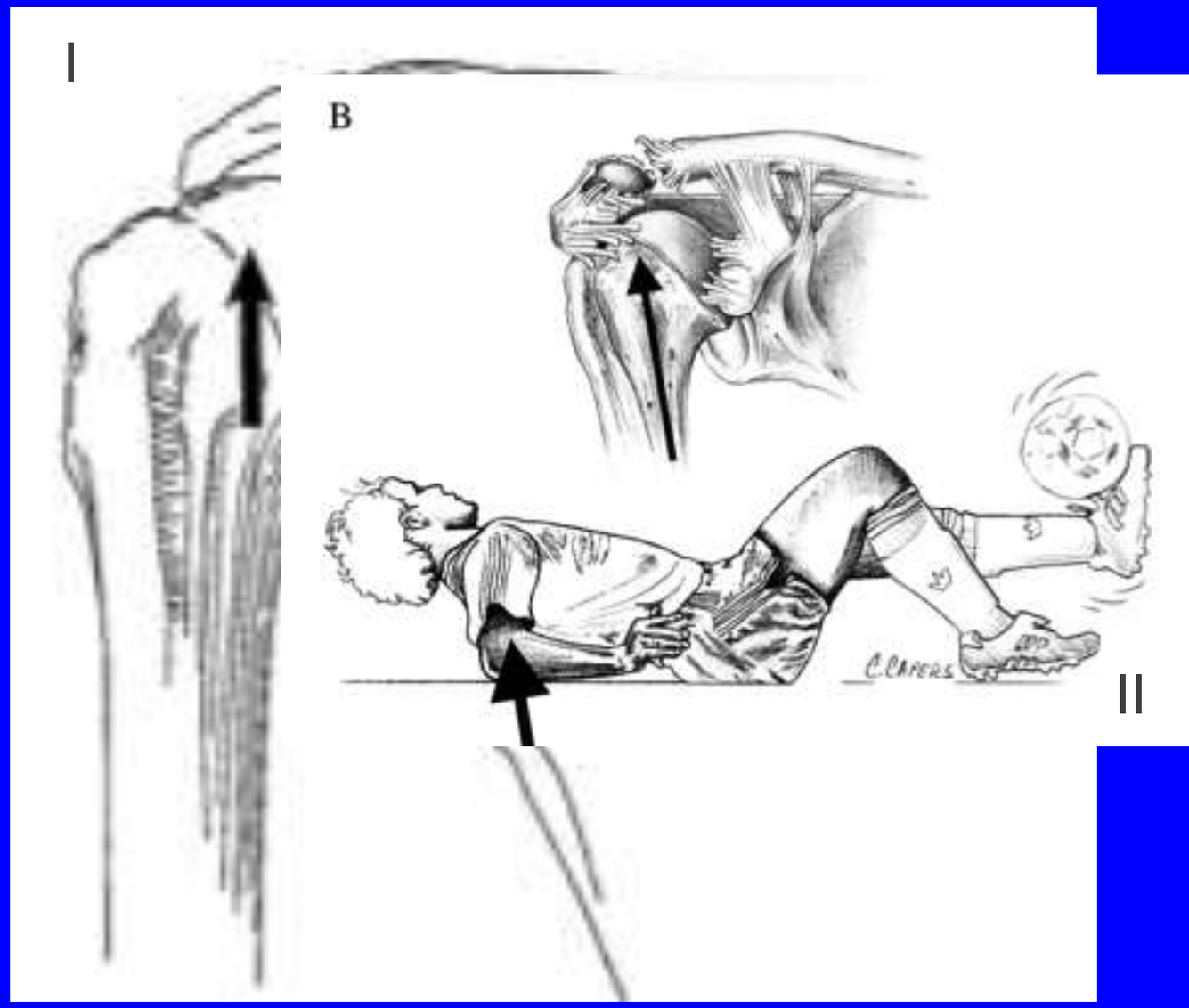
- Direct: Fall on superior aspect of shoulder, arm ADDuct (most common)

Mazzoca et al: Injuries to the acromiooclavicular joint in children, in Delee JC, Drez D (eds): Orthopedic Sports Medecine (ed 2) Philadelphia, PA. Saunders 2003 (pp 912-934)

Mechanism: Indirect

I. FOOS hand/elbow with Humerus Adducted

II. Humerus transfers upward force onto acromion



I. Mazzoca et al: Injuries to the acromiooclavicular joint in children, in Delee JC, Drez D (eds): Orthopedic Sports Medecine (ed 2) Philadelphia, PA. Saunders 2003 (pp 912-934)

II. Beim GM. **Acromioclavicular Joint Injuries.** *Journal of Athletic Training 2000;35(3):261–267*

Progression of Ligamentous Injury

I. Scapula is pushed downward and forward relative to the clavicle

II. Stretching and tensile failure
- midsubstance failure
- AC ligaments and capsule (low level force)
- Coracoclavicular ligaments (high level force)
- Trapezius muscle insertion/deltotrapezial fascia

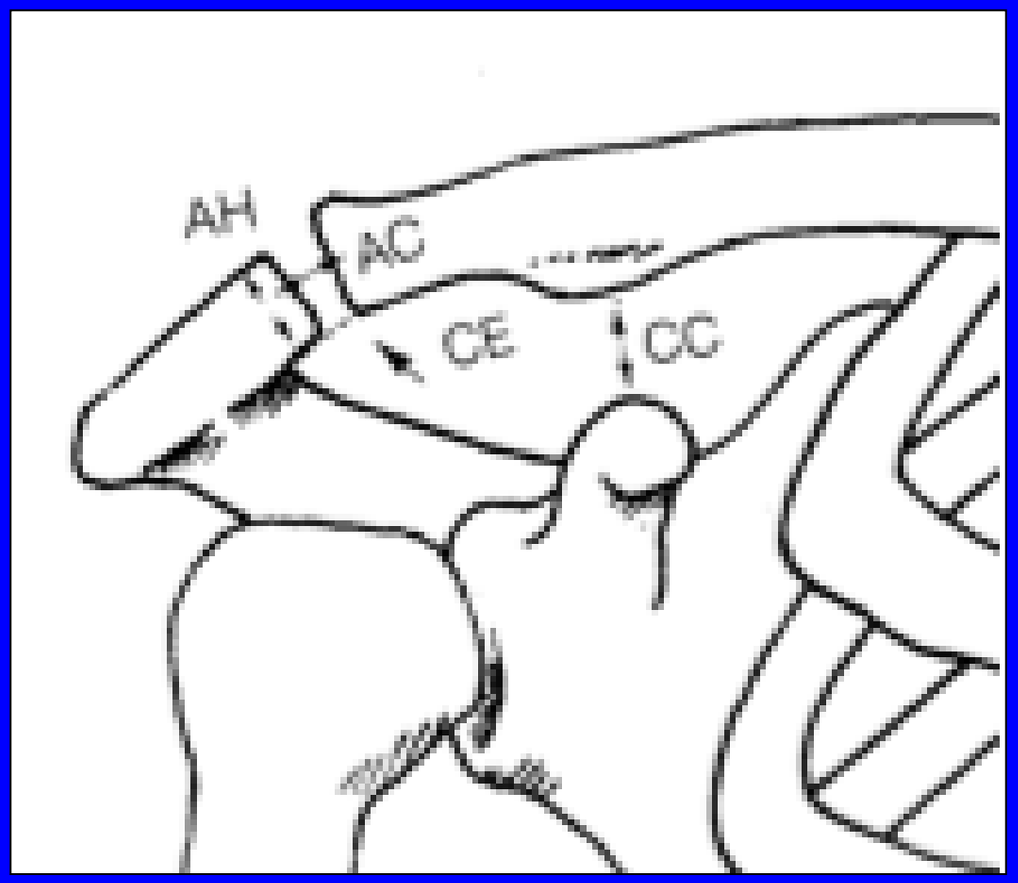
AC Joint injury: Clinical evaluation

Klonz A, Loitz D. Das Akromioklavikulargelenk. *Unfallchirurg* 2005. 108:1049–1060

I. Supportive history
II. Tenderness ⬇ ROM
III. Soft tissue swelling
IV. Ecchymosis
V. Assess for Abn skin contour suggesting deltotrapezial fascia failure

IMaarten Hendrik Moen, Robert-Jan de Vos, Todd S Ellenbecker, et al. **Clinical tests in shoulder examination: how to perform them.** *Br J Sports Med 2010 44: 370-375*

Imaging evaluation: Radiographs

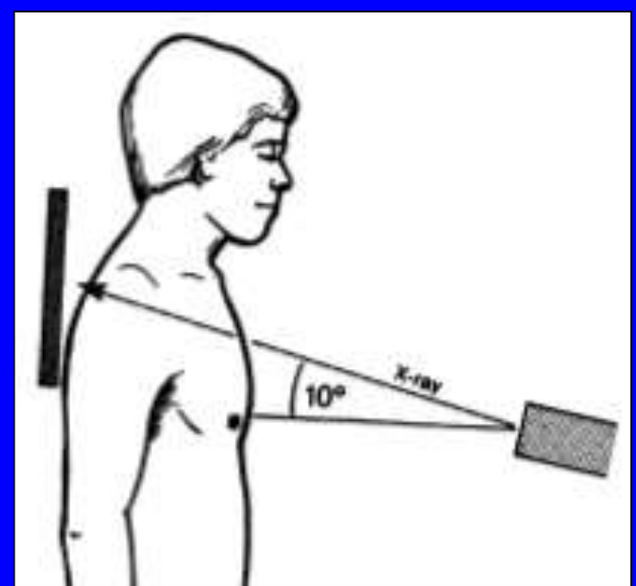


I. Routine shoulder (axillary, transcapular Y) helpful in Grade IV dislocation
II. Nml AC: 3-7 mm
III. Nml CC: 11-13 mm
IV. Distal clavicle should never be above superior acromion
V. contralateral side may be helpful (May normally see distal clavicle subluxation)

Bossart PJ, loyce SM, Manaster BJ, Packer SM: Lack of efficacy of 'weighted' radiographs in diagnosing acute acromioclavicular separation. Ann Emerg Med January I988;17:20-24.

Imaging evaluation: Radiographs

I. Zanca view
   - most accurate to assess AC articular surface
   - Moves scapula out of field
   - Standard AP view shoulder overpenetrates AC jt
   - Use ½ penetration strength
   - 10-15 degree cranial angulation of xray beam



Rockwood Jr CA, Williams GJ, Young C. Disorders of the acromioclavicular joint. In: Rockwood Jr CA, Matsen F, editors. The shoulder. Philadelphia: W. B. Saunders Co.; 1998. p. 483-554

Imaging evaluation: Radiographs

I. Stryker notch view
   - If have a normal coracoclavicular distance but AC joint dislocation, suspect base of coracoid fracture
   - Xray beam is centered over coracoid process and tilted 10 deg cephalad

http://www.wheelessonline.com/images/strykera.jpg

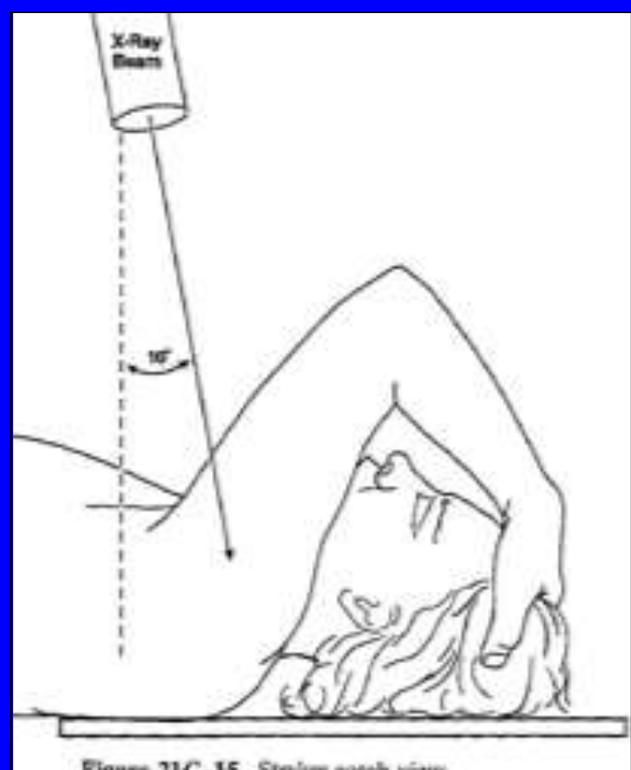
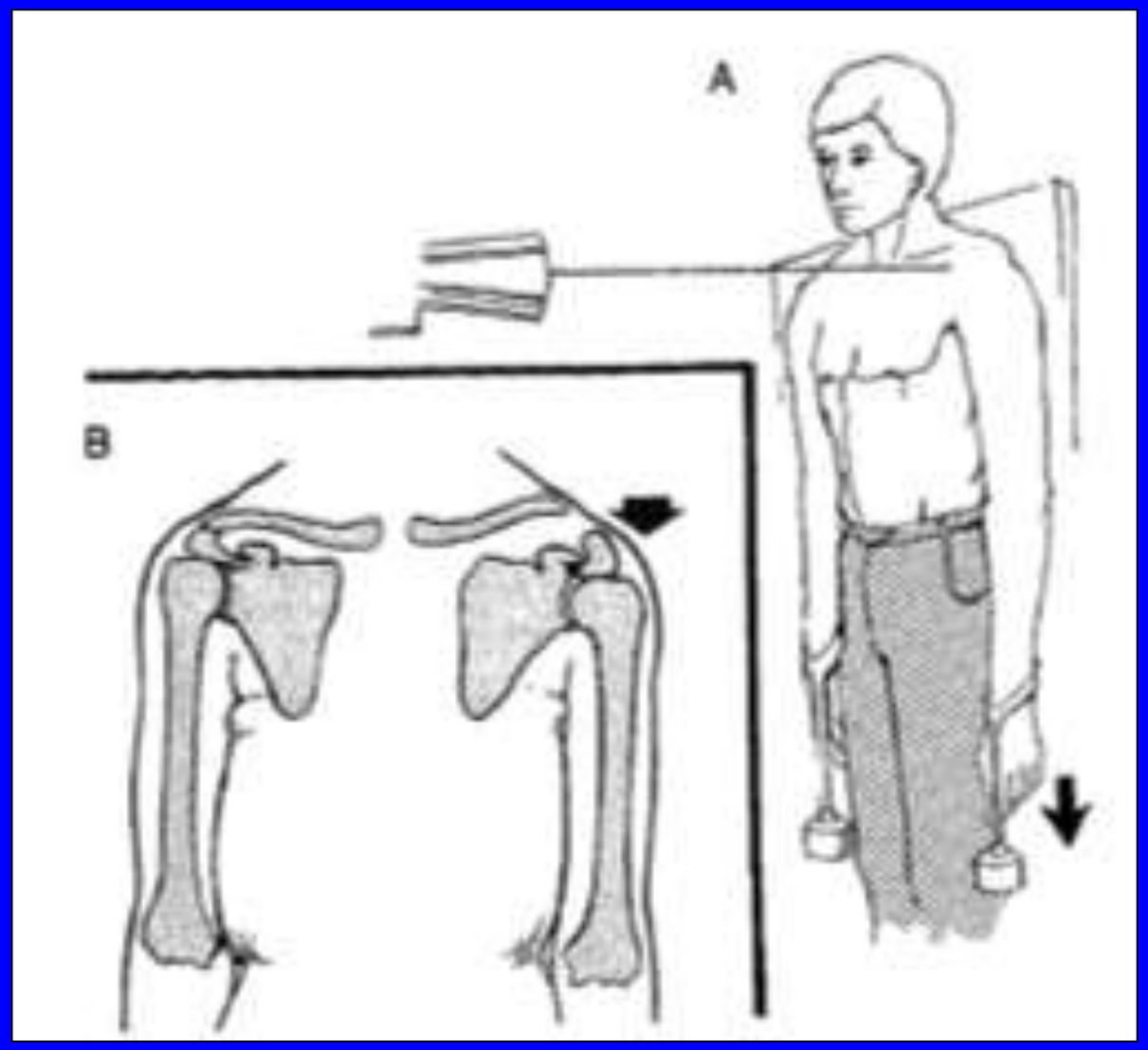


Figure 21C–15. Stryker notch view.

Mazzoca et al: Injuries to the acromiooclavicular joint in children, in Delee JC, Drez D (eds): Orthopedic Sports Medecine (ed 2) Philadelphia, PA. Saunders 2003 (pp 912-934)

Stress Radiographs



I. AP view both AC jts
II. 10-15 lbs
III. Weights thought to accentuate coracoclavicular ligament insufficiency
IV. May widen CC and AC distance alike
V. Elucidate grade III injury if CC space widens

Mazzoca et al: Injuries to the acromiooclavicular joint in children, in Delee JC, Drez D (eds): Orthopedic Sports Medecine (ed 2) Philadelphia, PA. Saunders 2003 (pp 912-934)

Stress Radiographs: Debated efficacy

Lack of Efficacy of 'Weighted' Radiographs in Diagnosing Acute Acromioclavicular Separation

I. 84 cases dx with AC Jt injury in ED underwent AC jt imaging

II. Without and with 10 lb weights

III. In 3 cases Grade 1, 2 upgraded to grade 3 with addition of weights

IV. In 7 cases weights underestimated AC joint injury when compared to plain film

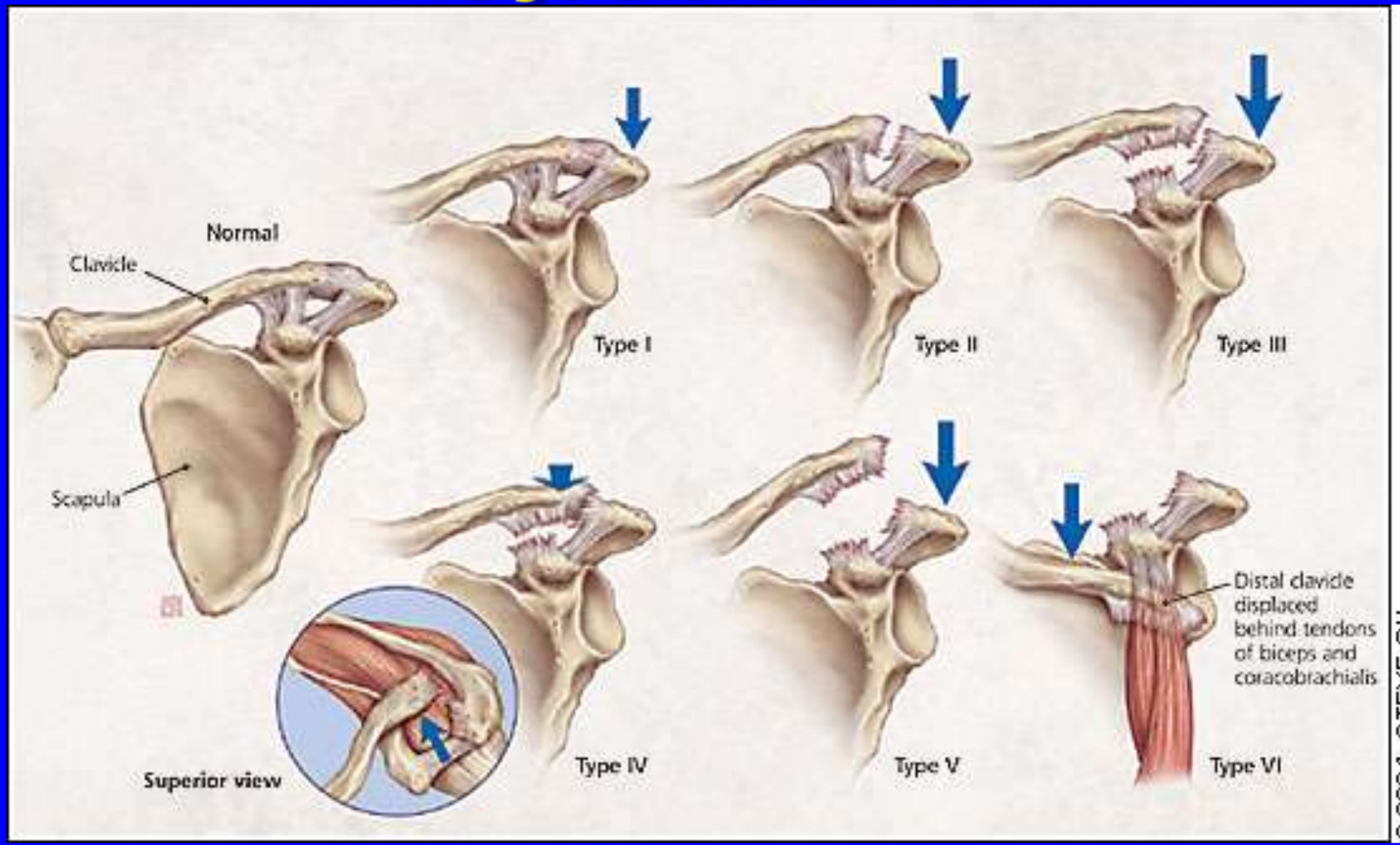
- 6/7 weights caused normal side AC/CC distance to increase

Bossart PJ, loyce SM, Manaster BJ, Packer SM: Lack of efficacy of 'weighted' radiographs in diagnosing acute acromioclavicular separation. *Ann Emerg Med January* I988;17:20-24.

Imaging Evaluation: CT/MR

I. CT for complex/subtle (base coracoid)
II. MRI-not routinely performed to eval AC jt
   - Often seen while evaluating other shoulder path
   - **Pros**: exquisite detail helps in troubleshooting cases where diagnosis is uncertain
   - **Cons**: often difficult to differentiate degenerative change from capsular/ligament injury
   - **Cons**: patient is supine which limits amount of gravity-assisted inferior acromion displacement utilized by radiography

Modified Rockwood Classification
AC Jt dislocation



Modified Rockwood Classification AC Jt dislocation

Table 1

Characterization of Acromioclavicular Joint Injuries by the Rockwood Classification*

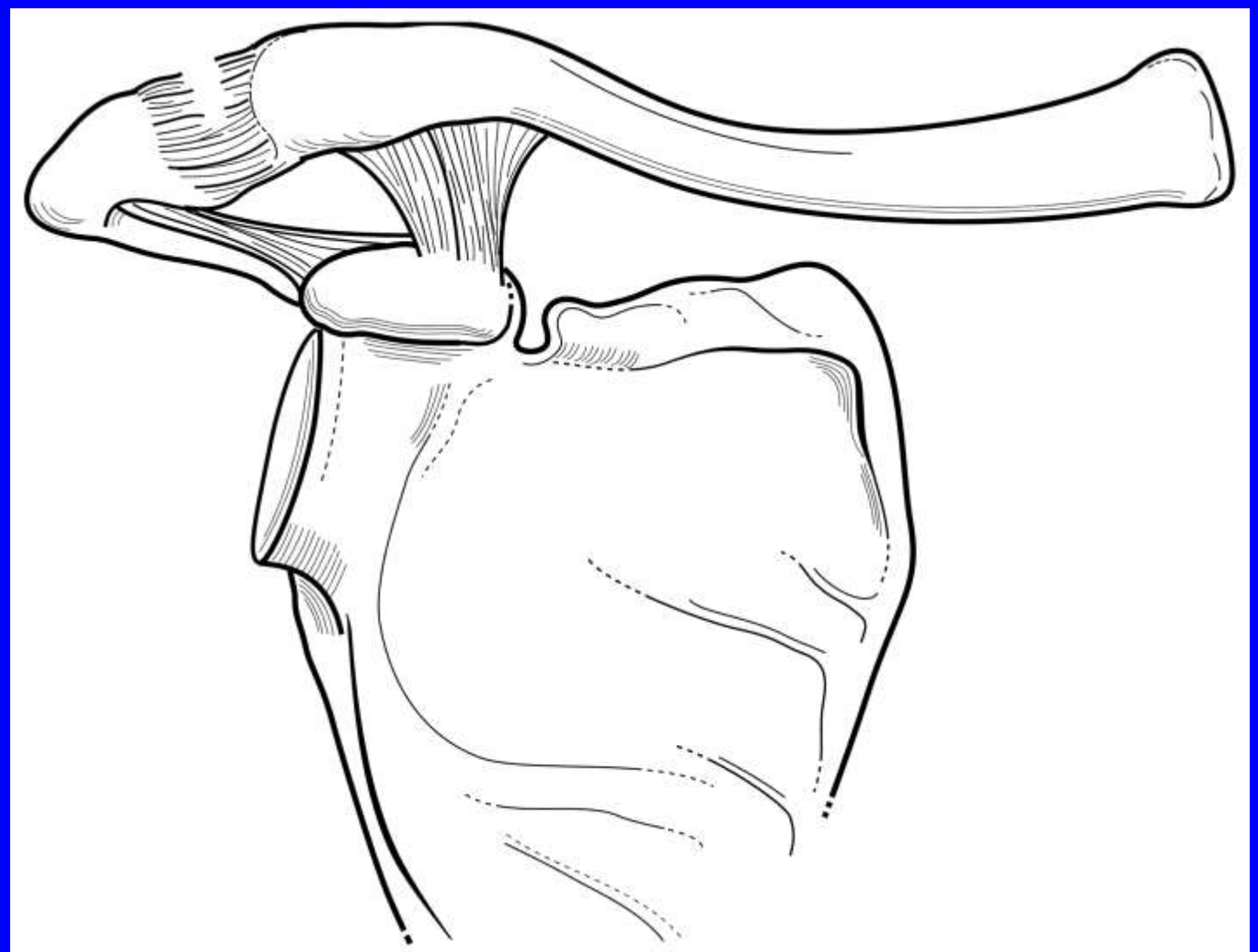
Type	AC Ligaments	CC Ligaments	Deltopectoral Fascia	Radiographic CC Distance Increase	Radiographic AC Appearance	AC Joint Reducible
I	Sprained	Intact	Intact	Normal (1.1 to 1.3 cm)	Normal	N/A
II	Disrupted	Sprained	Intact	<25%	Widened	Yes
III	Disrupted	Disrupted	Disrupted	25%-100%	Widened	Yes
IV	Disrupted	Disrupted	Disrupted	Increased	Posterior clavicle displacement	No
V	Disrupted	Disrupted	Disrupted	100%-300%	N/A	No
VI	Disrupted	Intact	Disrupted	Decreased	N/A	No

* The type of AC injury can be discerned based on the pattern of ligament injury, AC joint position on radiographs, and whether the AC joint can be reduced on physical examination.

AC = acromioclavicular, CC = coracoclavicular, N/A = not applicable

Simovitch R. Acromioclavicular Joint Injuries: Diagnosis and Management. *J Am Acad Orthop Surg 2009;17: 207-219*

Grade 1 Injury



Alyas F et al. Radiographics 2008;28:463-479

I. Sprain or torn acromioclavicular ligaments
II. Normal radiographs
III. PE:
   - AC jt tenderness, STS
   - No tenderness upon palpation of CC interspace

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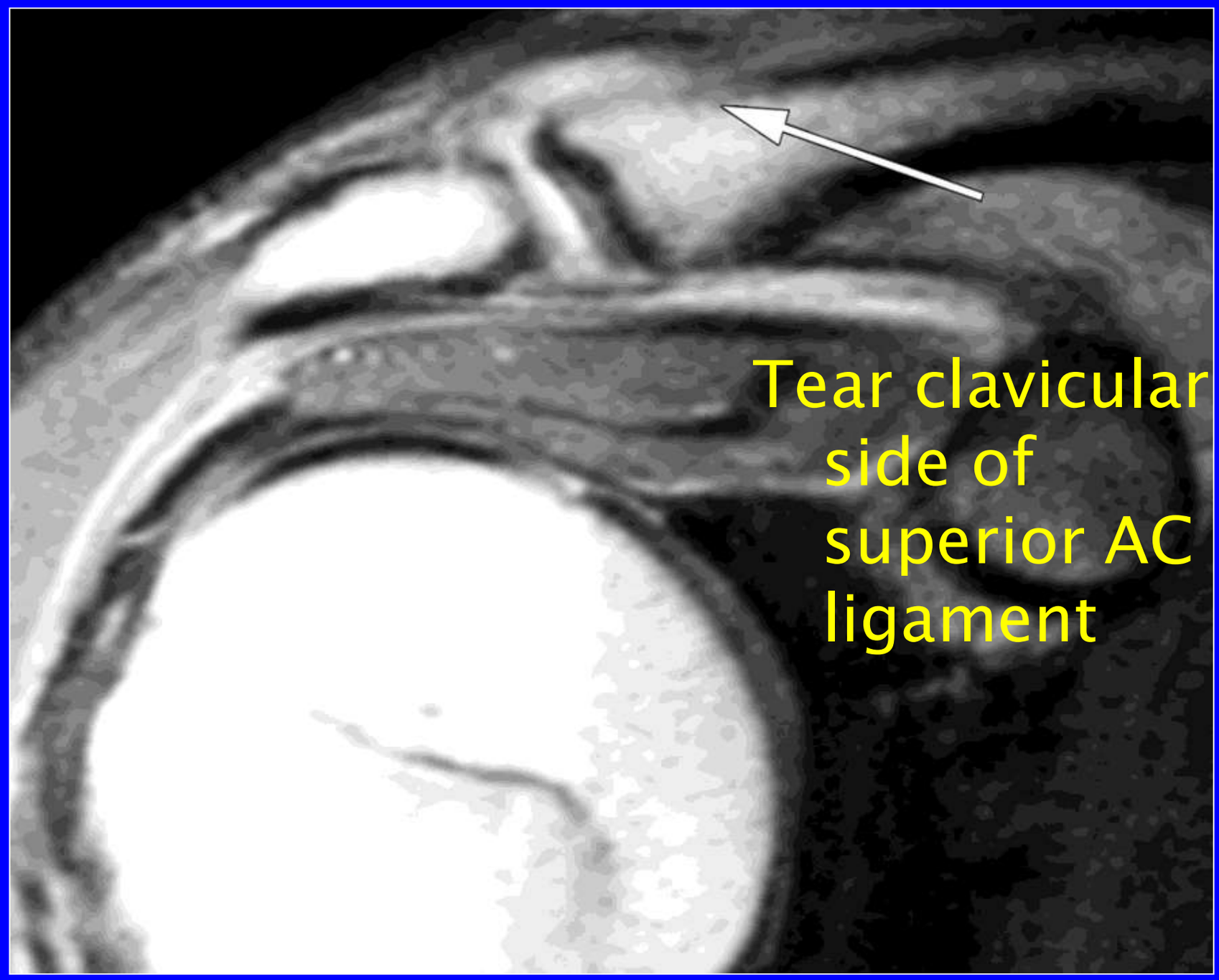
Grade 1 Injury



Alyas F et al. Radiographics 2008;28:463-479

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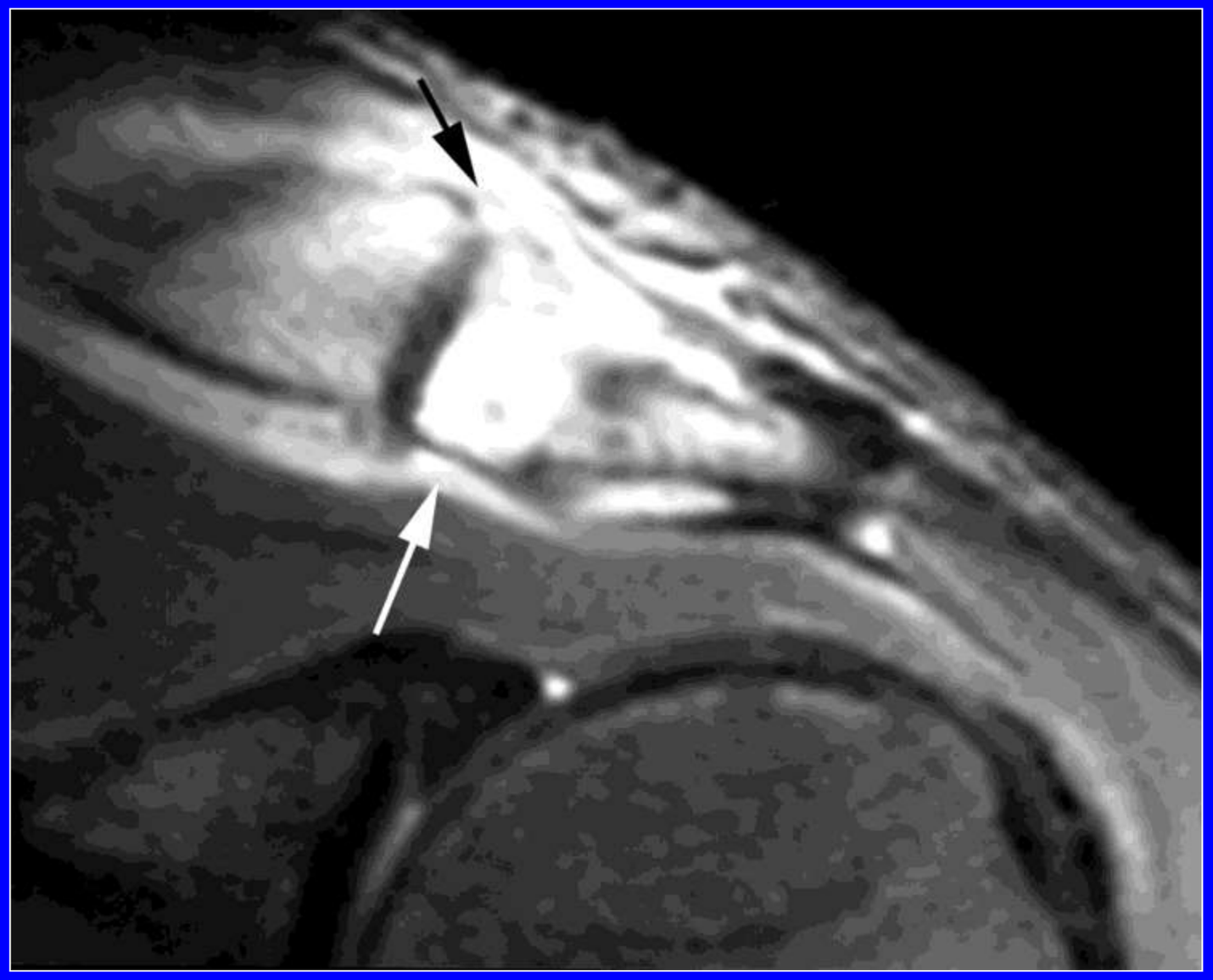
Grade 1 Injury



Alyas F et al. Radiographics 2008;28:463-479

I. Torn superior AC ligament

II. Pericapsular edema

III. Intact inferior AC ligament

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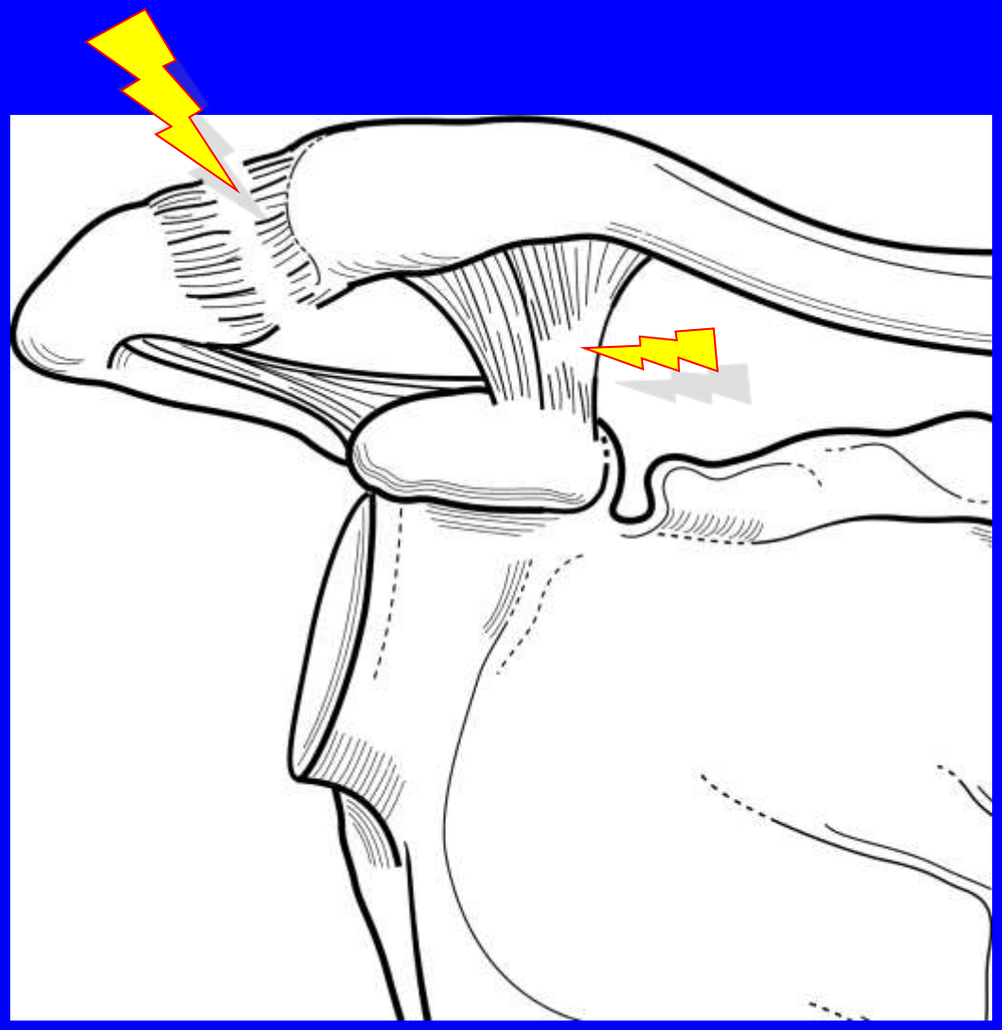
Grade 2 Injury



I. AC ligaments disrupted
   - Horizontal instability

II. CC lig may be sprained, but intact

III. Up to 50% vertical subluxation of clavicle

IV. PE
   - slight prominence of the distal clavicle
   - Tenderness may be present in the CC interspace

Alyas F et al. Radiographics 2008;28:463-479

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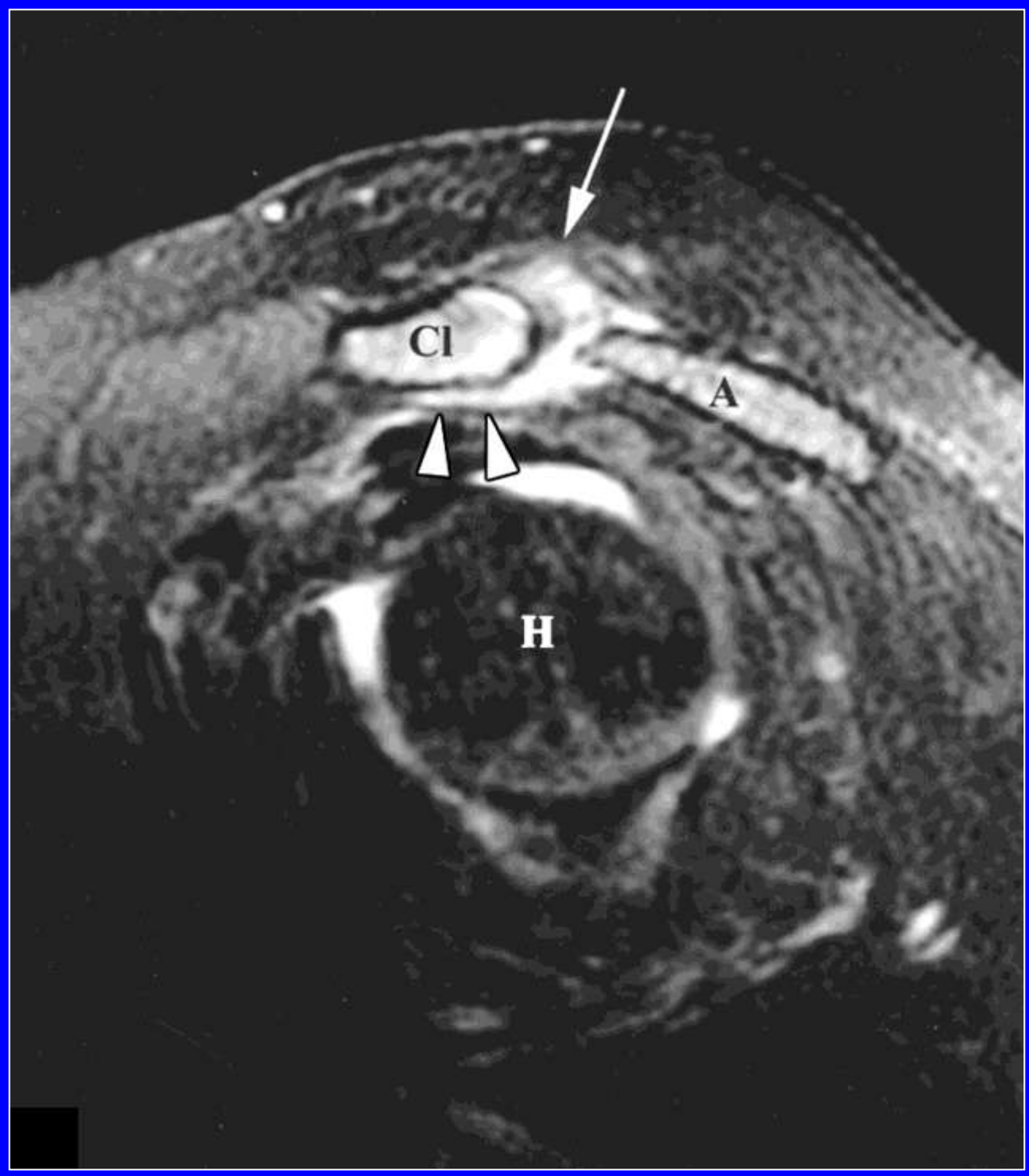
Grade 2 Injury



Antonio, G. E. et al. Am. J. Roentgenol. 2003;180:1103-1110

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Grade 2 Injury

Antonio, G. E. et al. Am. J. Roentgenol. 2003;180:1103-1110

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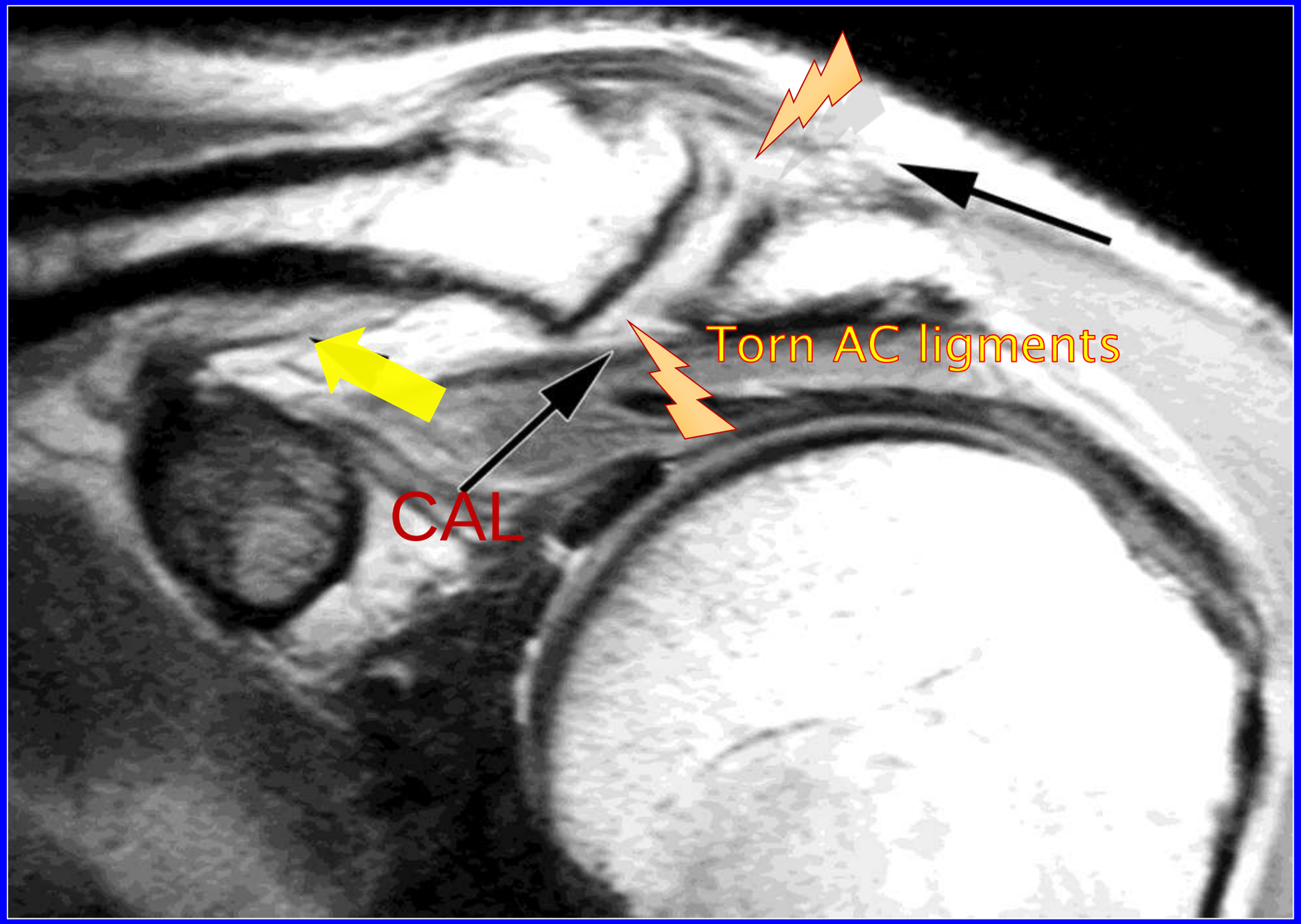
Grade 2 Injury

Trapezoid ligament attenuated at clavicular insertion



Alyas F et al. Radiographics 2008;28:463-479

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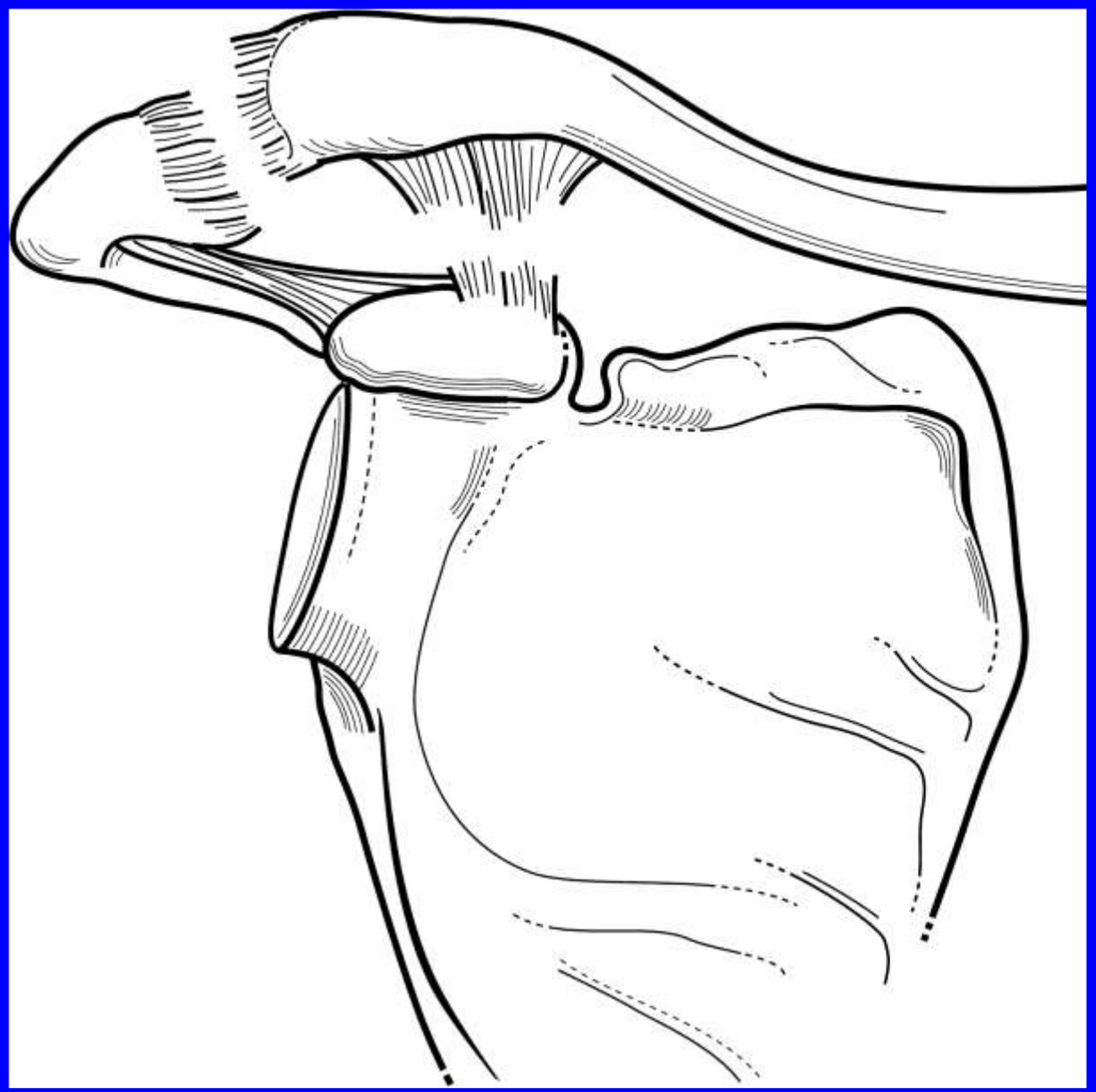
Grade 3 Injury



Alyas F et al. Radiographics 2008;28:463-479

I. Up to 40 % of all AC jt dx
II. Complete AC, CC lig tears
III. AC Jt dislocation
IV. May have partial tear of fascia
V. PE Findings
   - Prominent distal clavicle
   - ↓ displacement of shoulder/arm
   - Lost suspensory support of AC and CC ligaments.

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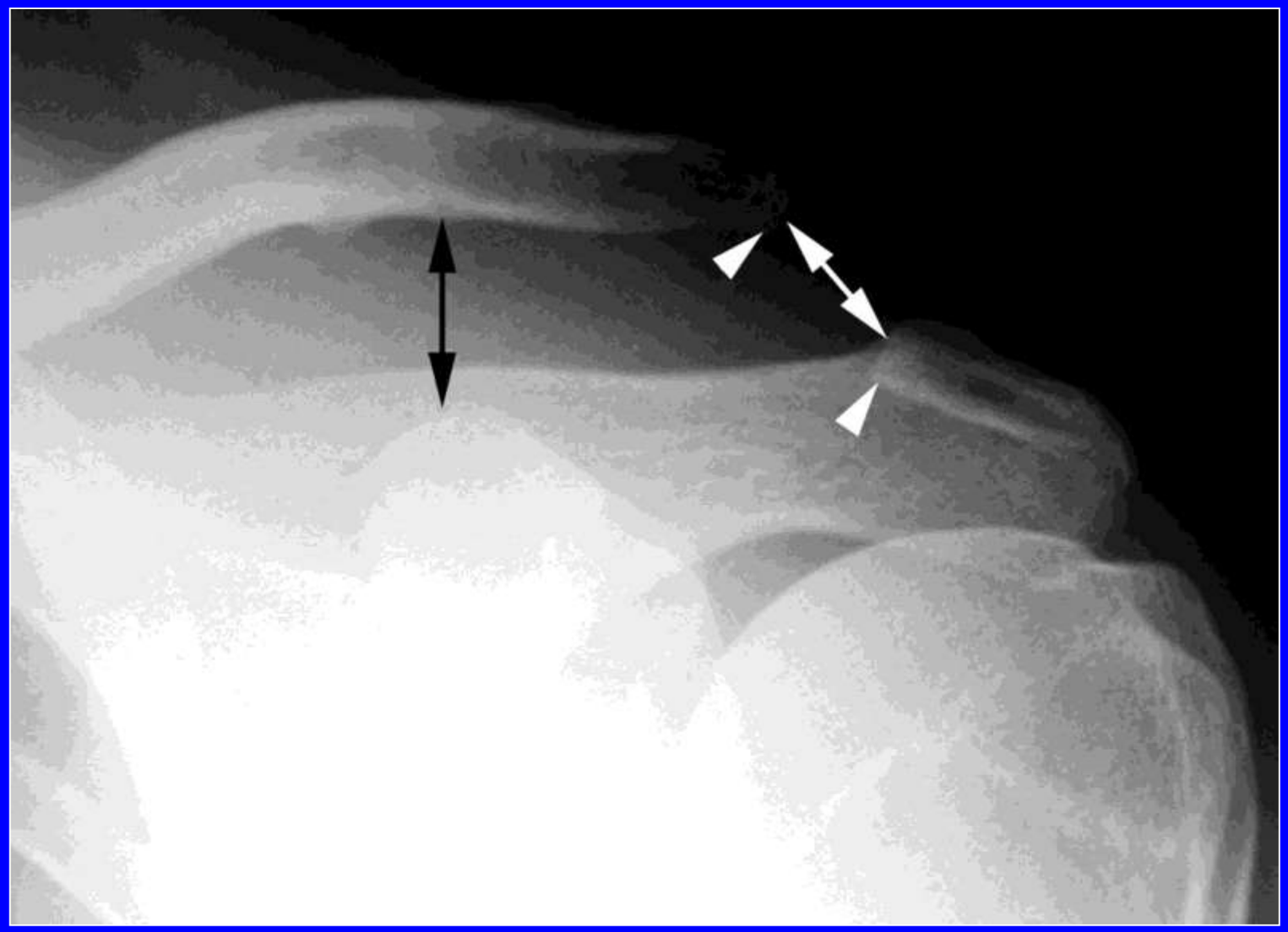
Grade 3 Injury



Alyas F et al. Radiographics 2008;28:463-479

I. widened AC distance 10 mm

II. widened CC distance 20 mm (50% increase)

III. superior dislocation clavicle relative to the acromion up to 100% nml

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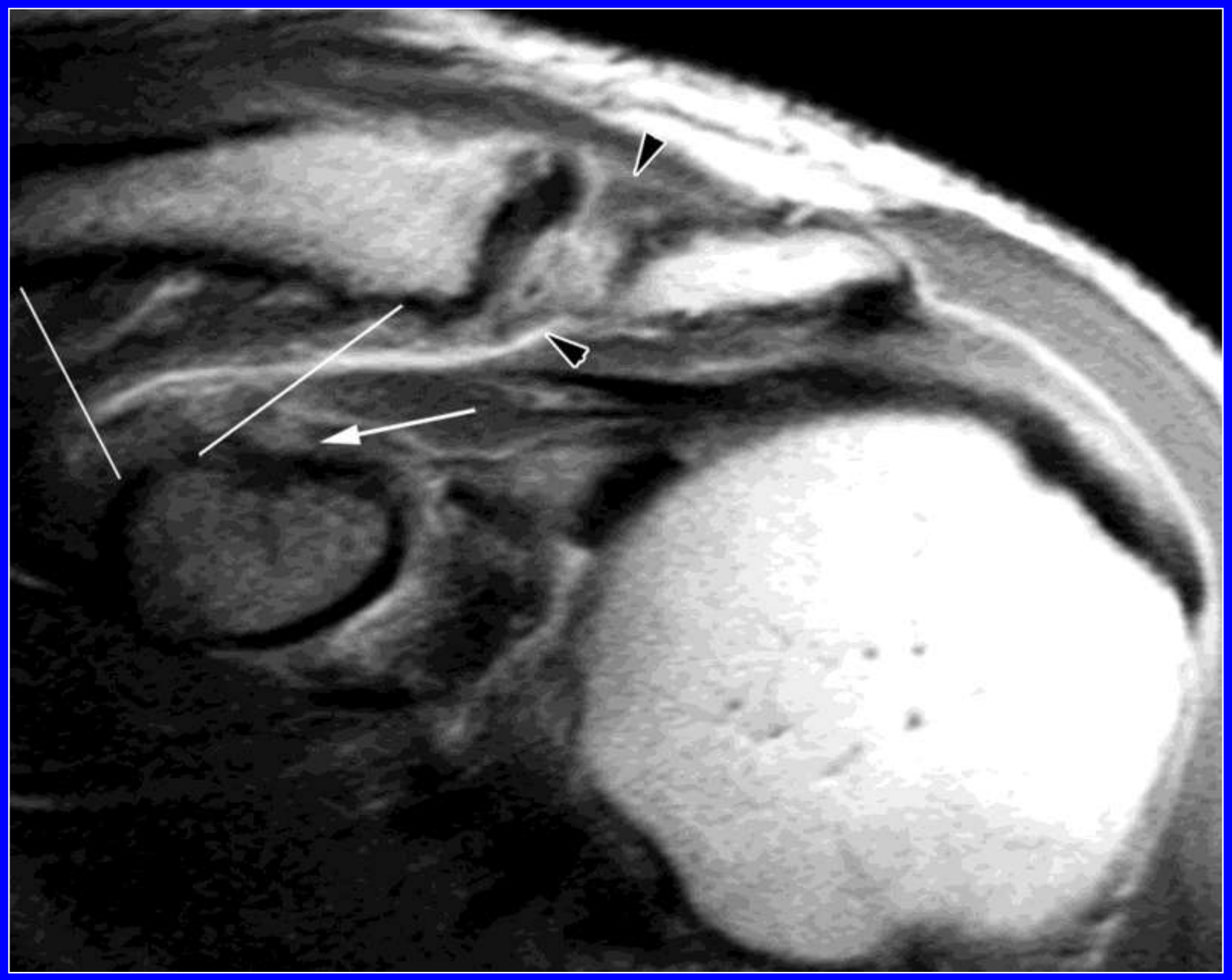
Grade 3 Injury



I. Tears of the superior and inferior AC ligaments

II. Torn trapezoid and conoid CC ligaments

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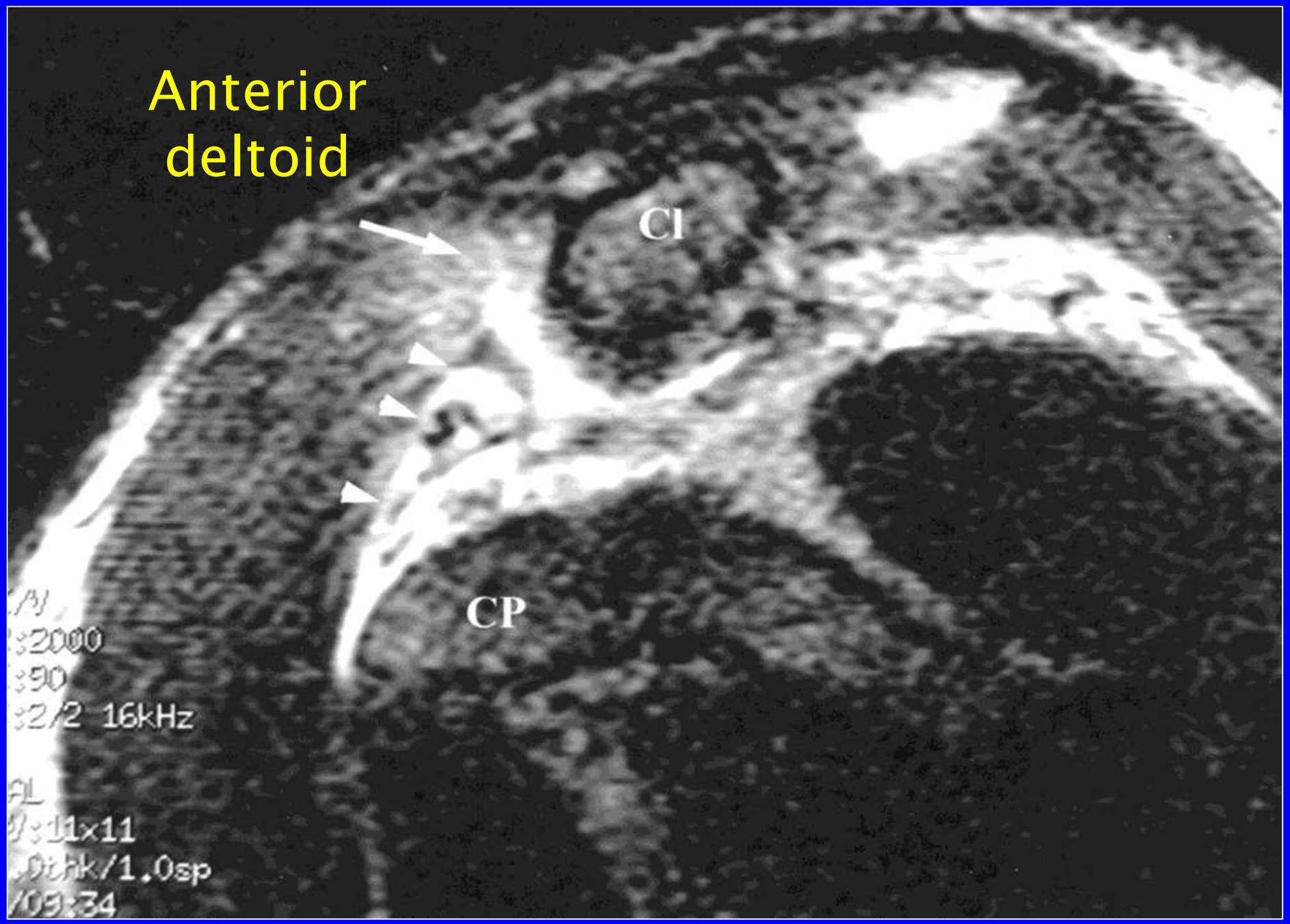
Grade 3 Injury



Antonio, G. E. et al. Am. J. Roentgenol. 2003;180:1103-1110

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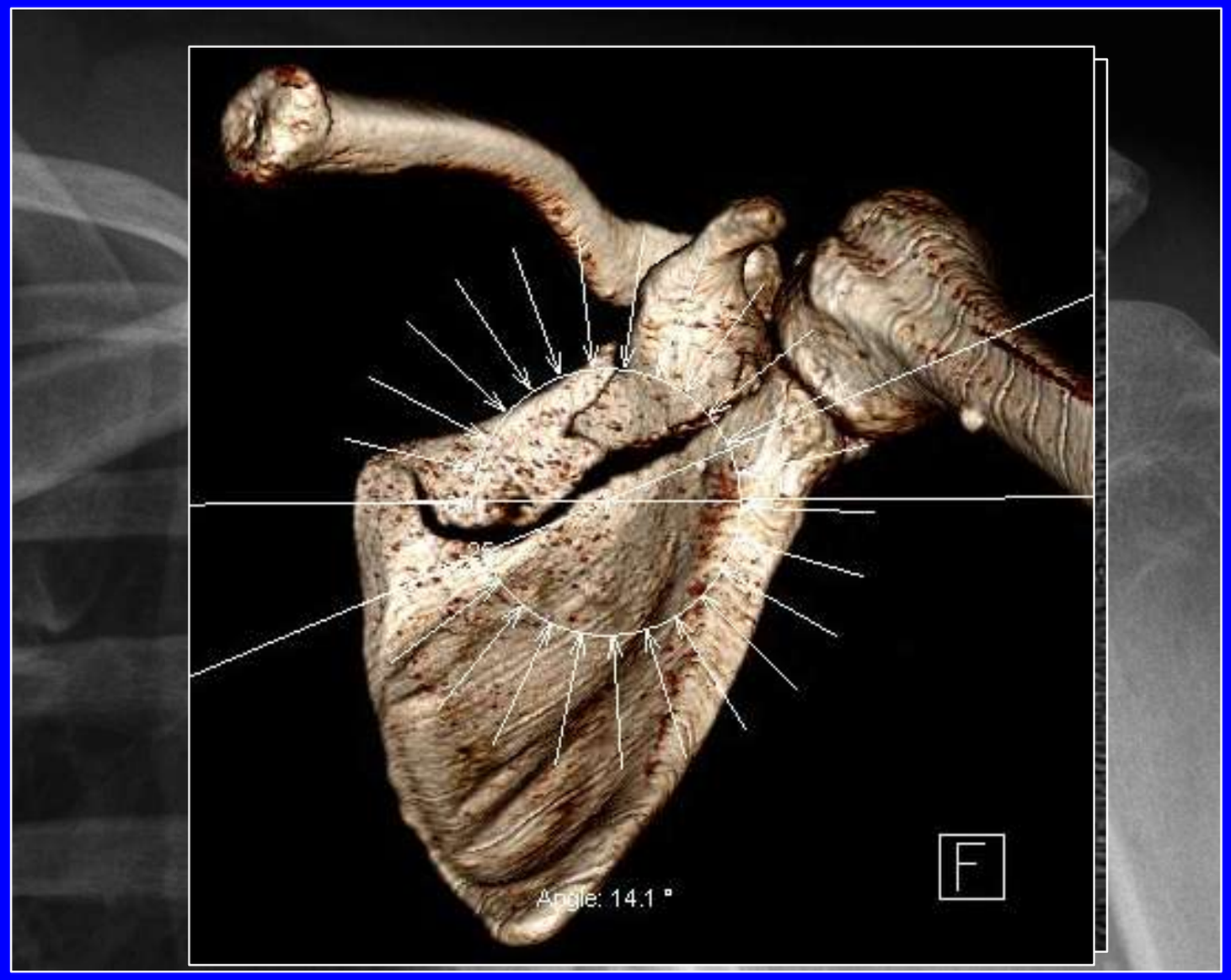
Grade 3 Equivalent



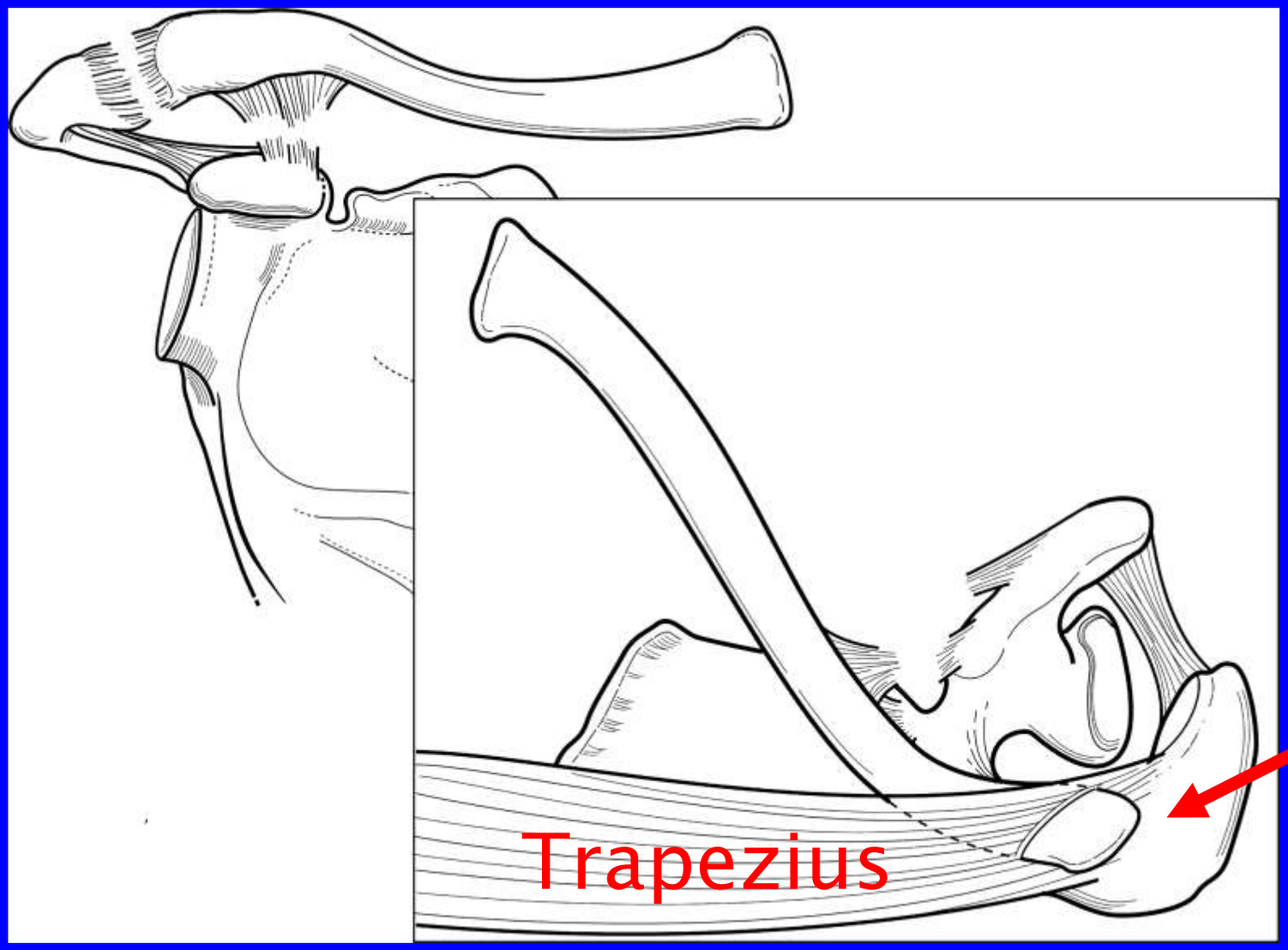
24775942

I. <u>Torn AC ligaments</u>
- distal clavicle elevated 5 mm relative to acromion

II. <u>Scapular fracture</u>
- Glenoid
- Coracoid base
  - Fx results in functional loss of CC ligaments
- spine to medial scapular border

Case Courtesy Mini Pathria MD

Grade 4 Injury



I. Complete AC, CC lig tears

II. Clavicle dislocated posteriorly into or through trapezius (buttonholing)

III. distal clavicle is fixed in position, perforated trapezius

Alyas F et al. Radiographics 2008;28:463-479

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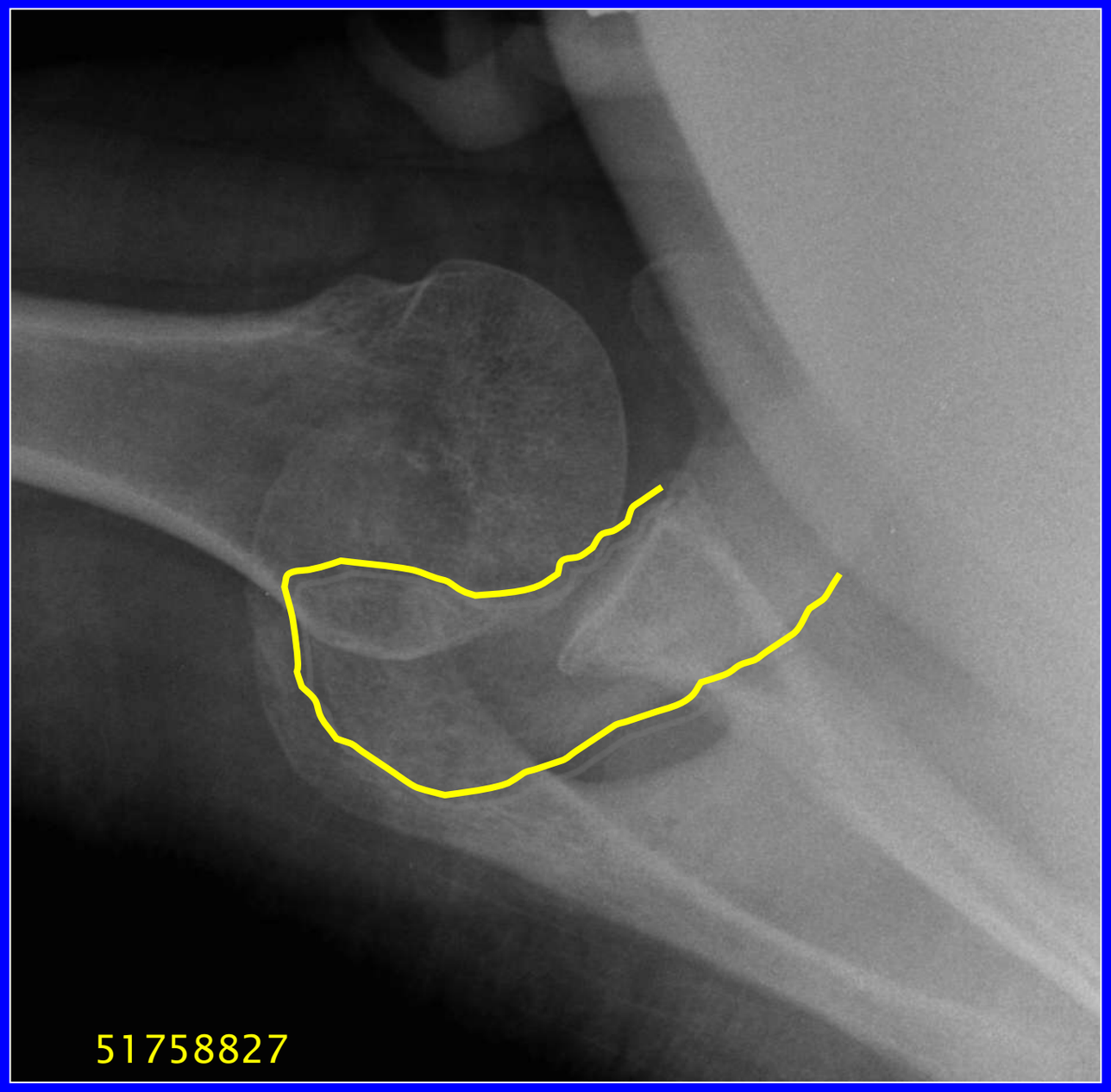
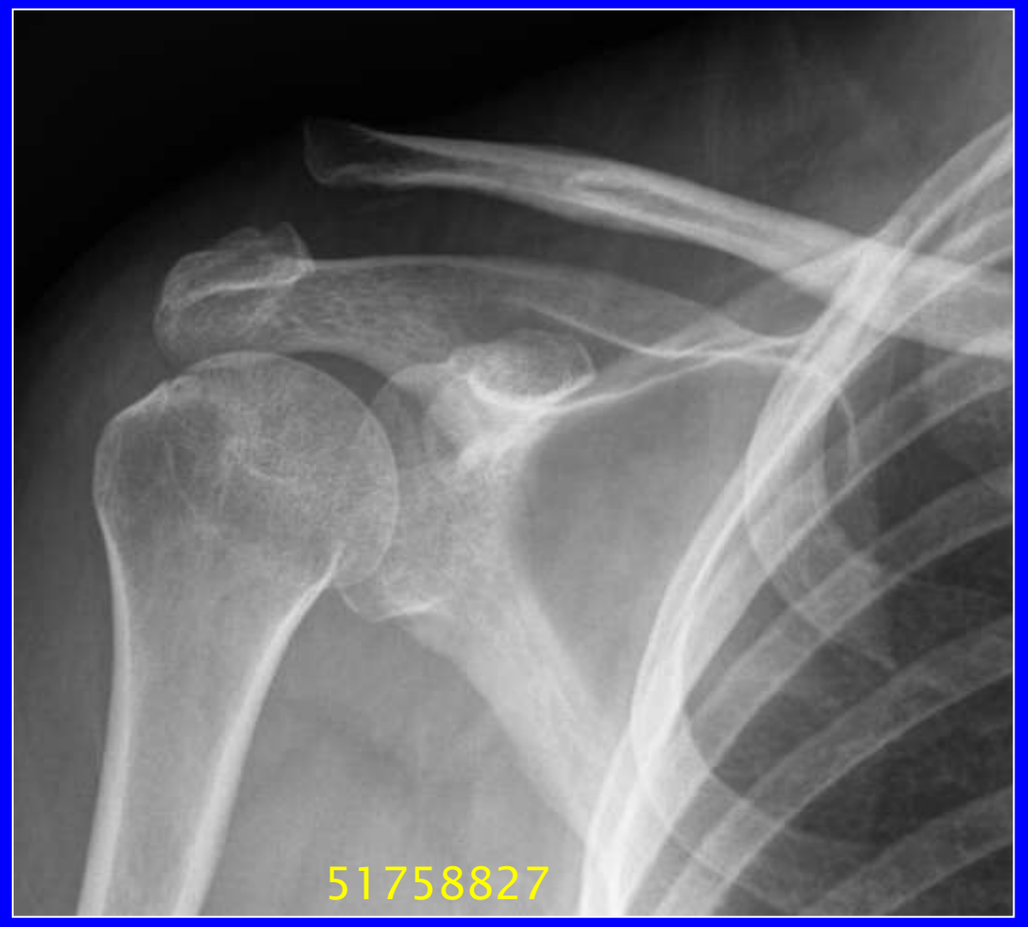
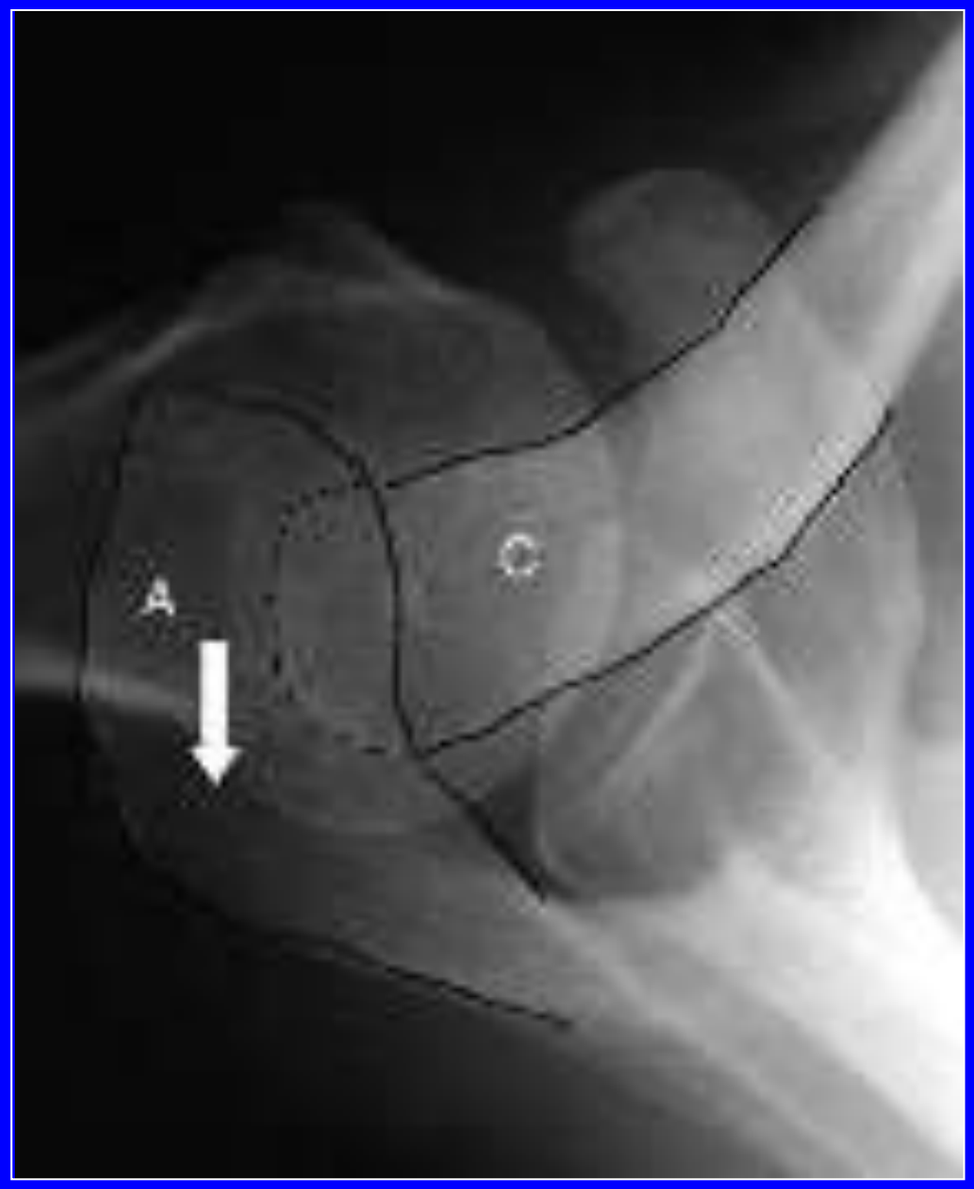
Grade 4 Injury





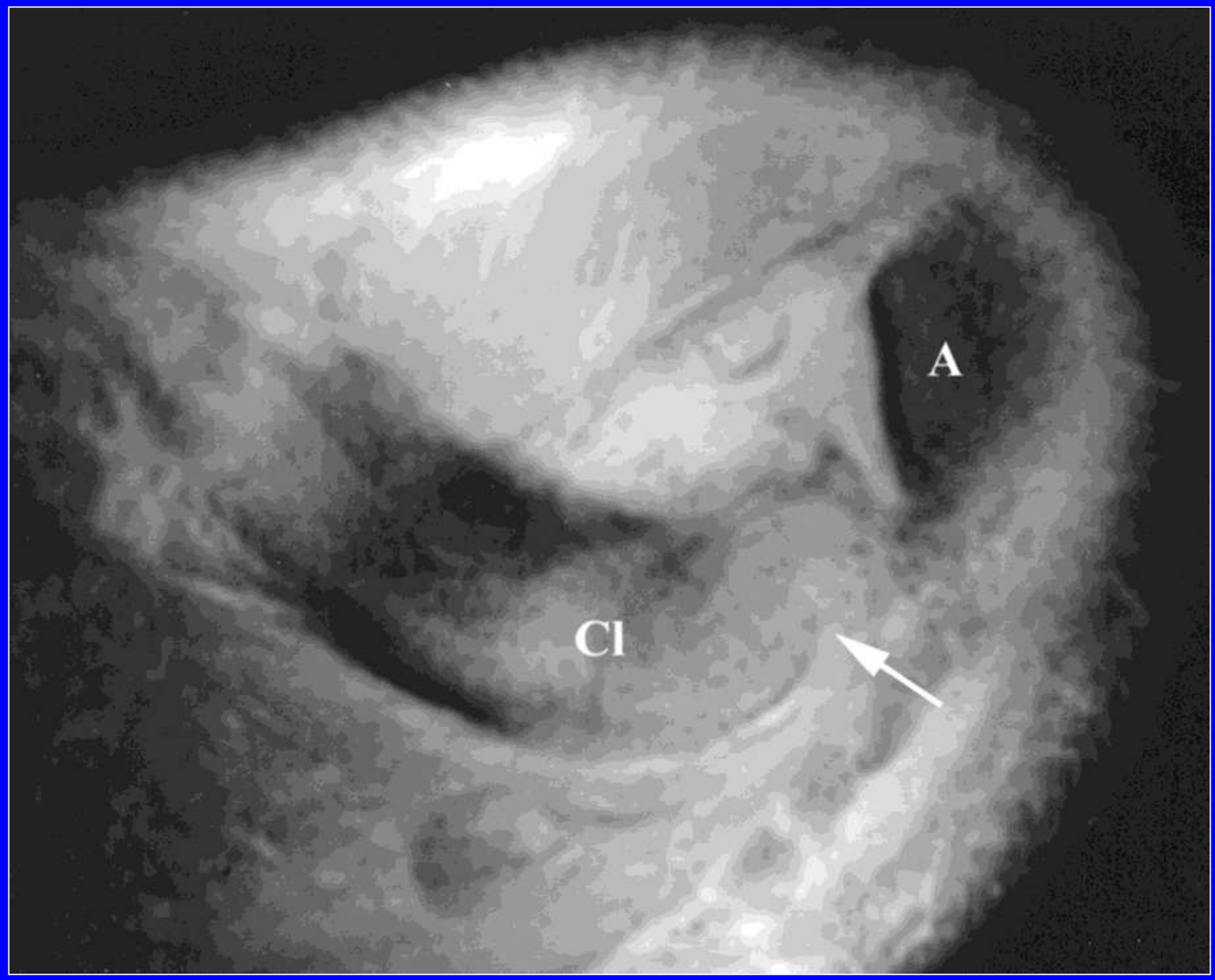
Case Courtesy Tudor Hughes MD

Grade 4 Injury



Simovitch R. Acromioclavicular Joint Injuries: Diagnosis and Management. *J Am Acad Orthop Surg 2009;17: 207-219*

Grade 4 Injury



Antonio, G. E. et al. Am. J. Roentgenol. 2003;180:1103-1110

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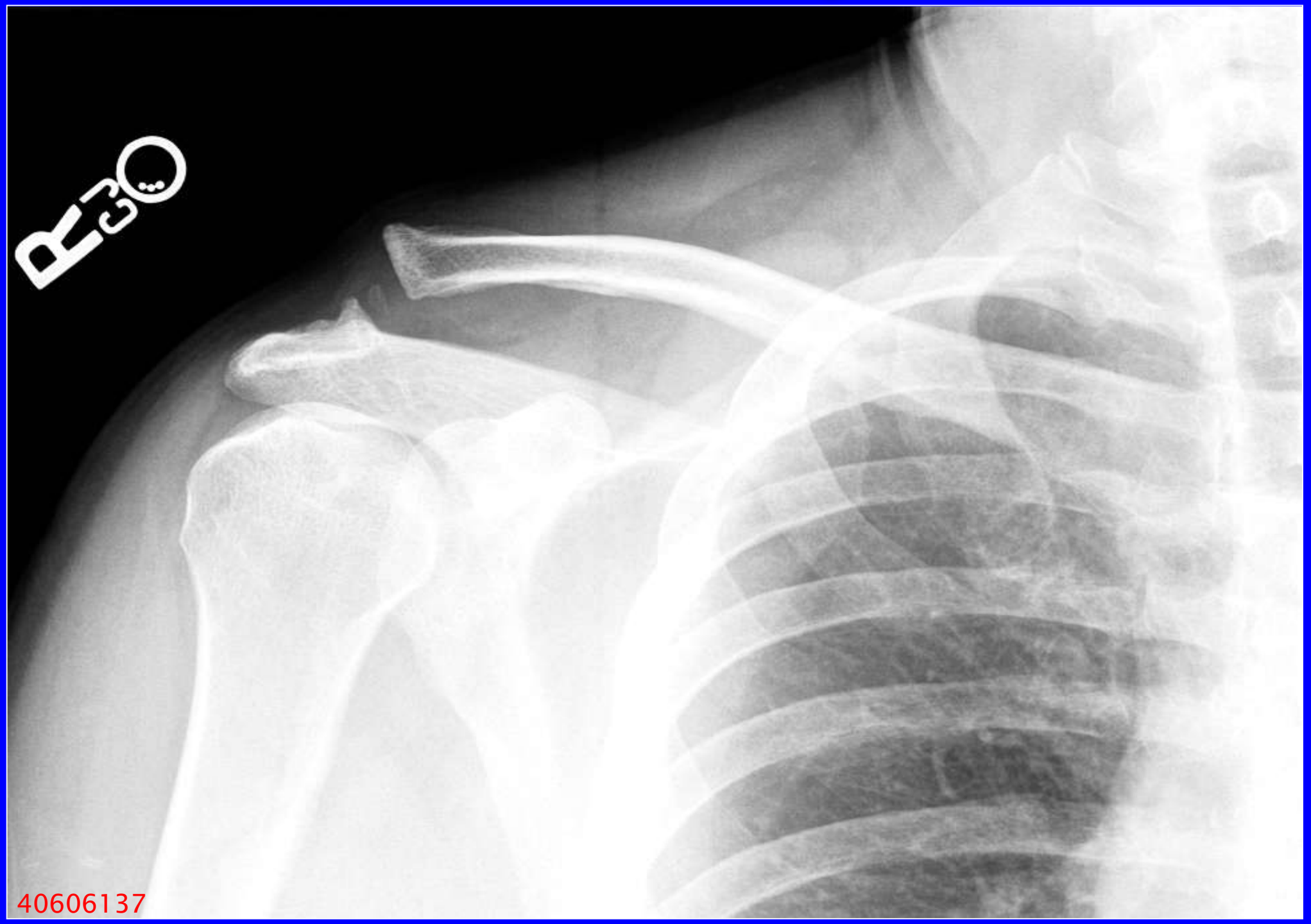
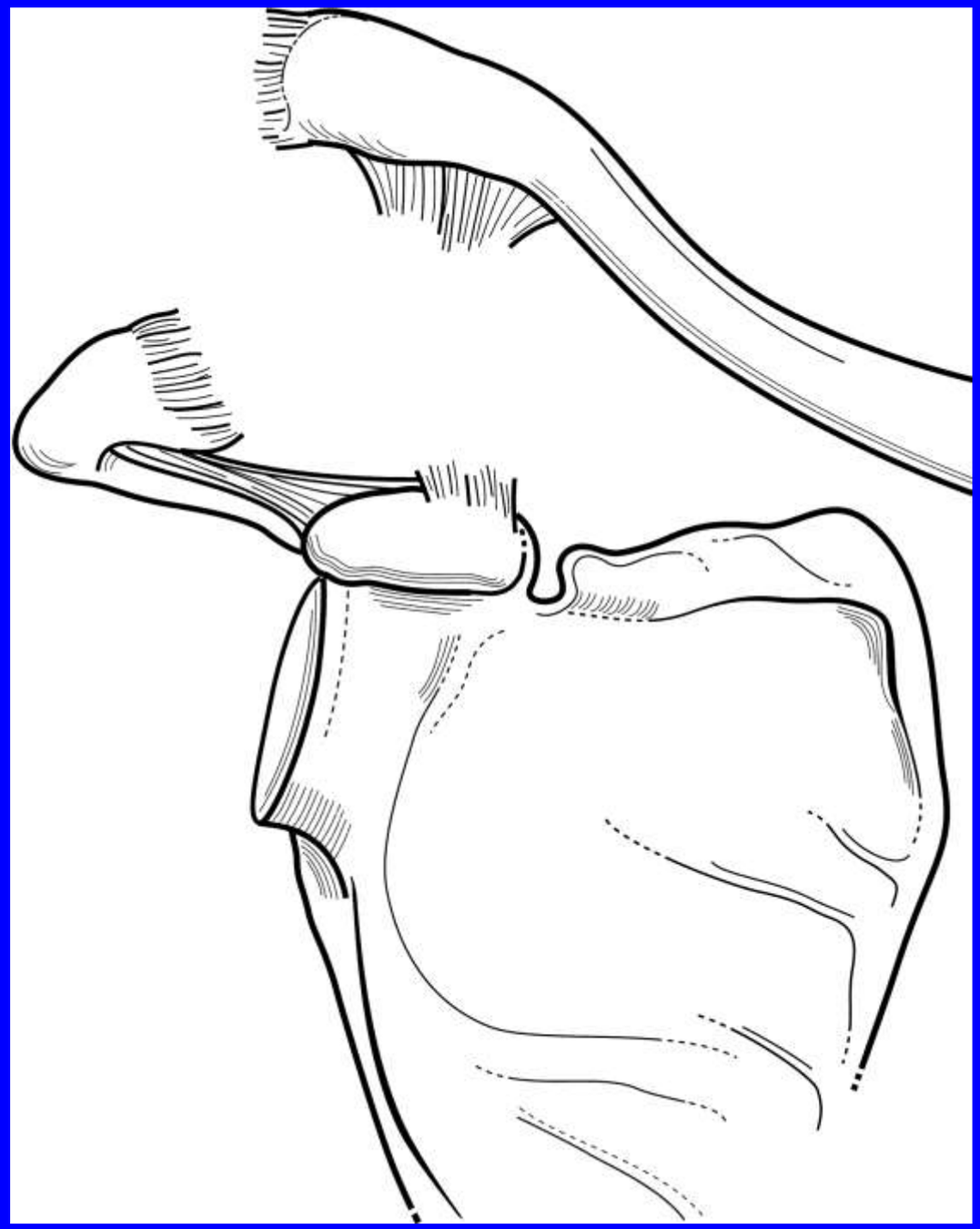
AJR

Tennis Injury



Case Courtesy Christine Chung MD

Grade 5 Injury



Alyas F et al. Radiographics 2008;28:463-479

I. Exaggerated grade III
II. Complete AC, CC ligament tears
III. wide separation of the AC Jt
IV. Inferior displacement of scapula may result in traction upon and injury to brachial plexus
V. Disruption of the deltotrapezial fascia results in the clavicle appearing subQ

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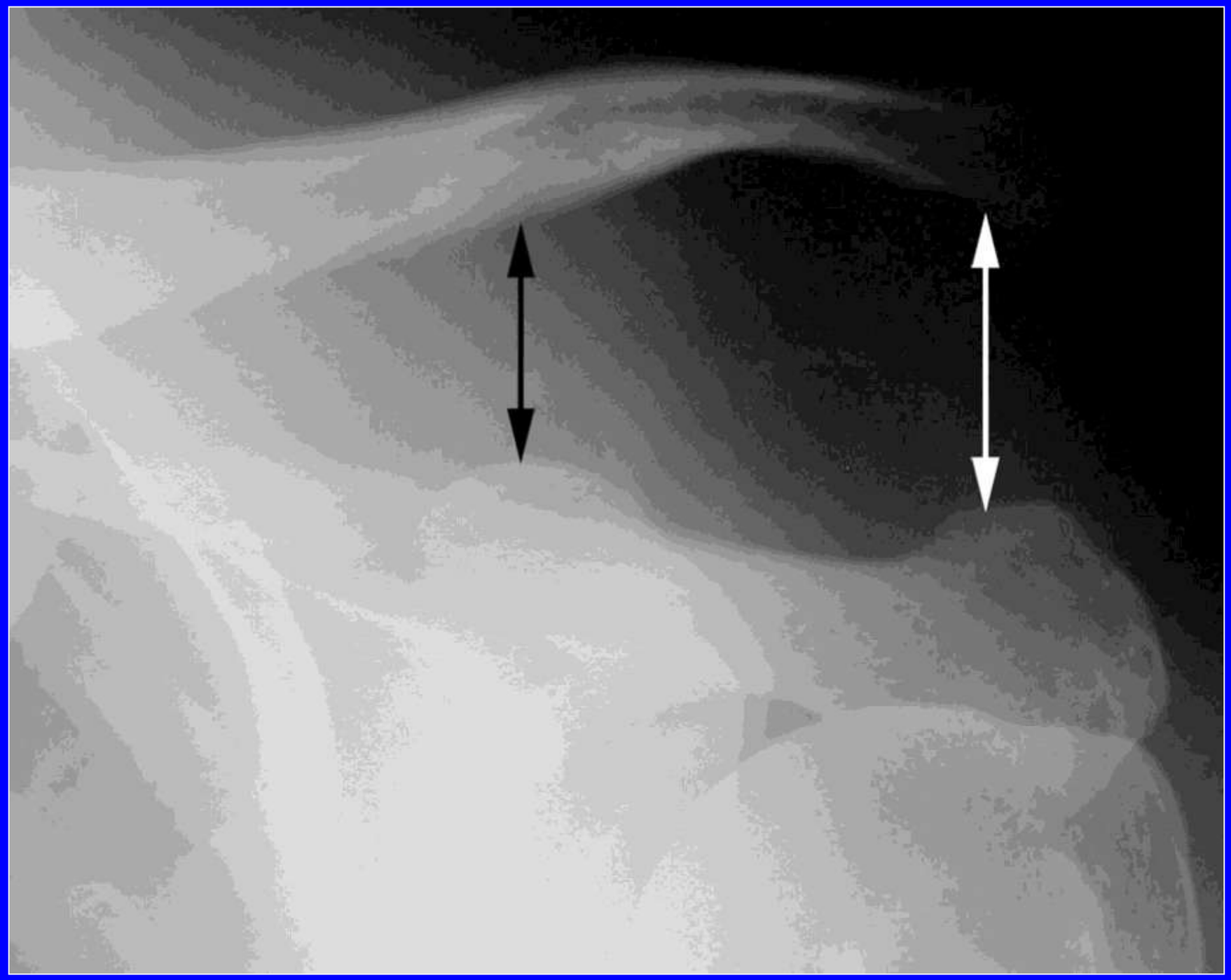
Grade 5 Injury



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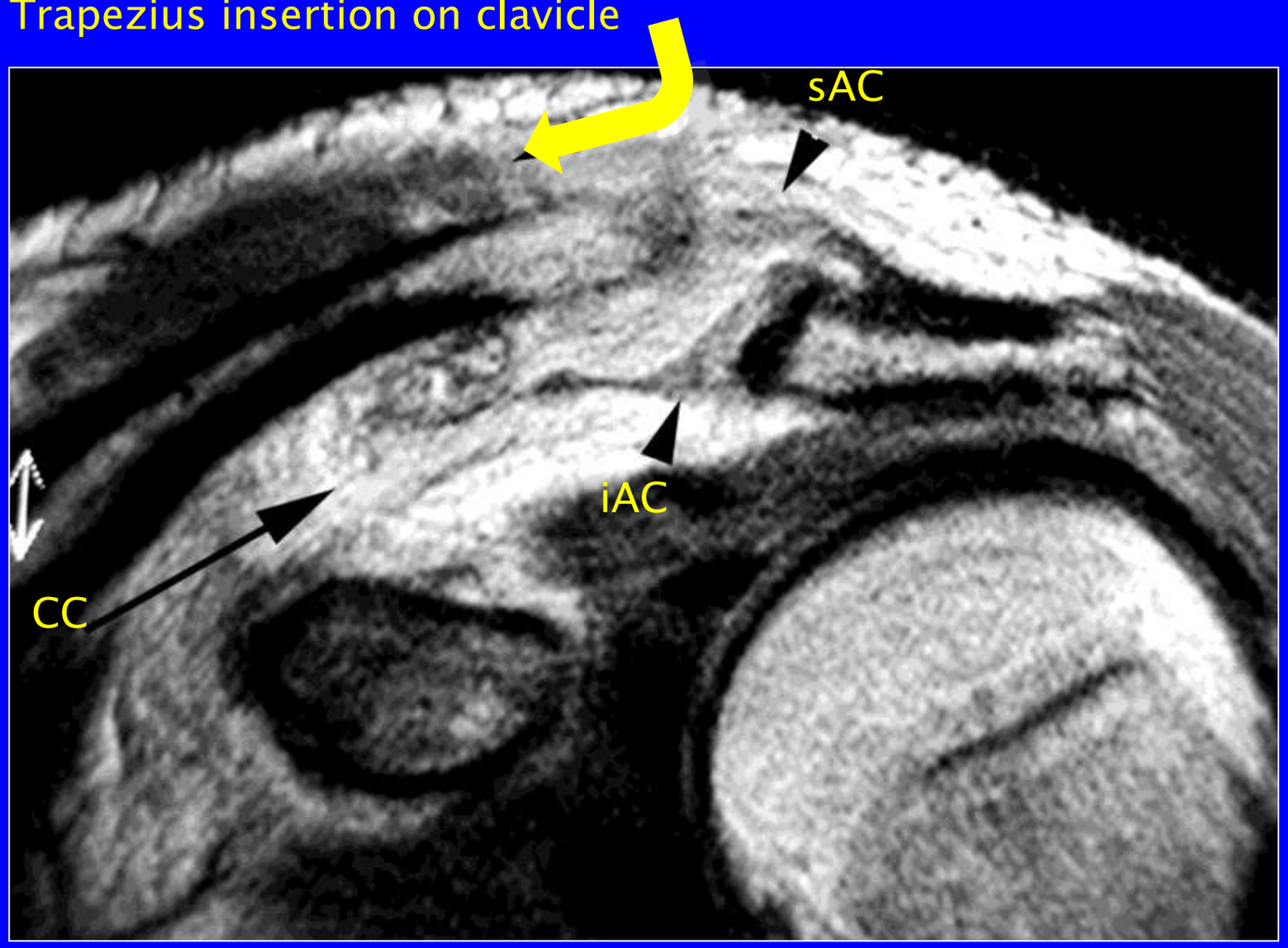
Grade 5 Injury



Alyas F et al. Radiographics 2008;28:463-479

I. Complete AC and CC ligament tears
II. AC, CC space wide
III. Torn trapezius insertion upon clavicle

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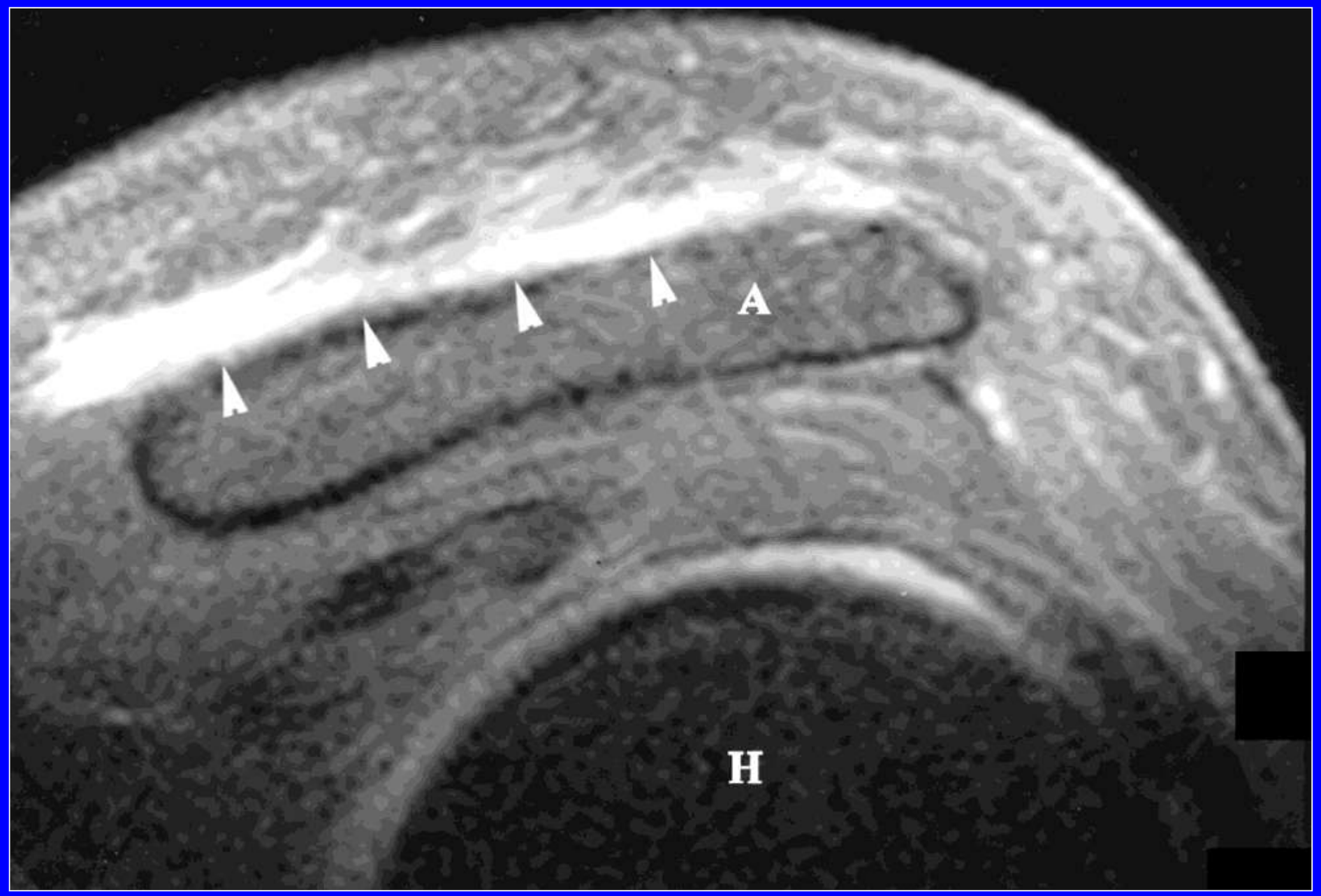
Grade 5 Injury



Antonio, G. E. et al. Am. J. Roentgenol. 2003;180:1103-1110

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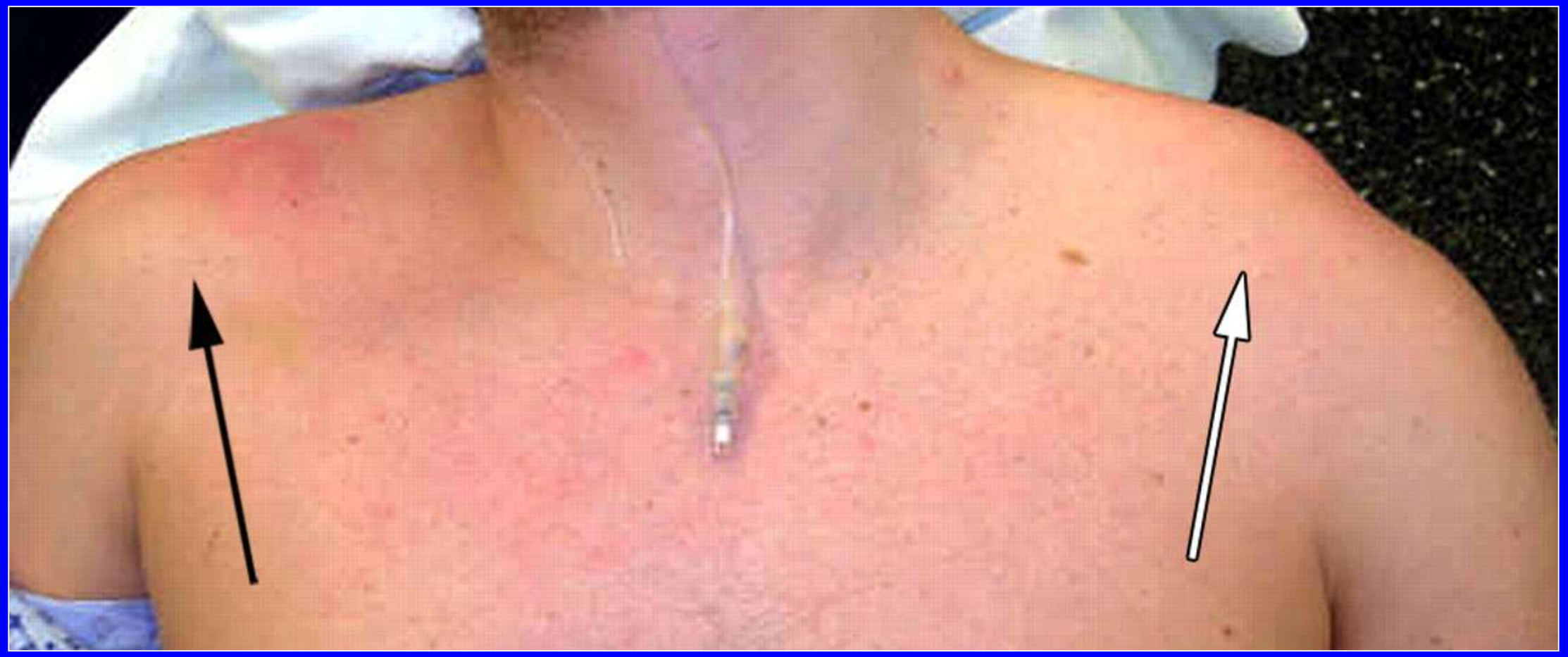
Grade 5 Injury



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Grade 5 Injury

Klonz A, Loitz D. Das Akromioklavikulargelenk. *Unfallchirurg* 2005. 108:1049–1060

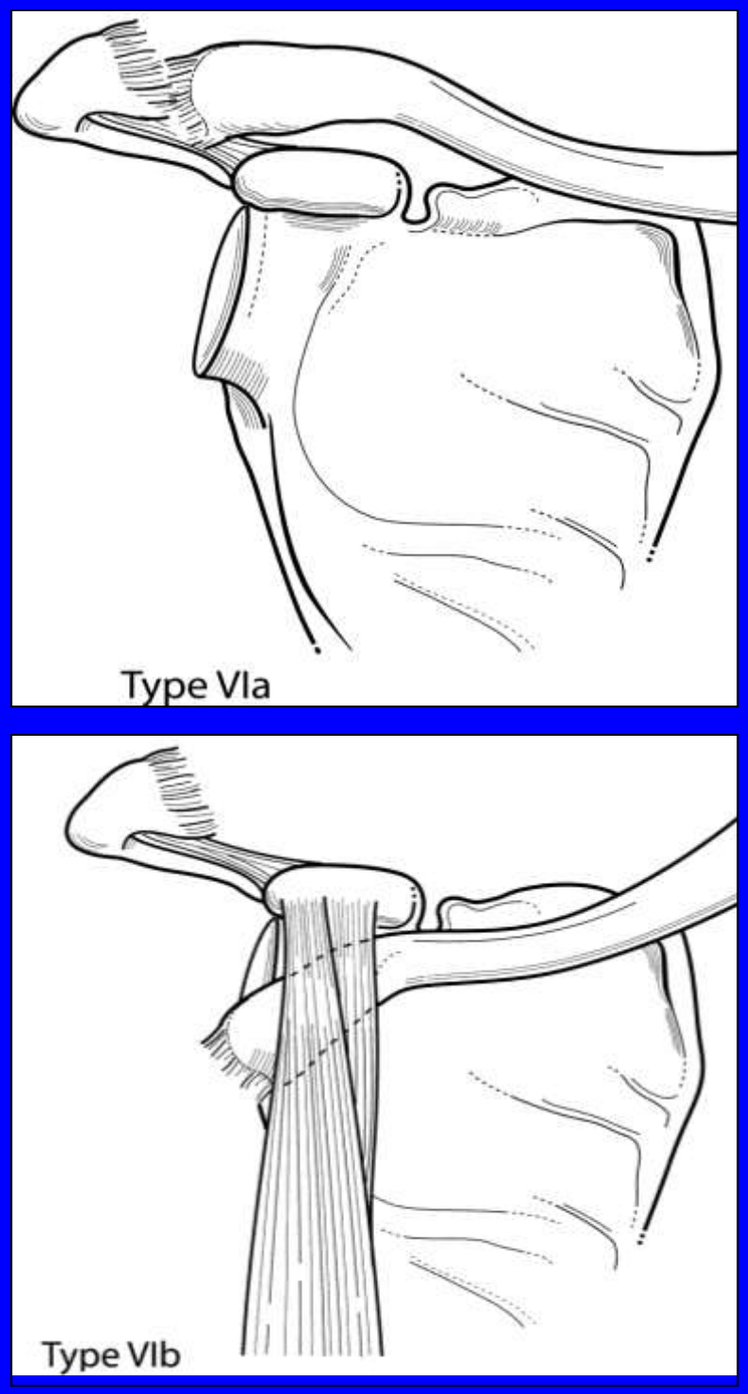
Grade 5 Injury

Mazzoca et al: Injuries to the acromiooclavicular joint in children, in Delee JC, Drez D (eds): Orthopedic Sports Medicine (ed 2) Philadelphia, PA. Saunders 2003 (pp 912-934)

Grade 5 Injury: deltrotrapezial fascia defect

Klonz A, Loitz D. Das Akromioklavikulargelenk. *Unfallchirurg* 2005. 108:1049–1060

Grade 6 Injury



I. Complete AC ligament tear

II. Inferior dislocation of the clavicle relative to the acromion (6a) or coracoid process (6b)

III. **<u>Subacromial displacement</u> (6a)** may have restricted/painful glenohumeral joint movement

IV. **<u>Subcoracoid displacement</u> (6b)** may be associated with brachial plexus or vascular injury

Alyas F et al. Radiographics 2008;28:463-479

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Pediatric AC Jt Injuries: Curtis Classification

I.

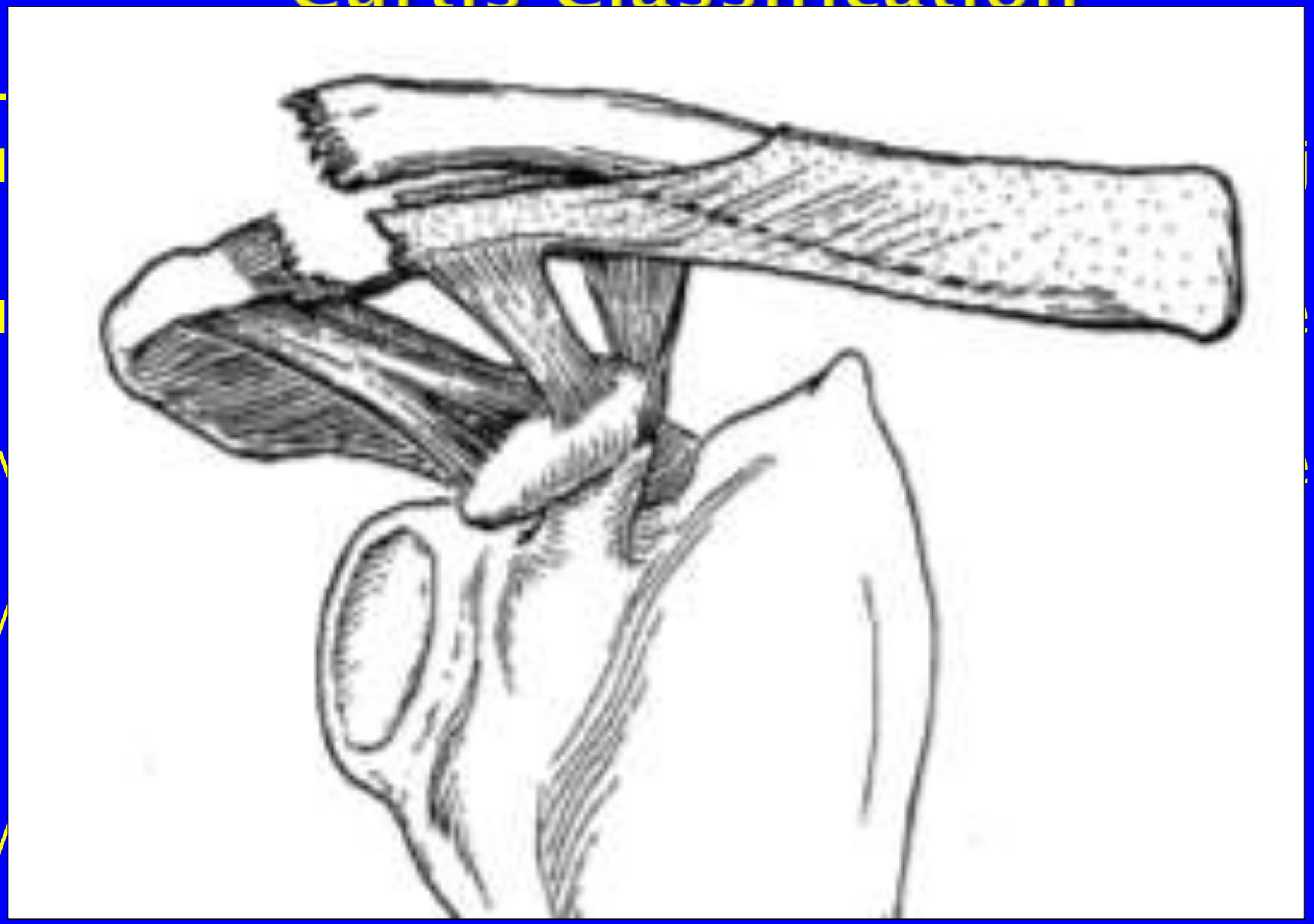
II

II

IV

V

V



Beim GM, Warner JP: Clinical and radiographic evaluation of the acromioclavicular joint. Oper Tech Sports Med 5: 68, 1997

Treatment Goals

I. Pain free ROM
II. Return to baseline strength
III. No limitations of activities

Grade 1, 2 AC Jt Injury: Treatment

I. Nonoperative: Grade 1, 2
   - Rest:
     - Grade 1: sling for 1 week
     - Grade 2: sling 2 weeks
   - After pain subsides start Rehab program
     - Passive ROM
     - Isometric strengthening
     - Progressive Isotonic strengthening
     - No contact sports or heavy lifting 2-3 months (healing)

Grade 1, 2 AC Jt Injury: Effect of Capsular Injury on joint mechanics

I. Up to 40% patients with grade 2 injury had persistent symptoms 6 mo-5 yrs after initial injury
II. With AC capsule injury→ horizontal instability AC jt
III. Results in increased force upon coracoclavicular ligament complex in response to anterior and posterior loads
IV. CC ligaments try to compensate when AC capsule injured, but they may be at increased risk for subsequent failure
V. Surgical reconstruction must address the AC capsule in order for ligament reconstruction success

Debski RE et al. Effect of Capsular Injury on Acromioclavicular Joint Mechanics. *J Bone Joint Surg Am.* 2001;83:1344-1351.

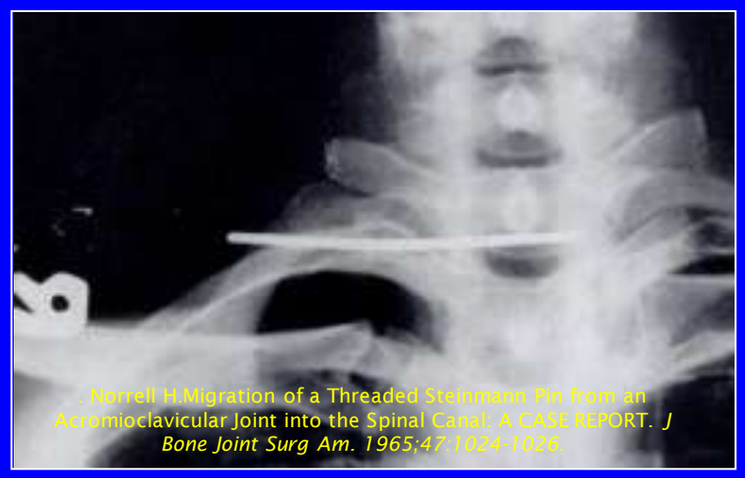
AC Jt dislocation: Treatment

I. Grade 3-controversial most favor nonoperative management
II. Patients often have persistent disability when not surgically treated
III. Bannister et al compared surgical vs nonsurgical treatment of grade 3 and 5 injuries
   - Grade 3, <2cm AC displacement fared better with immobilization
   - Grade 3, >2cm AC displacement fared better with fixation

AC Jt dislocation: Treatment

I. Grades 4, 5, 6: Operative
   - 1) Primary AC Jt fixation + DT fascia repair
   - 2) Dynamic Muscle Transfers
   - 3) Coracoclavicular fixation
   - 4)+ AC, CC lig and DTF repair

Primary AC Joint fixation



Norrell H.Migration of a Threaded Steinmann Pin from an Acromioclavicular Joint into the Spinal Canal: A CASE REPORT. *J Bone Joint Surg Am. 1965;47:1024-1026.*

Melenevsky Y. Clavicle and acromioclavicular joint injuries: a review of imaging, treatment, and complications. Skeletal Radiol *Skeletal Radiology (6 June 2010)*

Nadarajah R et al. Clavicular hook--plate: complications of retaining the implant. *Injury, Int. J. Care Injured* (2005) 36, 681–685.

I. Rigid fixation device
   - May promote distal clavicle osteolysis (stress shielding?)

II. May use with CC ligament, fascia repair

III. Kirschner wires, Steinmann pins
   - Abandoned: pins migrate into spine, heart, great vessels

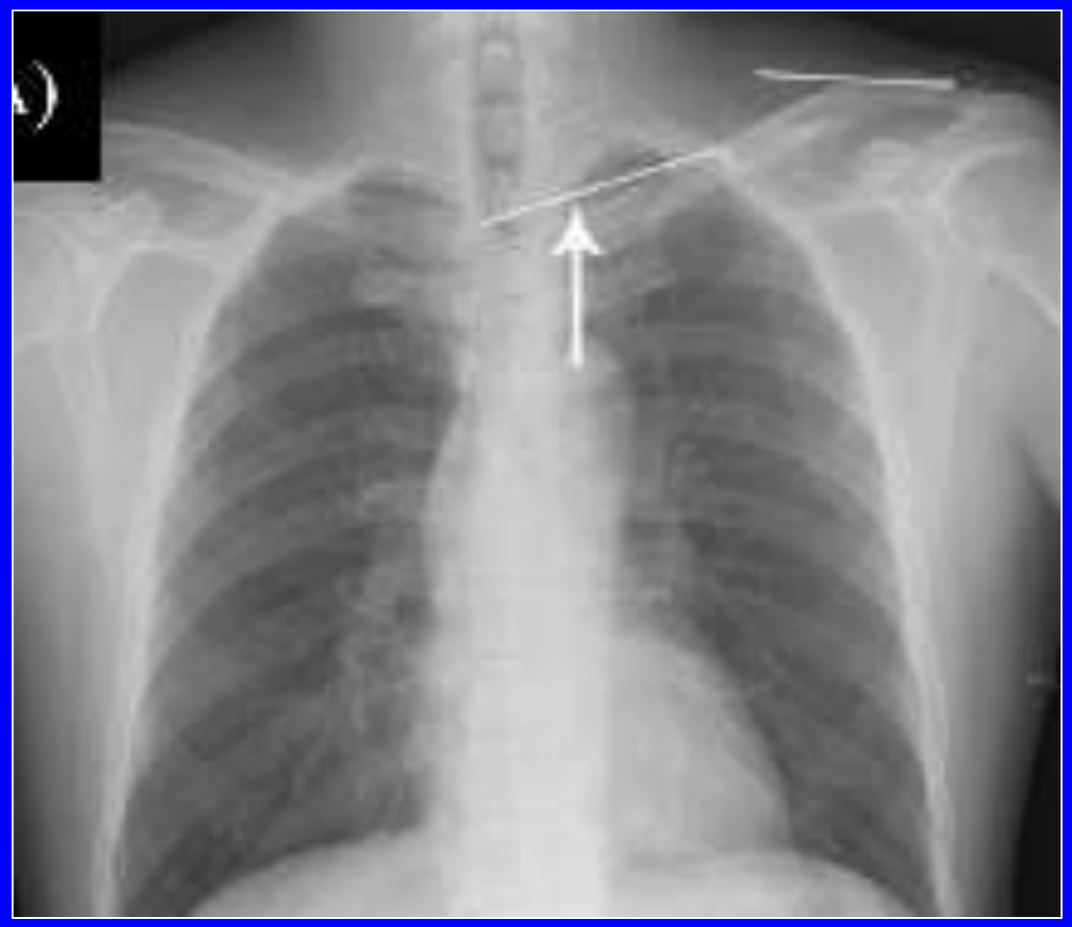
IV. Threaded screws

V. Hook plate (8-12 wks)
   - Easy, great reduction, less migration than screws

VI. Eventually have to remove hardware

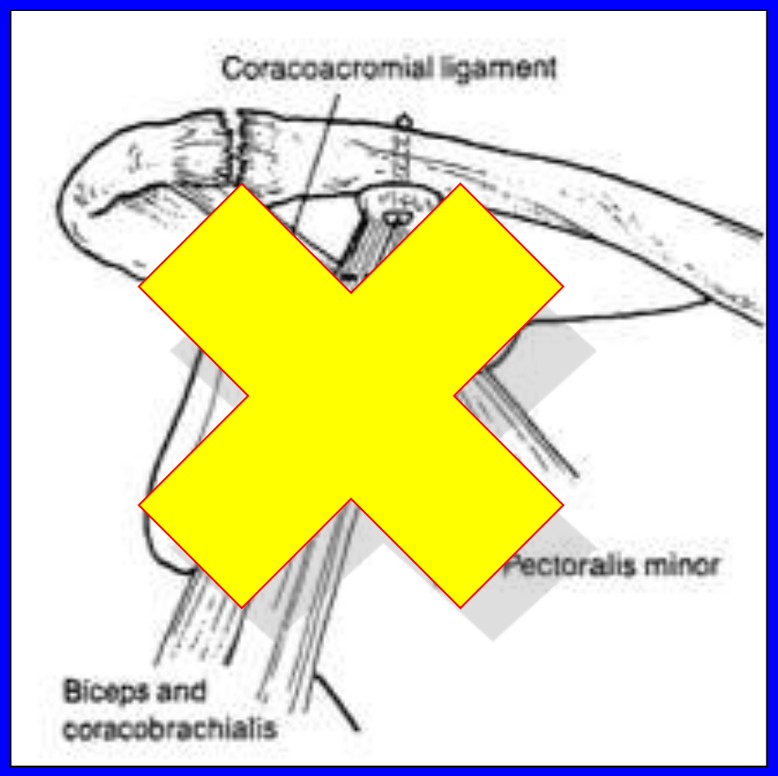
VII. Hardware may migrate or fail
   - AC joint motion results in hardware failure

Primary AC Joint fixation complication: Tracheoinnominate artery fistula



Wu Yi-Hsuan et al.Tracheoinnominate artery fistula caused by migration of a Kirschner wire. *European Journal of Cardio-thoracic Surgery* 36 (2009) 214—216

Dynamic Muscle Transfer

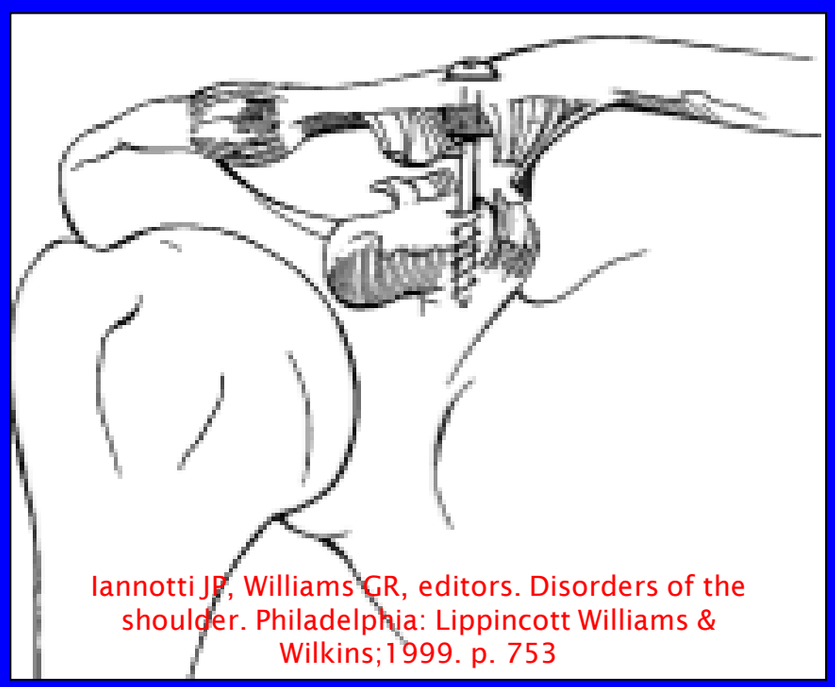


I. Coracobrachialis and short head biceps normally attach to Coracoid tip
II. Coracoid Tip osteotomy
III. Transferred to undersurface of clavicle
IV. Inferior pull of tendon should stabilize distal clavicle
V. Excessive motion
   - Residual joint pain
   - Traction injury (musculocutaneous n.)
   - Delayed union/nonunion

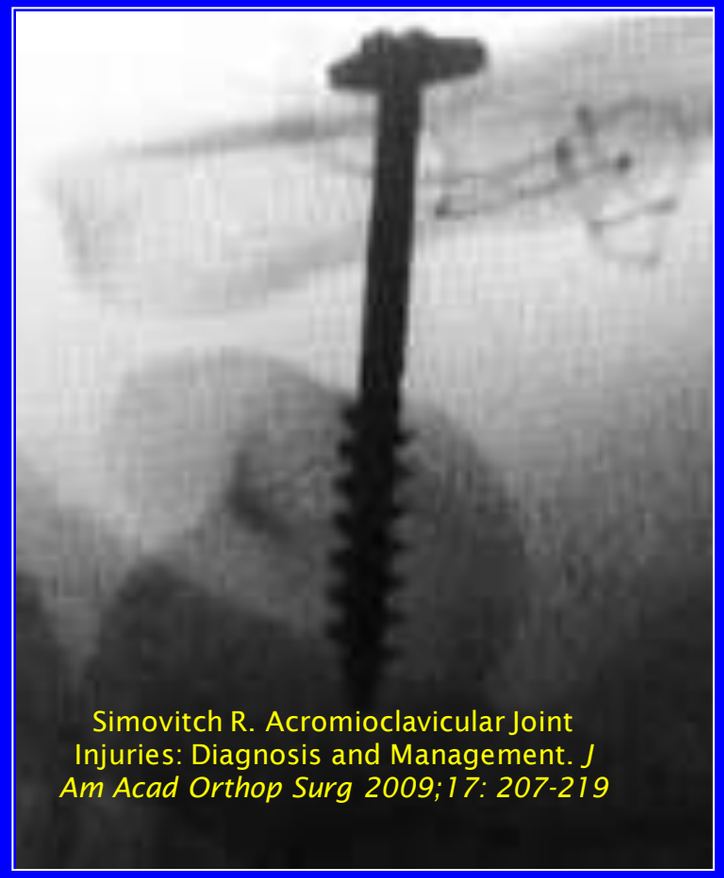
Mazzoca et al: Injuries to the acromiooclavicular joint in children, in Delee JC, Drez D (eds): Orthopedic Sports Medicine (ed 2) Philadelphia, PA. Saunders 2003 (pp 912-934)

Primary Coracoclavicular Fixation

1. Coracoclavicular screw
   - Popularized by Bosworth 1941
   - Need adequate purchase of coracoid or will fail
   - Coracoid fracture doen not help
   - Staged removal of screw



Iannotti JP, Williams GR, editors. Disorders of the shoulder. Philadelphia: Lippincott Williams & Wilkins;1999. p. 753



Simovitch R. Acromioclavicular Joint Injuries: Diagnosis and Management. *J Am Acad Orthop Surg 2009;17: 207-219*

MacDonald PB, Lapointe P. Acromioclavicular and Sternoclavicular Joint Injuries. *Orthop Clin N Am* 39 (2008) p 539

Primary Coracoclavicular Fixation

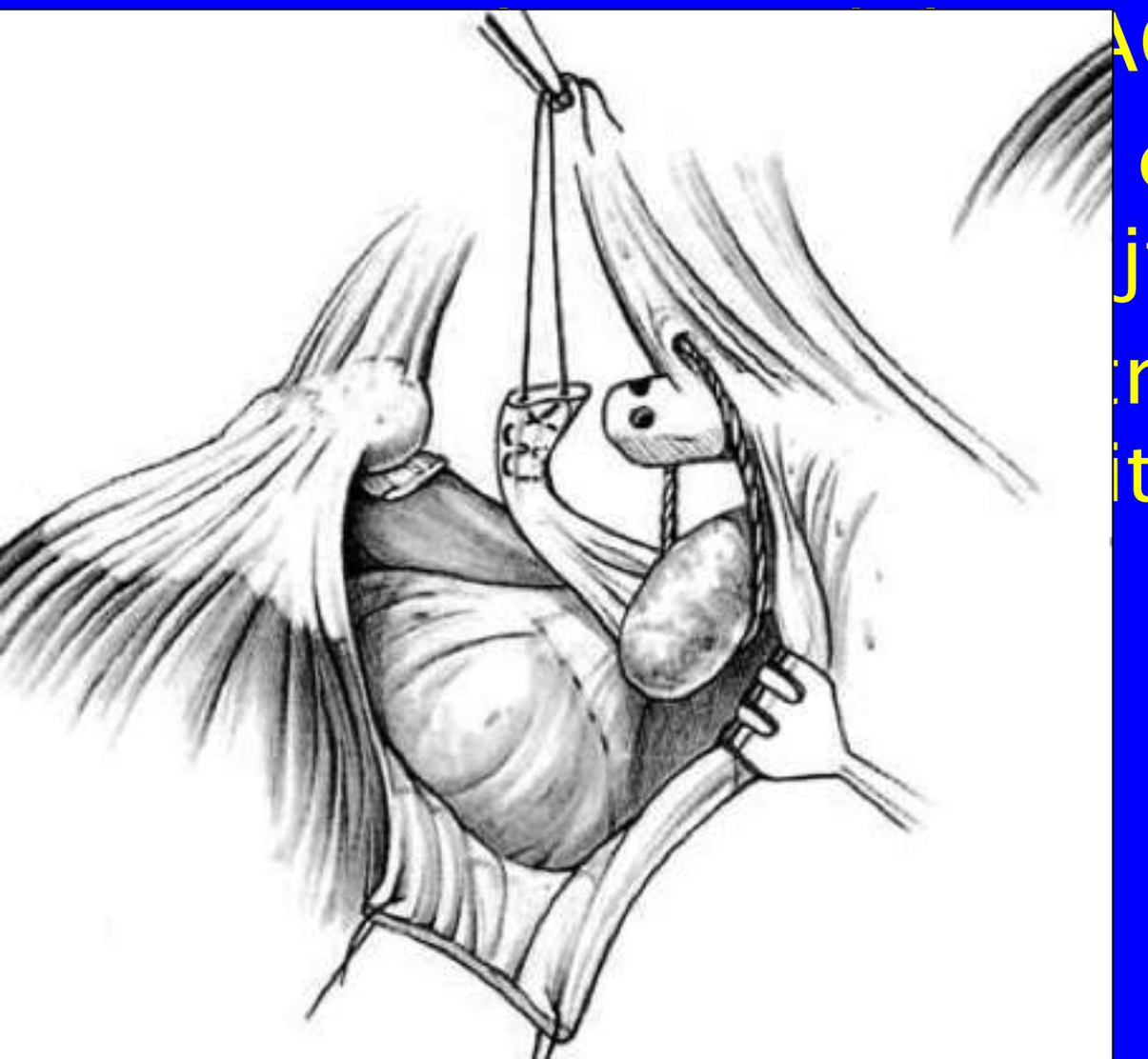
1. Coracoclavicular Suture loops, cable
   - Cable fracture/suture cutout from motion
   - No screw removal needed

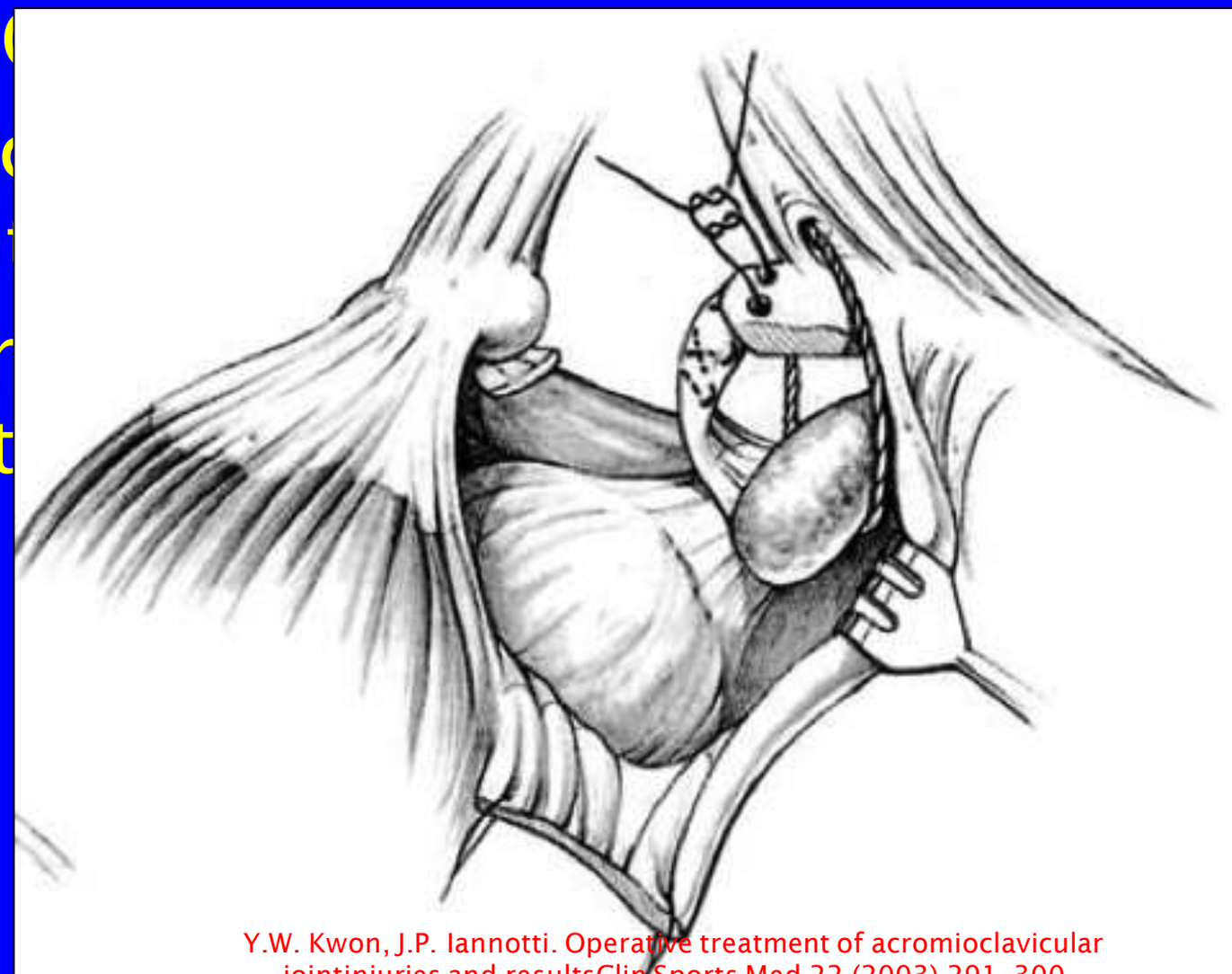
Melenevsky Y. Clavicle and acromioclavicular joint injuries: a review of imaging, treatment, and complications. Skeletal Radiol *Skeletal Radiology (6 June 2010)*

Y.W. Kwon, J.P. Iannotti. Operative treatment of acromioclavicular jointinjuries and resultsClin Sports Med 22 (2003) 291–300

Ligament Transfer

I. Modified Weaver Dunn (open)
   - CA ligament detached from anterior acromion (+/- bone chip) and transferred to the clavicle in

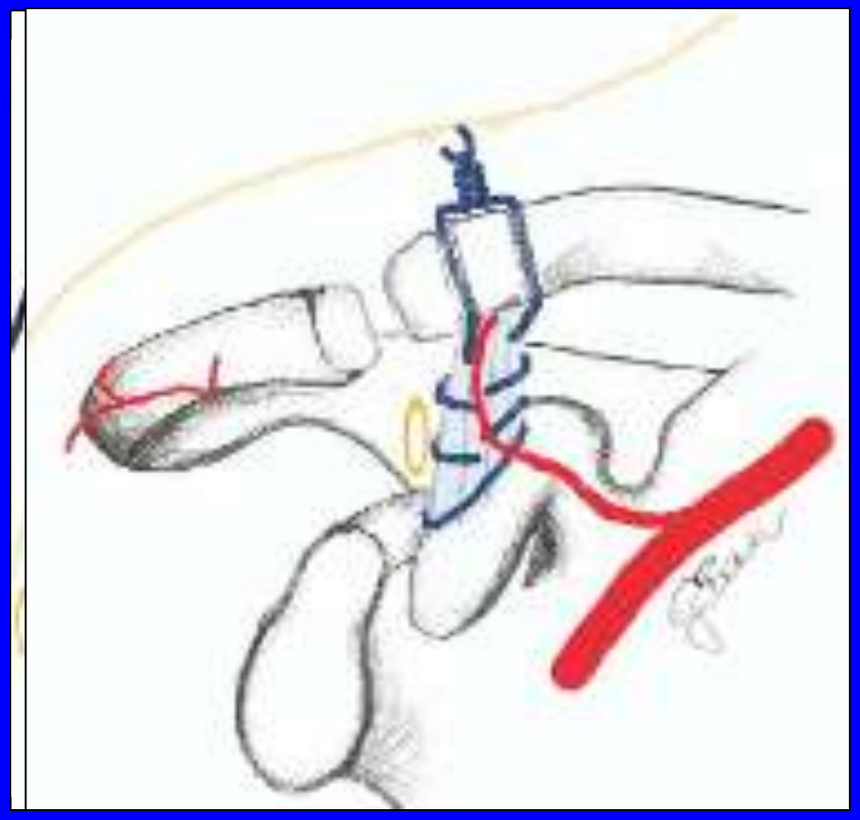




Y.W. Kwon, J.P. Iannotti. Operative treatment of acromioclavicular jointinjuries and resultsClin Sports Med 22 (2003) 291–300

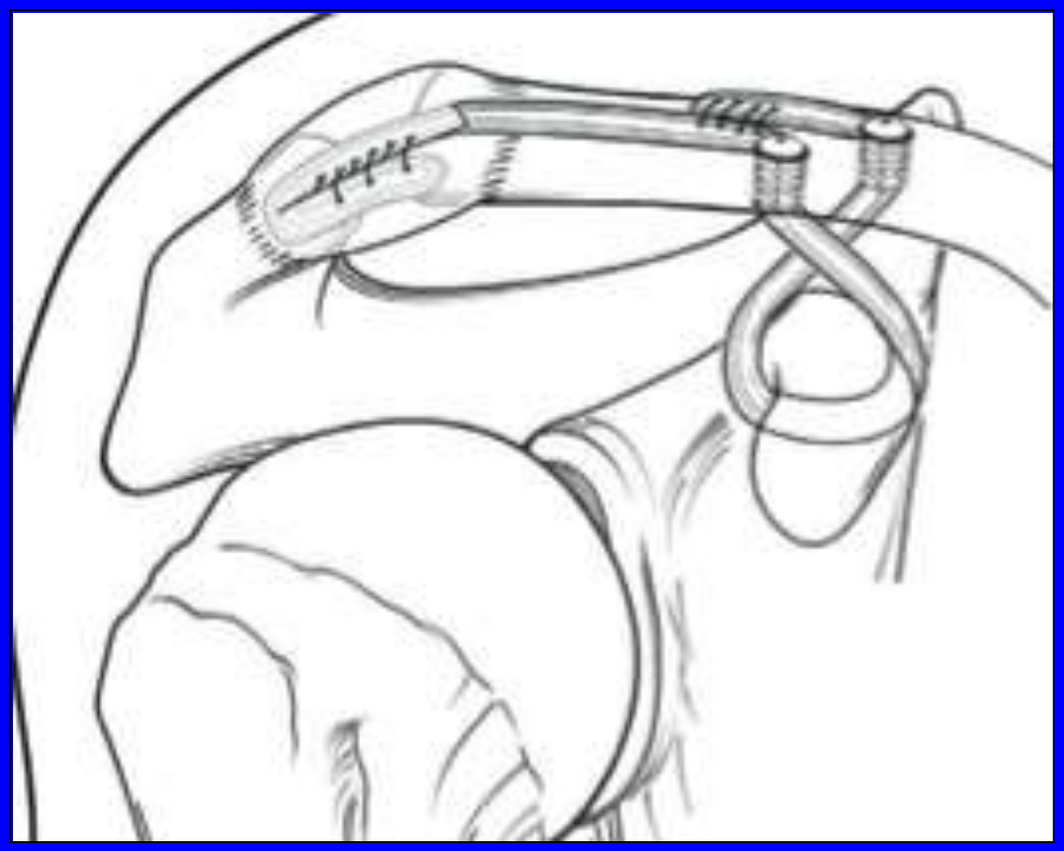
Ligament Transfer

I. Modified Weaver Dunn (arthroscopic)
- Access to AC joint through small incisions
- Limit disruption of fascia
- Faster postoperative recovery, less painful
- Fewer complications



Lafosse L, Baier GP, Leuzinger J. Arthro- scopic treatment of acute and chronic acromioclavicular joint dislocation. *Arthroscopy* 2005;21:1017.e1-1017.e8

Anatomic CC Ligament Reconstructrion (ACCR)



I. Diagnostic shoulder arthroscopy
II. arthroscopic distal clavicle excision
III. CA ligament is detached from acromion
IV. CAL attached to distal clavicle through two drill holes
V. Tendon auto/allograft (gracilis, semitendinosis, Tibialis Anterior) looped under coracoid and through two drill holes in the clavicle
VI. Graft tied to itself (figure-of-eight) or fixed to the clavicle with interference screws

Nicholas A Bontempo and Augustus D Mazzocca. Biomechanics and treatment of acromioclavicular and sternoclavicular joint injuries. *Br J Sports Med 2010 44: p. 365*

AC Jt Reconstruction: Post-Op Biomechanical considerations

I. Weaver Dunn (CAL transfer) 25% native CC complex strength
II. Weaver Dunn CAL + suture or cable increases construct strength
III. CC screw highest tensile strength, stiffness
IV. ACCR best approximates native function and stability of AC jt and CC Ligament complex

http://www.cnet.co.uk/i/c/blg/cat/cartech/03_change_gears.jpg

Learning Objectives

- ✓ ~~Review the clinical features and significance of AC joint injury~~
- ✓ ~~Review normal AC Joint anatomy~~
- ✓ ~~Become familiar with basic AC joint biomechanics~~
- ✓ ~~Be able to classify AC joint injuries based upon modified Rockwood Classification~~
- ✓ **List common causes of extrinsic subacromial impingement**
- ✓ Review common AC joint arthritides
- ✓ Bonus round

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Impingement

I. Internal/Intrinsic
II. Primary Extrinsic
   - Subcoracoid
   - Subacromial

http://distractible.org/wp-content/uploads/2008/11/vulcannervepinch.jpg

http://www.cjw-sportsclinic.co.uk/Impingement.html

Extrinsic Subacromial Impingement: Why

I. Common cause of compression of SupraT, subA/D bursa and LHBT between CA arch and greater tuberosity

II. Lose normal gliding of periarticular soft tissues with abduction or arm elevation

III. Coracoacromial Arch alteration result in encroachment of subacromial space

IV. Implicated in subacromial bursitis, factor in developing RTC tears

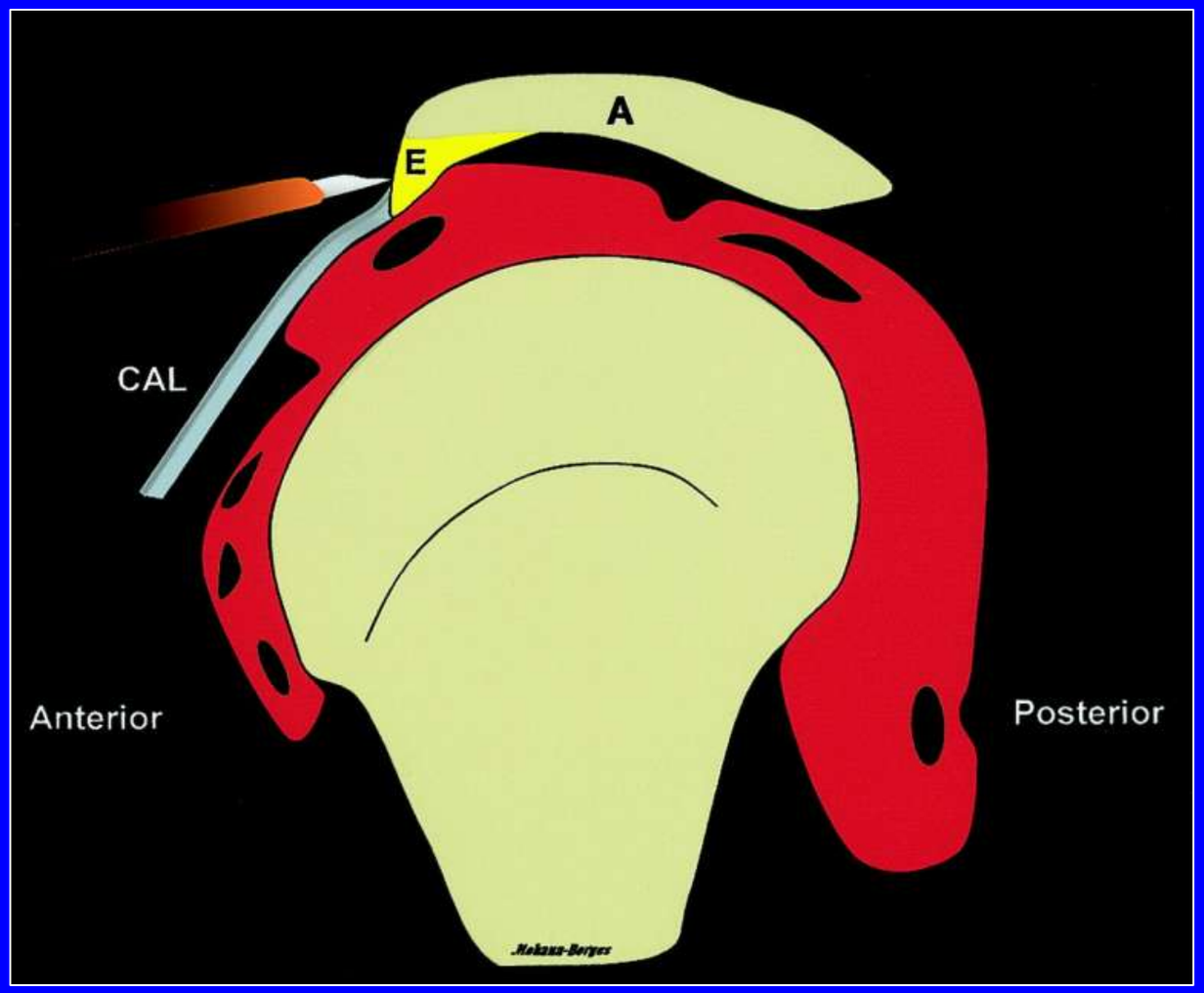
Chung CB, Steinbach LS. MRI Of The Upper Extremity: Shoulder, Elbow, Wrist And Hand.
Lippincott Williams & Wilkins Nov 2009 p 246-254

Extrinsic Subacromial Impingement: Who

I. Athletes
II. Occupations repetitive overhead motion
III. Aging population

Chung CB, Steinbach LS. MRI Of The Upper Extremity: Shoulder, Elbow, Wrist And Hand. Lippincott Williams & Wilkins Nov 2009 p 246-254

Subacromial Impingement: CoracoAcromial Arch



Mohana-Borges A V R et al. Radiographics 2004;24:69-85

I. Acromion (ant 1/3 undersurface)
II. CA Ligament
III. Coracoid Process (ant 1/3)
IV. AC Jt
V. Humeral head (floor)

RadioGraphics

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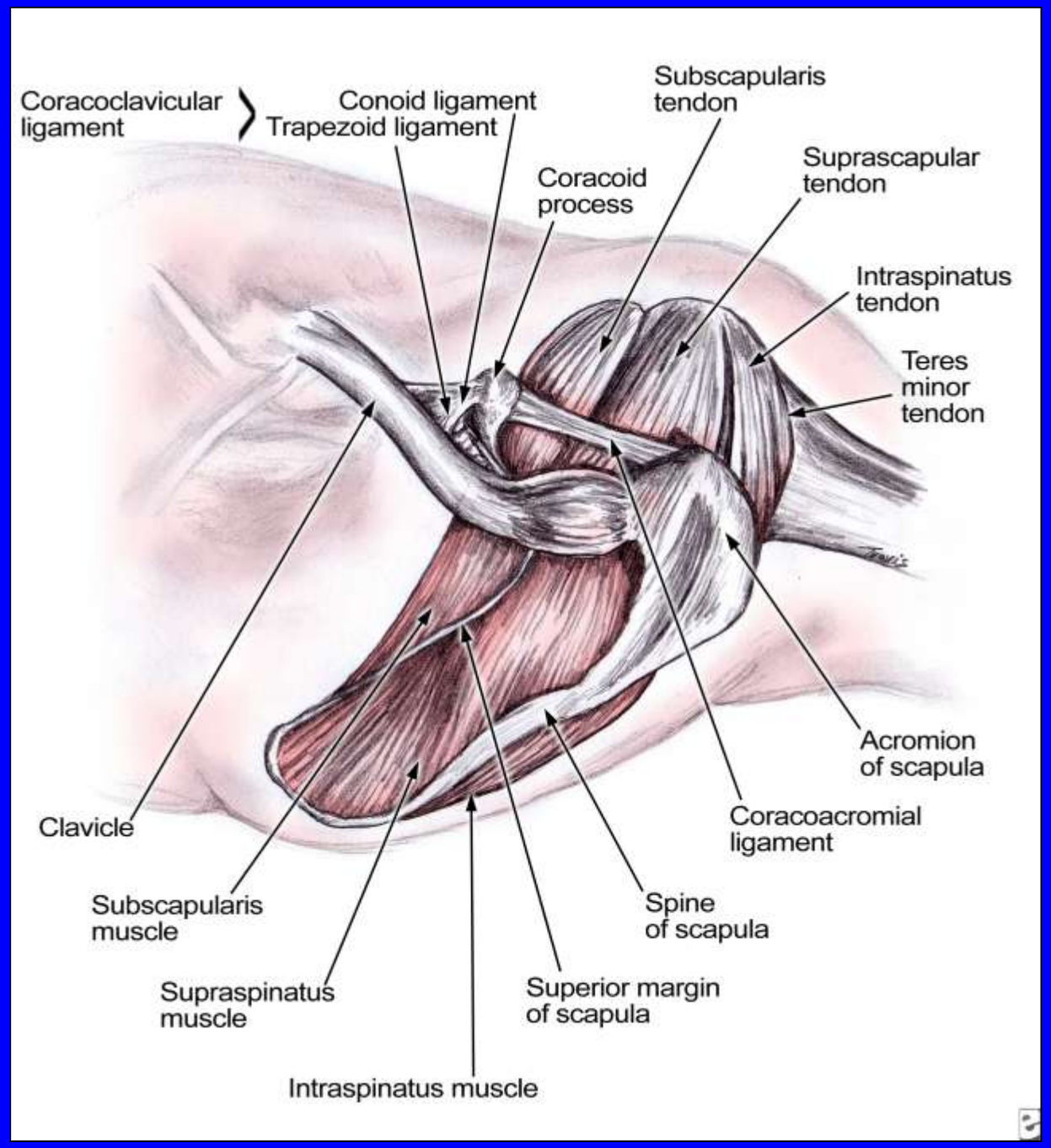
CA Arch superior view



http://img.medscape.com/pi/emed/ckb/orthopedic_surgery/1230552-1262849-2704.jpg

Extrinsic Subacromial Impingement: Osseous causes

I. Acromion Morphology

II. AC Joint distal clavicle osteophytes

III. Trauma
- Greater Tuberosity Fracture mal/nonunion)

Chung CB, Steinbach LS. MRI Of The Upper Extremity: Shoulder, Elbow, Wrist And Hand. Lippincott Williams & Wilkins Nov 2009 p 246-254

Acromial Morphologic Abnormalities

I. **Subacromial enthesophyte**
II. Anterior Hook (Type III)
III. Inferolateral downsloping
IV. Low position of acromion in relation to clavicle
V. Expansile Acromion mass (CA, pagets)
VI. Os Acromiale

Chung CB, Steinbach LS. MRI Of The Upper Extremity: Shoulder, Elbow, Wrist And Hand. Lippincott Williams & Wilkins Nov 2009 p 246-254

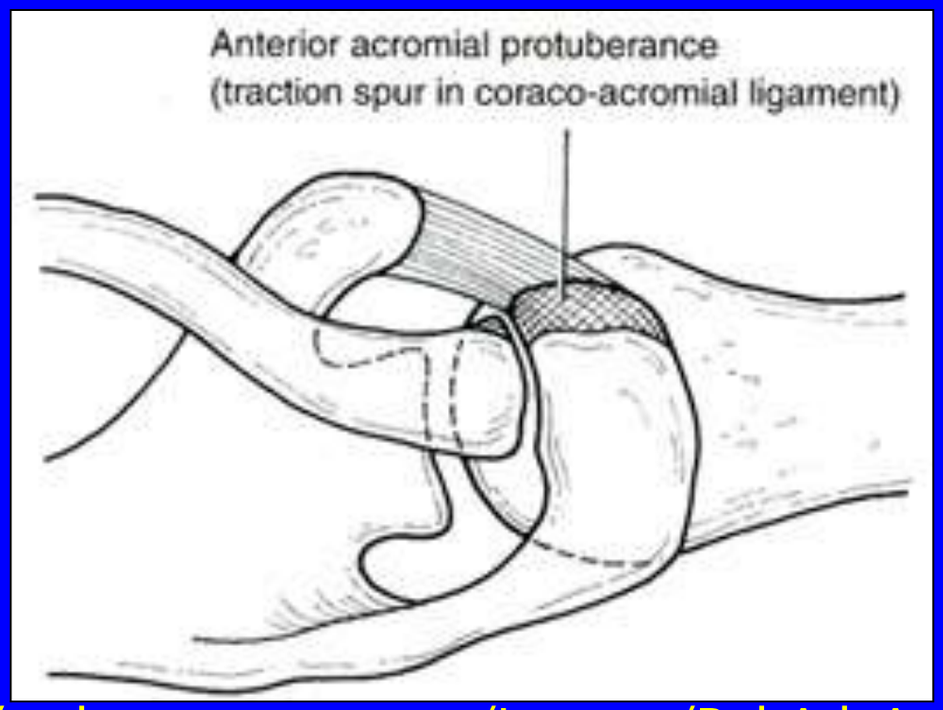
Subacromial enthesophyte

Nicholson GP et al. The acromion: Morphologic condition and age-related changes. A study of 420 scapulas. J SHOULDER ELBOW SURG 1996; 5: 1-11.

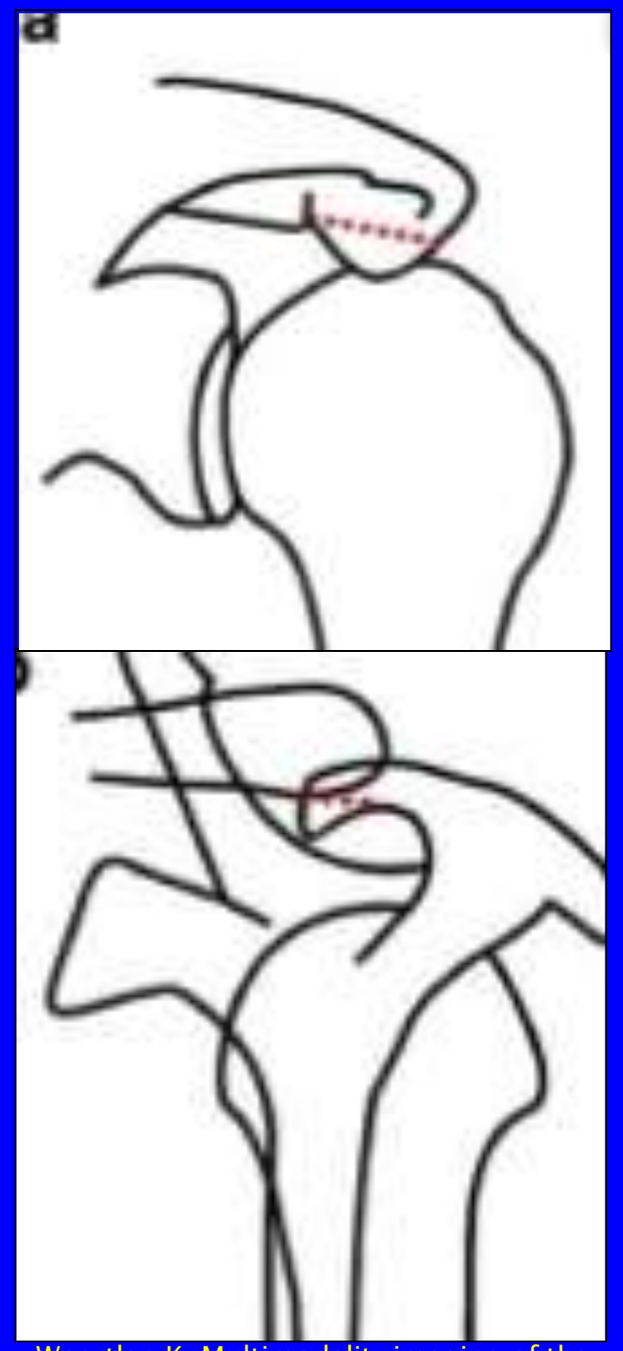
I. Begins as enchondral ossification at acromial insertion of CA ligament
II. Begin anterolaterally of acromion undersurface
III. Proceed in anteromedial direction, conforming to CA ligament path
IV. May be traction enthesophyte from buffering against humeral head elevation

Subacromial enthesophyte

Fealy S et al. The coracoacromial ligament: Morphology and study of acromial enthesopathy. J Shoulder Elbow Surg 2005;14:542-548

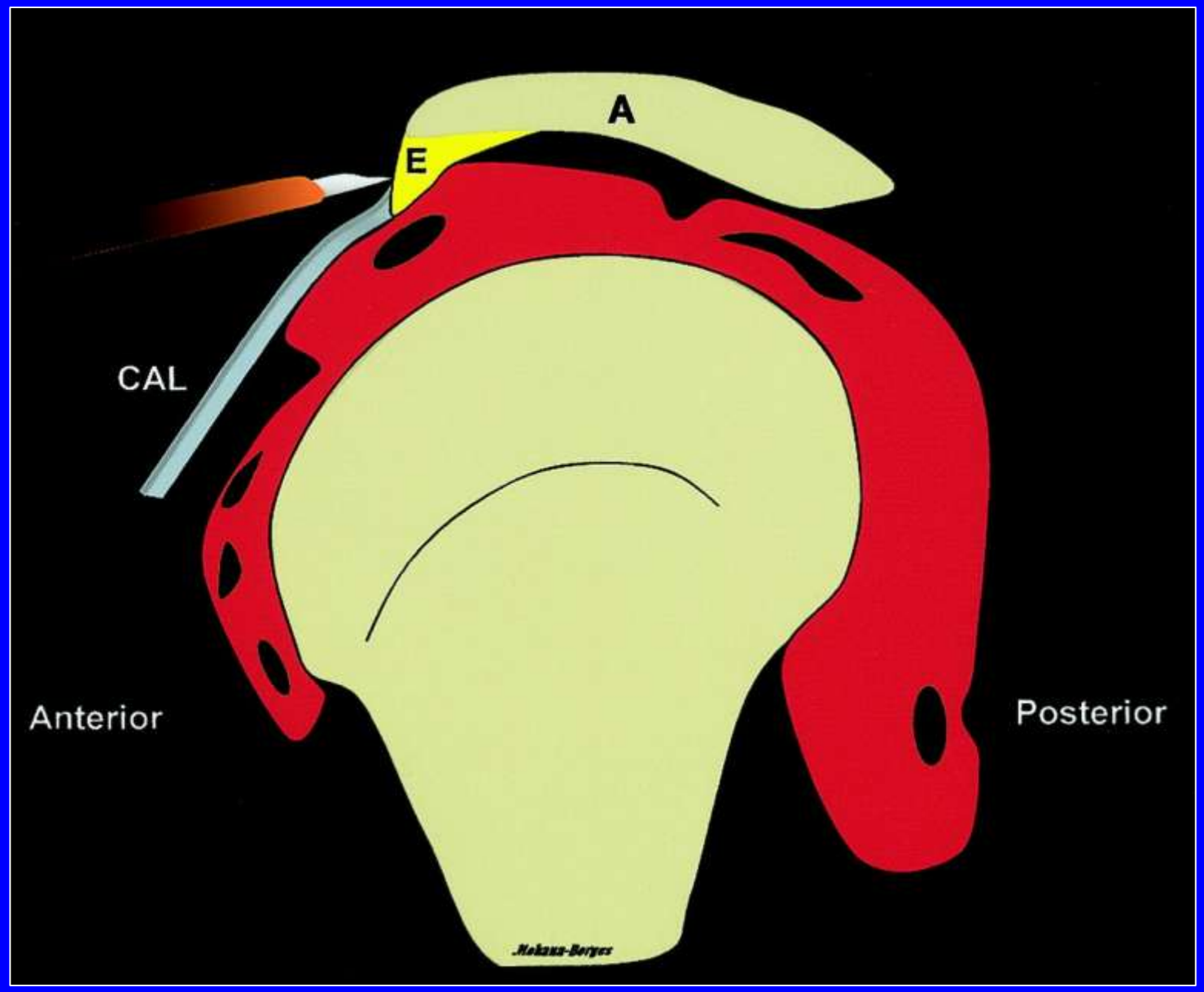


http://orthorogerson.com/images/PubAdvArthroAsad2-1-9A.jpg



Woertler, K. Multimodality imaging of the postoperative shoulder. Eur Radiol (2007) 17: p 3046

Subacromial enthesophyte



Mohana-Borges A V R et al. Radiographics 2004;24:69-85

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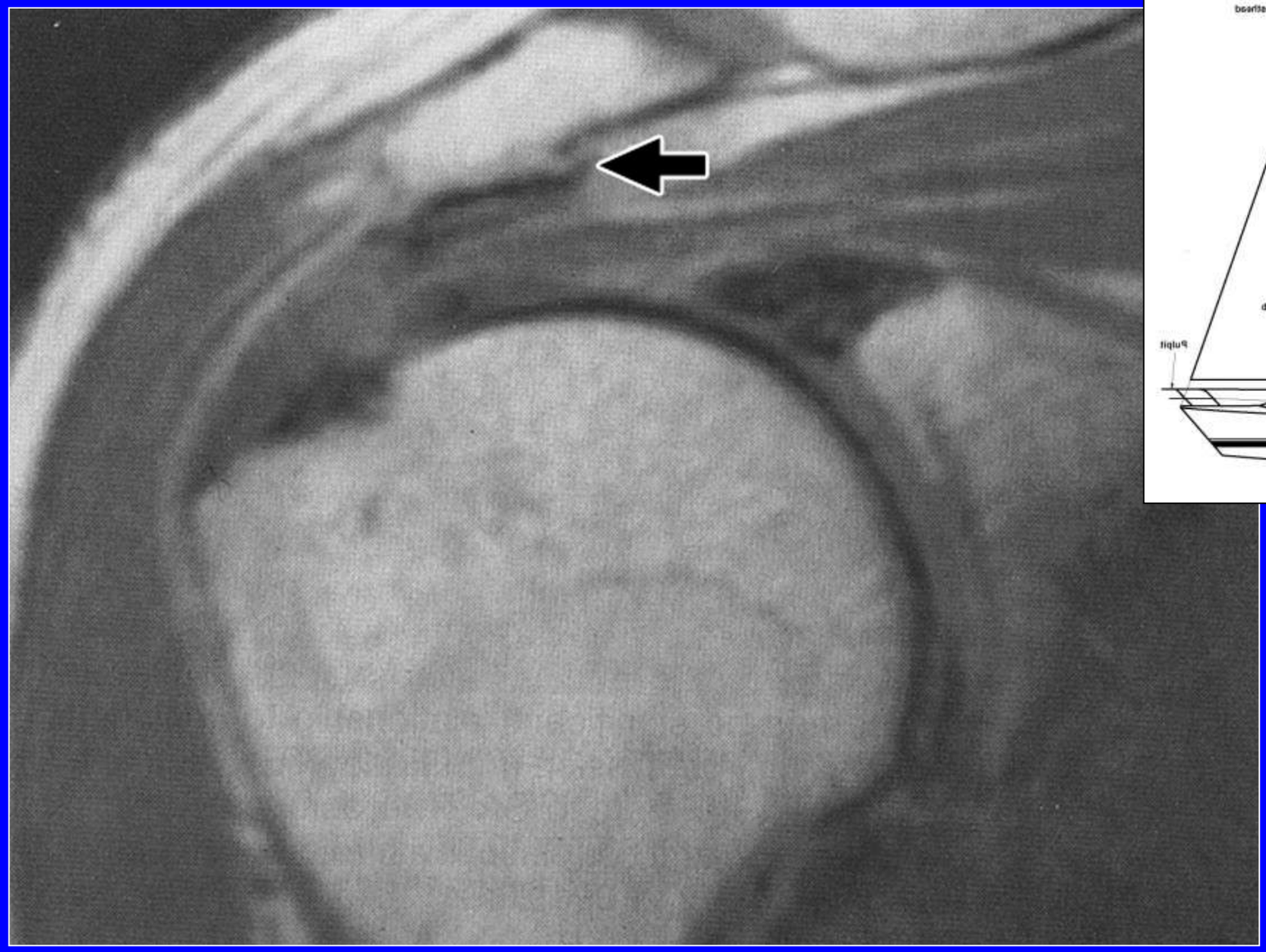
Subacromial enthesophyte

I. Identify this on MR at CAL attachment
   - Where CAL attaches, assess Acromion morphology and enthesophtyte
   - Look for marrow SI to diff from deltoid tendon attachment
   - Tricky if only cortical bone present
   - Can raise, not Dx, the possibility of impingement

Subacromial enthesophyte



Kramer, M. Am. J. Roentgenol. 2008;190:W376-W377

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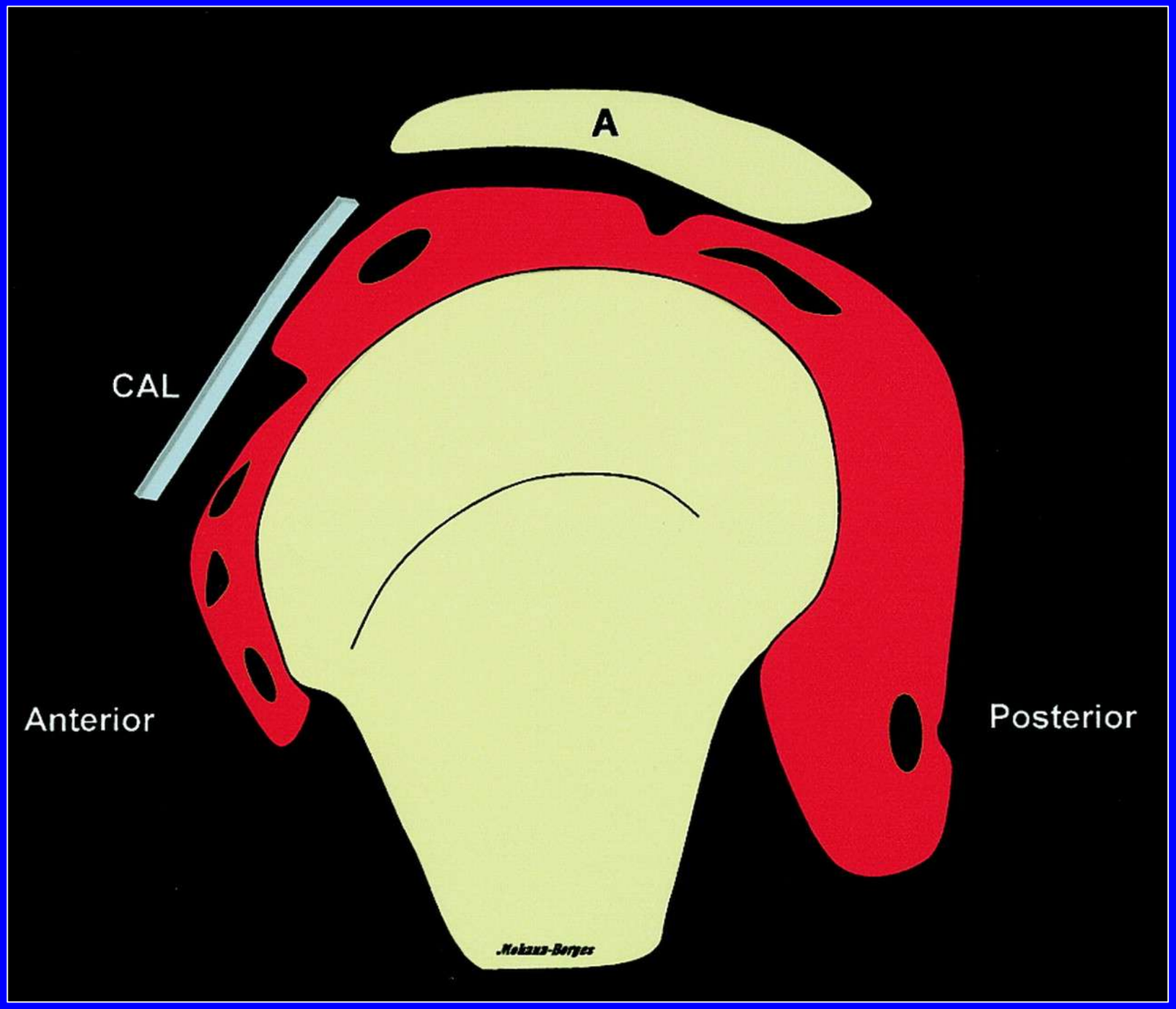
Subacromial enthesophyte

I. May narrow the coracoacromial arch
II. Some believe predispose to RTC tear
III. Ozaki et al
    - Evaluated 200 cadaveric shoulders
    - Evaluated undersurface of acromion and RTC gross and histologically
    - Partial articular sided tears-normal acromion
    - Partial bursal and FT tears-irregular acromion
    - Acromion changes may be reactive to intrinsic degeneration pattern

Ozaki J et al. Tears of the rotator cuff of the shoulder associated with pathological changes in the acromion. A study in cadavera. *J Bone Joint Surg Am.* 1988 Sep;70(8):1224-30.

Subacromial decompression



Mohana-Borges A V R et al. Radiographics 2004;24:69-85

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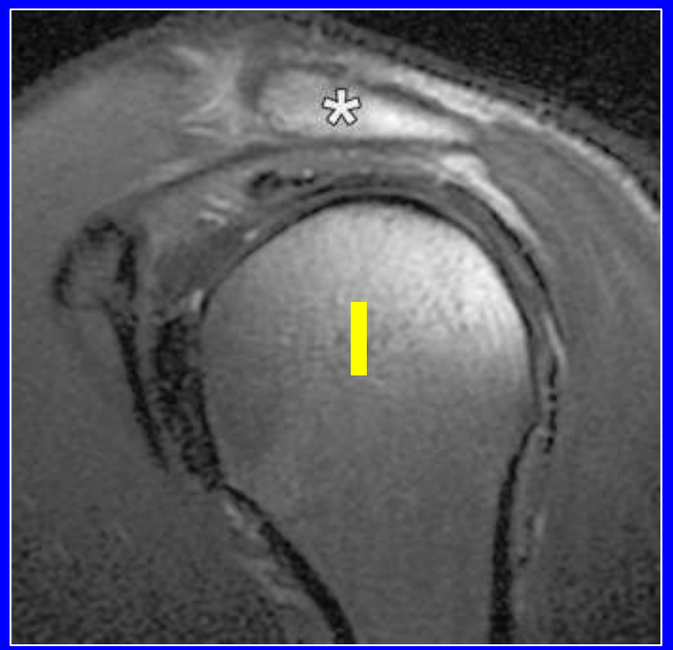
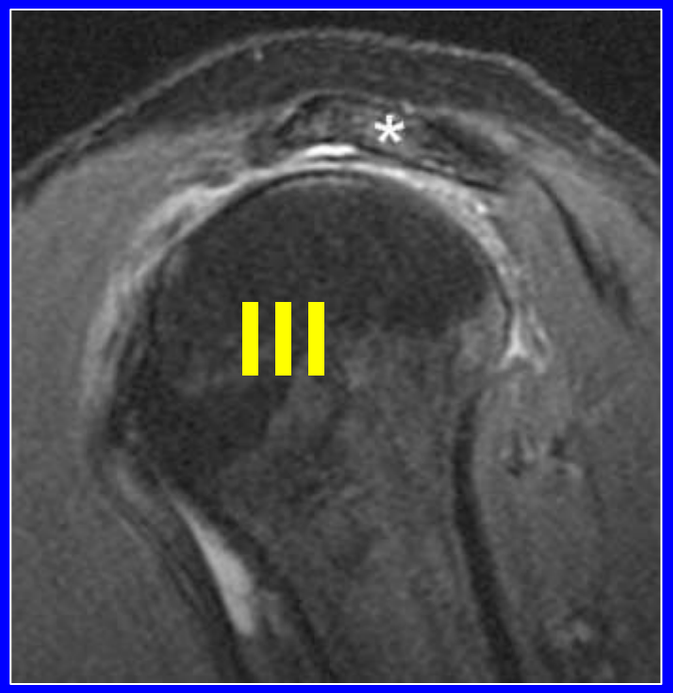
VI. Os Acromiale

Chung CB, Steinbach LS. MRI Of The Upper Extremity: Shoulder, Elbow, Wrist And Hand. Lippincott Williams & Wilkins Nov 2009 p 246-254

Acromial Subtypes





Morag Y et al. Radiographics 2006;26:1045–1065

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Acromial Morphologic Abnormalities

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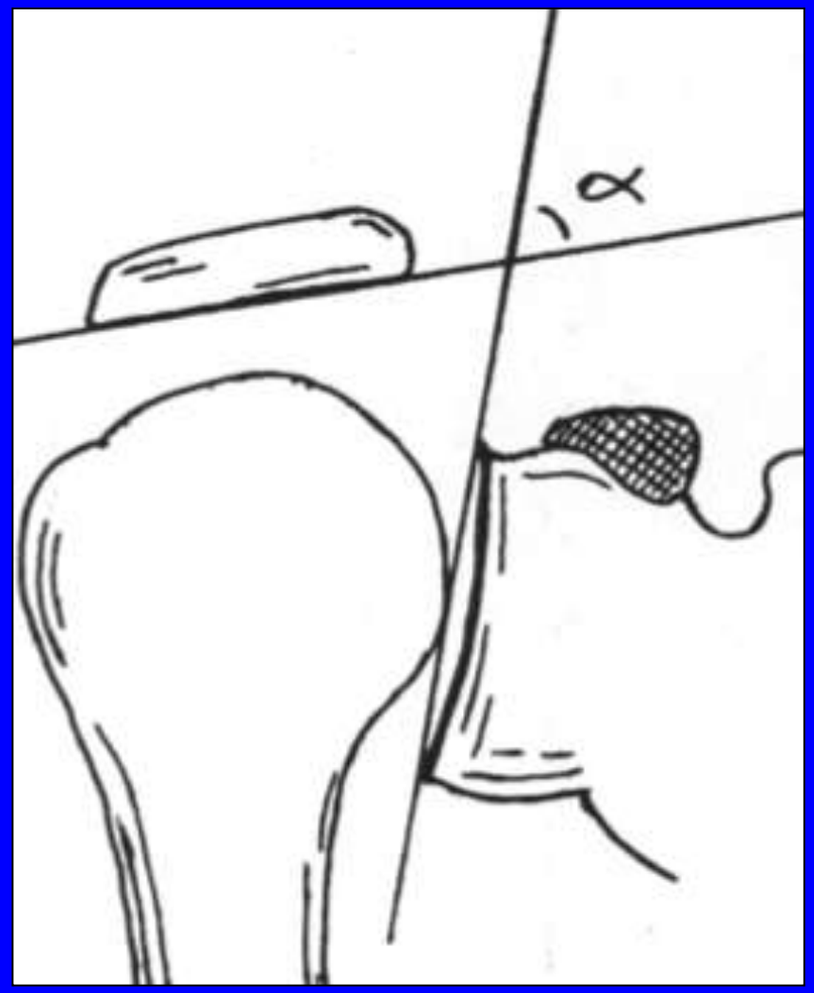


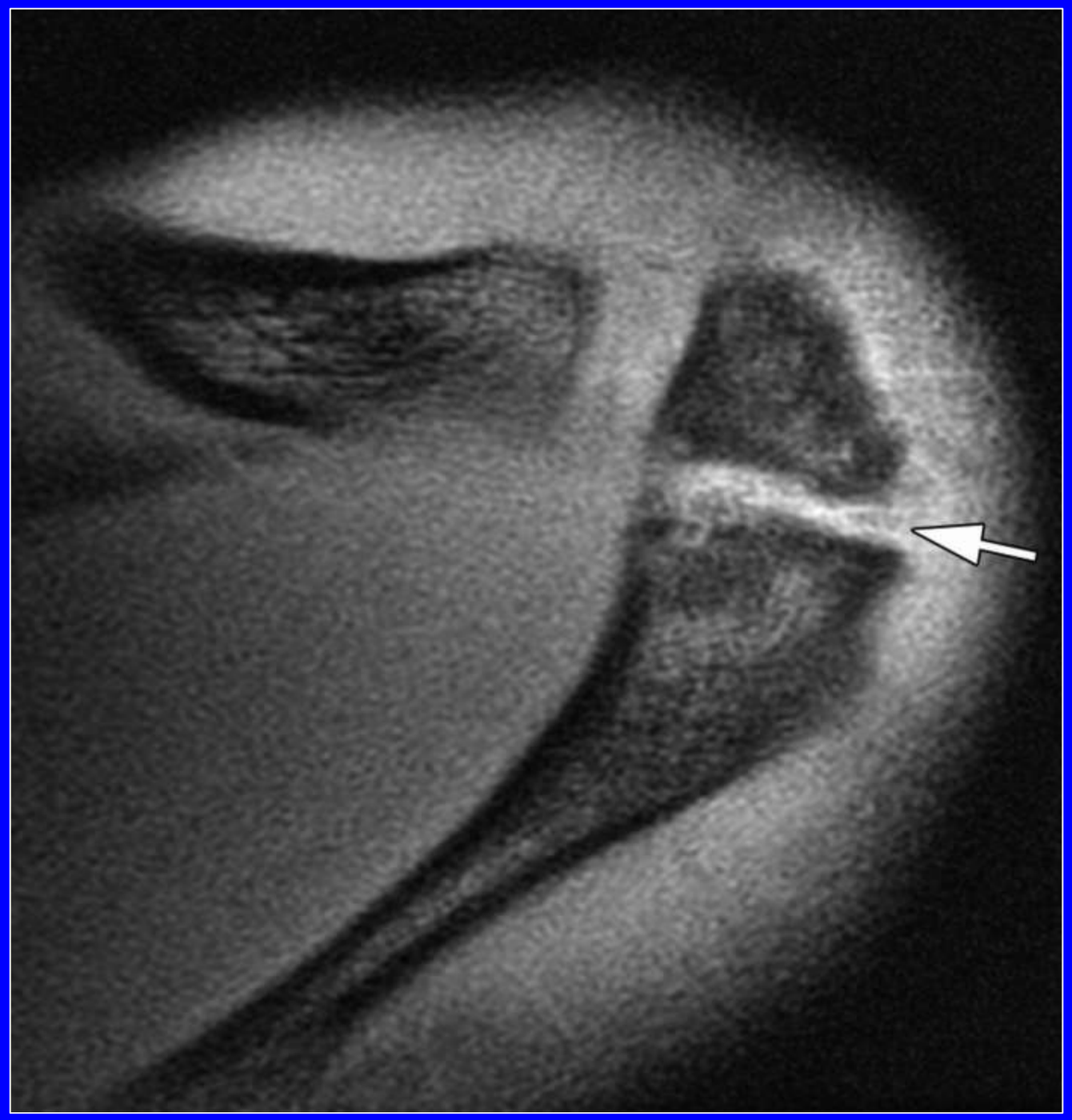
Banas MP et al. Relationship between the lateral acromion angle and rotator cuff disease. *J SHOULDER ELBOWSURG* 1995;4:454-61

Chung CB, Steinbach LS. MRI Of The Upper Extremity: Shoulder, Elbow, Wrist And Hand. Lippincott Williams & Wilkins Nov 2009 p 246-254

Shoulder Pain

Ortiguera CJ et al. Surgical management of the symptomatic os acromiale. *J Shoulder Elbow Surg* 11:521-8; 2002

Shoulder Pain



Morag Y et al. Radiographics 2006;26:1045–1065

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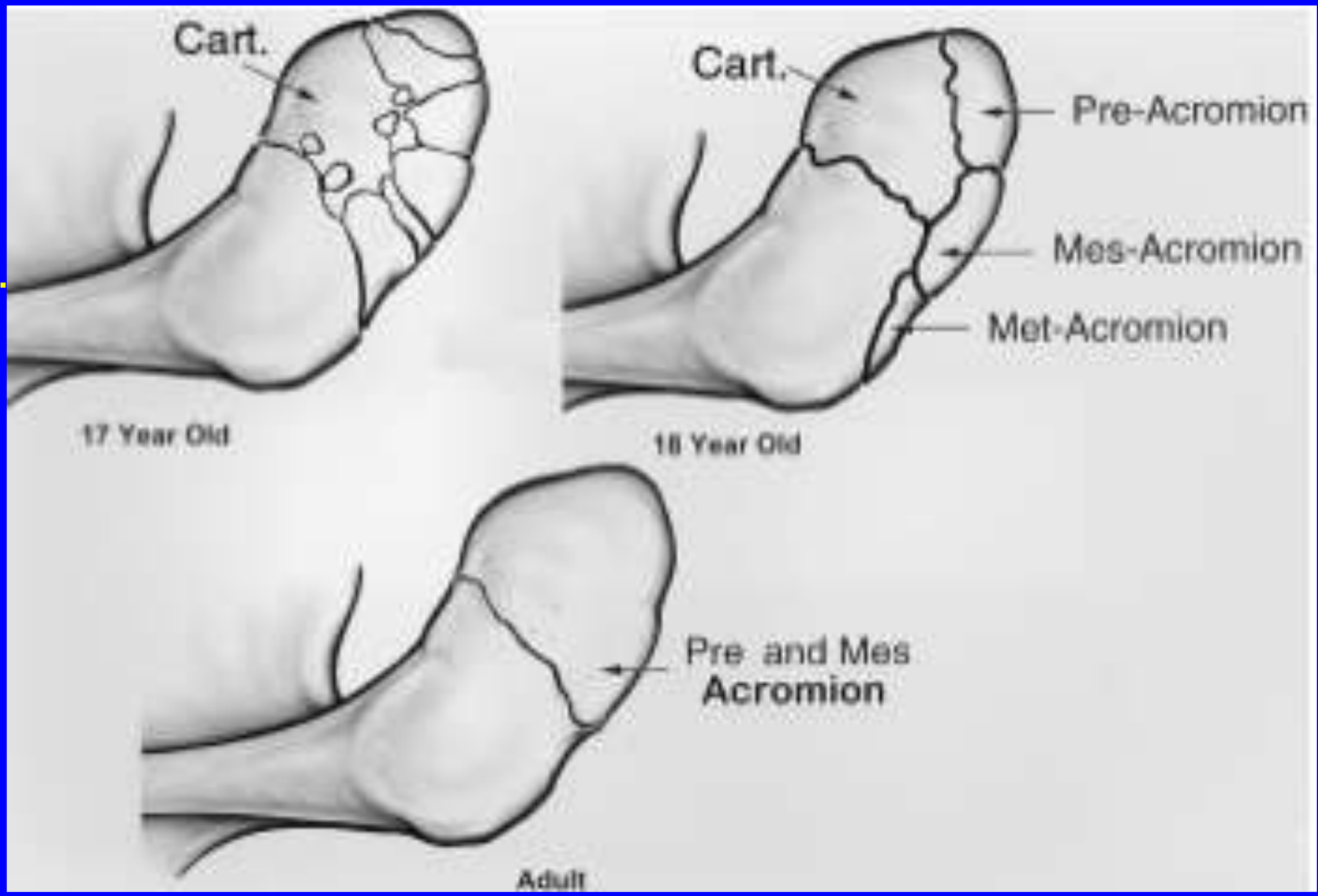
Os Acromiale

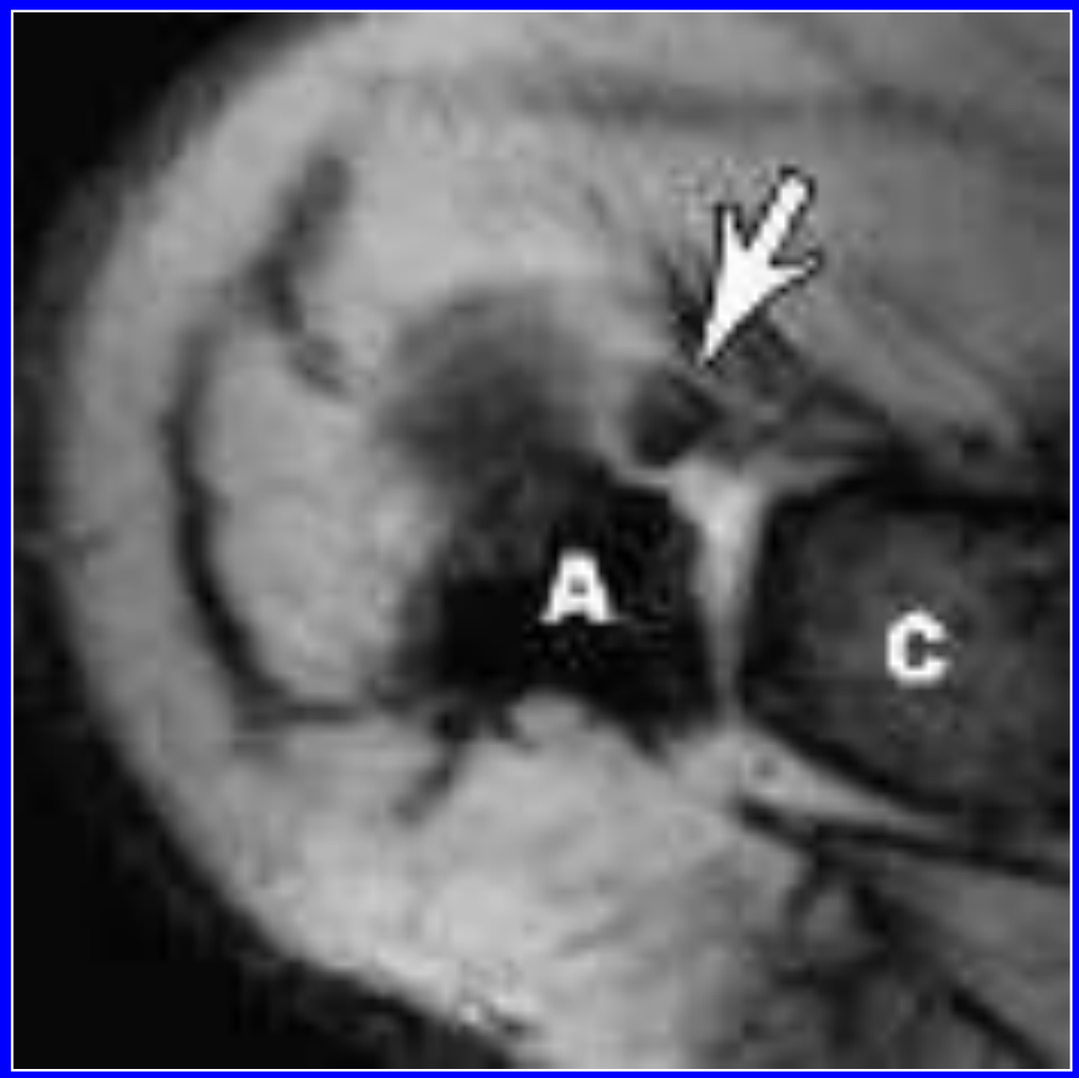
I.

II.



Sammarco VJ. Os Acromiale: Frequency, Anatomy, and Clinical Implications. *J Bone Joint Surg Am.* 2000;82:394-400.

Os Acromiale



Oullette H et al. Re-examining the association of os acromiale with supraspinatus and infraspinatus tears. *Skeletal Radiol* (2007) 36:835–839

Os Acromiale

I. Frequency 8% (1-15%)
II. More common in males, African Am
III. Up to 1/3 bilateral
    - Also more common in African Am
IV. Best seen on axillary view
V. Most asymptomatic-don't touch
    - May further destabilize with acromioplasty

Symptomatic Os Acromiale Tx

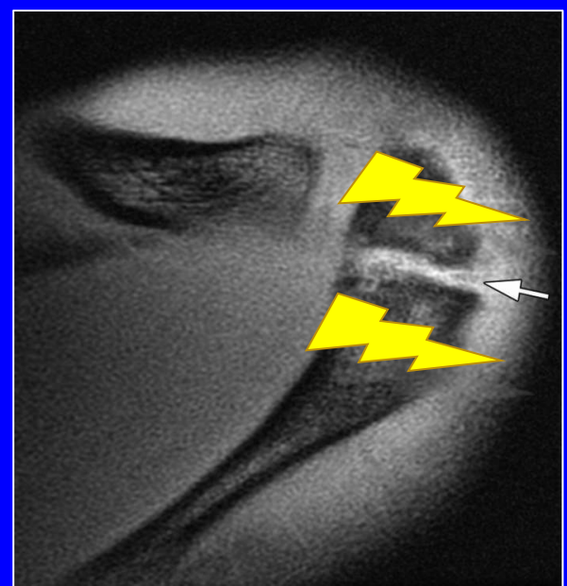
I. Symptomatic Os
   - Pinpoint tenderness at Os, abnormal motion
   - May see edema suggesting Abnormal motion
   - Has been associated with extrinsic subacromial impingement, RTC tears

II. 6 mo trial of conservative Tx
   - Physical therapy, NSAIDs
   - Subacromial steroid injection (1-2)/6 mo
   - Contraindication: RTC tear

Surgical Tx Os Acromiale

I. Free Fragment Excision (Reattach deltoid)
- Reserved for small fragments
- Mixed reviews, post-op deltoid dysfunction
- May further destabilize AC jt

II. Fragment Fixation
- Resect cartilage, then fuse (+/- bone graft)
- (+) Limits motion, decompresses SubAcromial space
- (-) 1. Nonunion (Limit with TAc approach)
  2. Hardware loosening (lack fusion)
  3. Acromion Fx
  4. Foreign body Rx
  5. **Pain** may necessitate removal



Surgical Tx Os Acromiale

III. Acromioplasty (Arthro>Open)

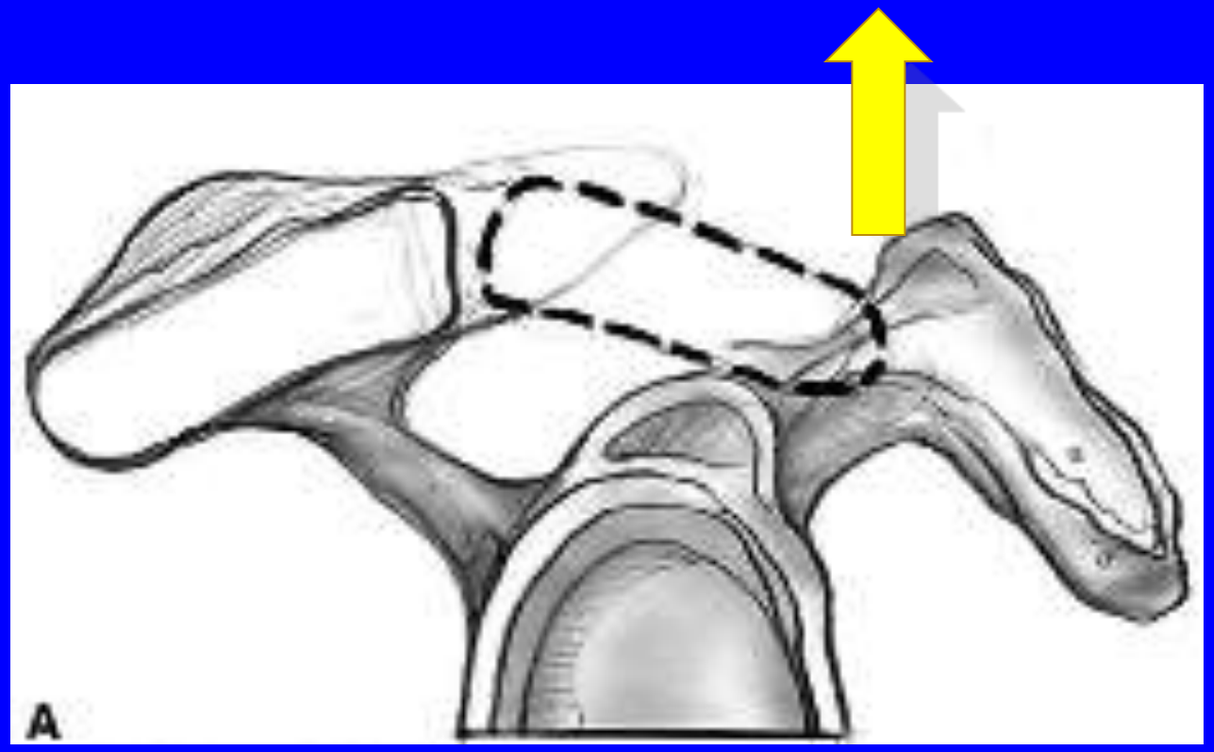
- No hardware to complicate
- Try to minimize deltoid dysfunction
- Preserving attachment of anterior deltoid fibers
- Too aggressive resection anteriorly may violate deltoid insertion → cause postop weakness or deltoid avulsion from acromion
- Preserve periosteum and some preserve CoracoAcromial Ligament

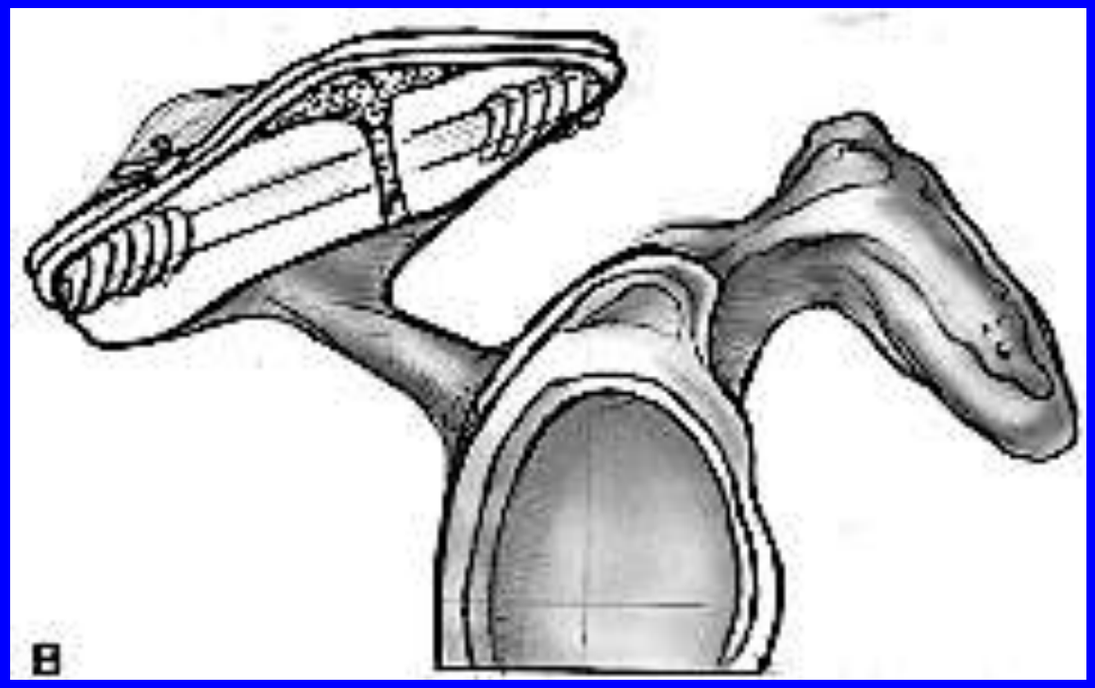
Surgical Tx Os Acromiale

Lag screw, tension band,
Elevate anterior fragment
to decompress
subacromial space

Peckett et al. Internal fixation of symptomatic os acromiale: A series of twenty-six cases. *J Shoulder Elbow Surg*. Vol 13, 4: 381-386. 2004

Unstable mesoacromion





A. Correction of Antero-Inferior tilt

B. Herbert screw, tension band fixation, bone graft

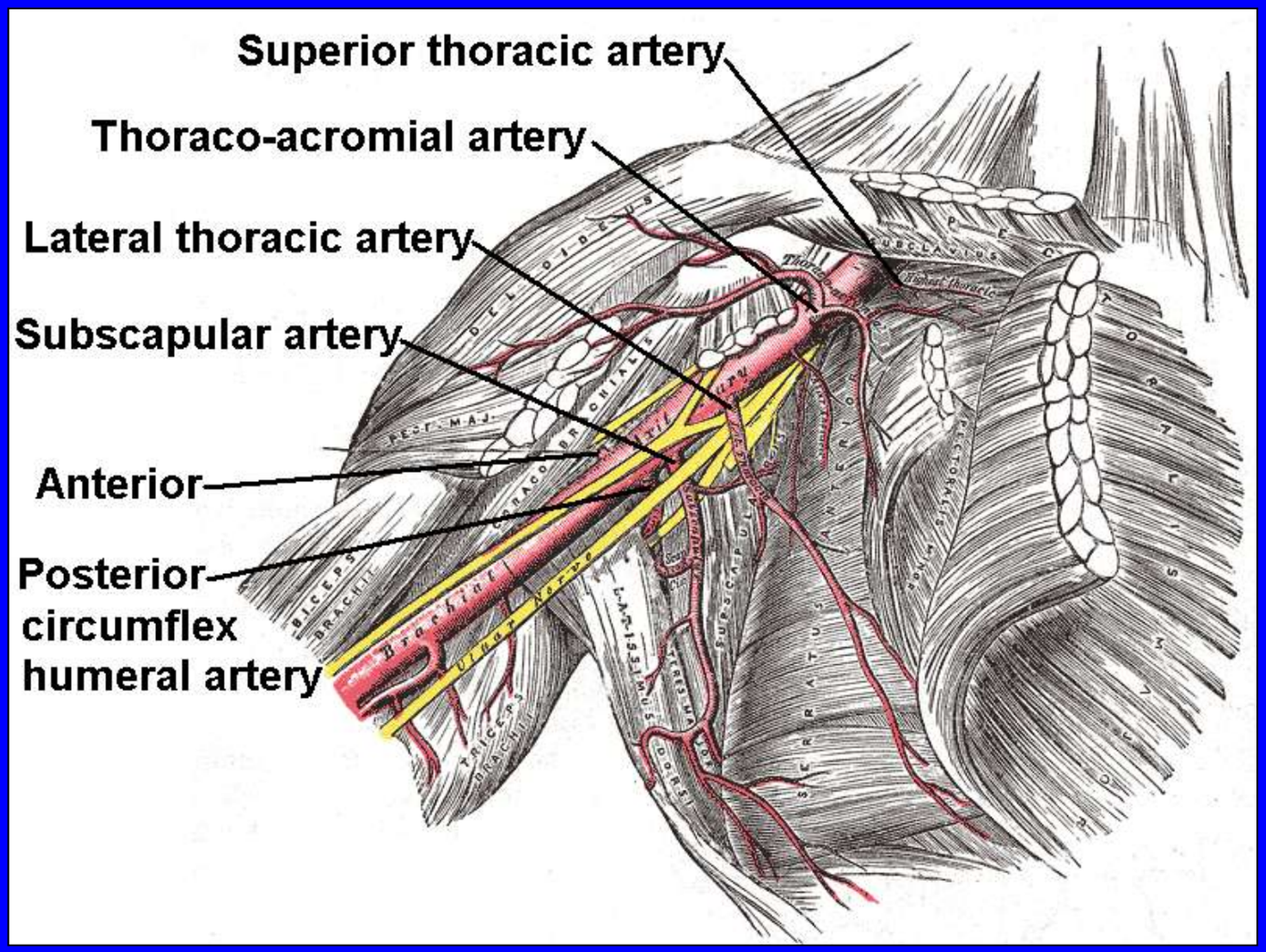
Ortiguera CJ et al. Surgical management of the symptomatic os acromiale.
J Shoulder Elbow Surg 11:521-8; 2002

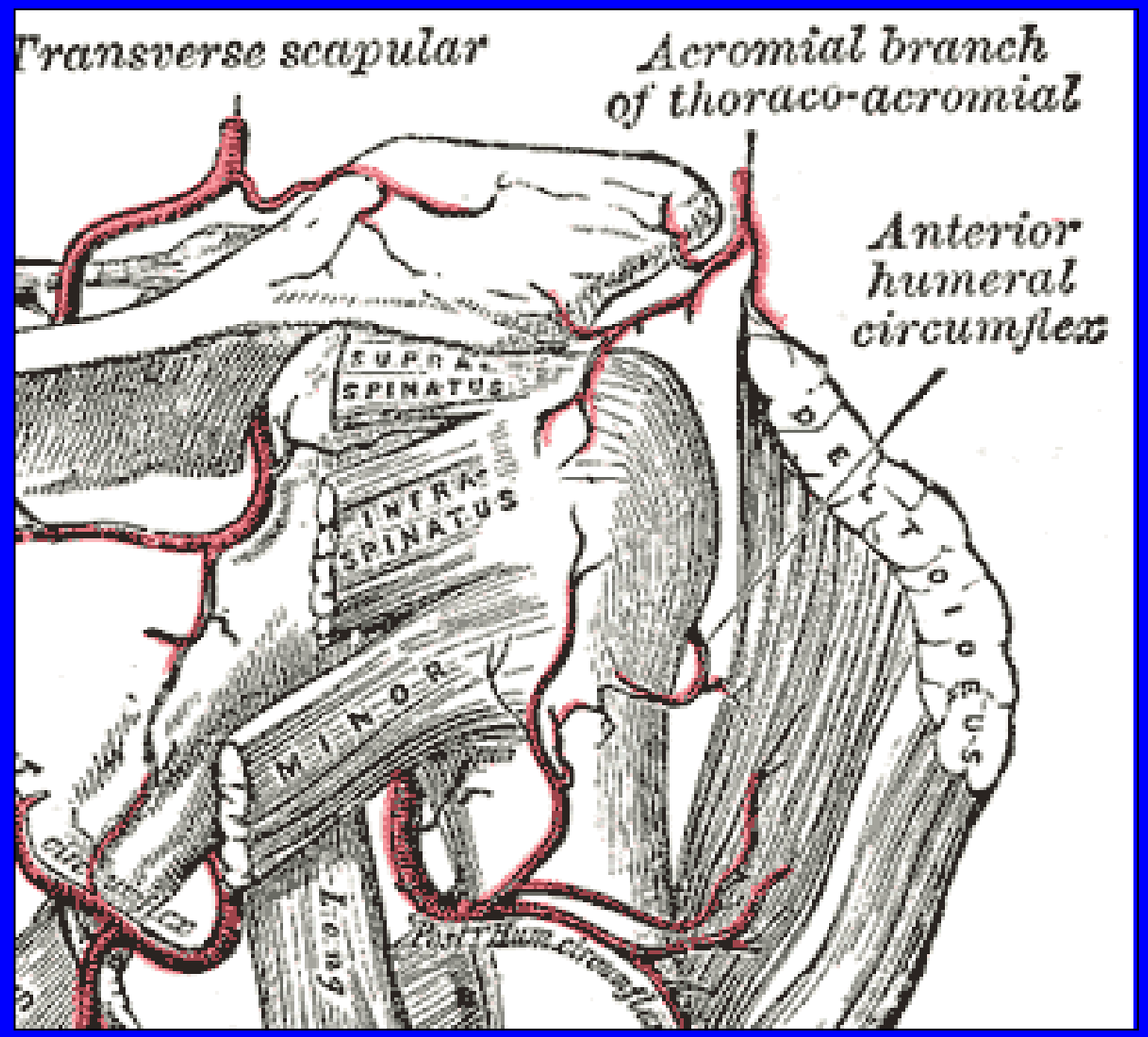
Surgical Tx Os Acromial: Nonunion

I. Open deltoid off approach
   - Terminal Thoracoacromial artery divided

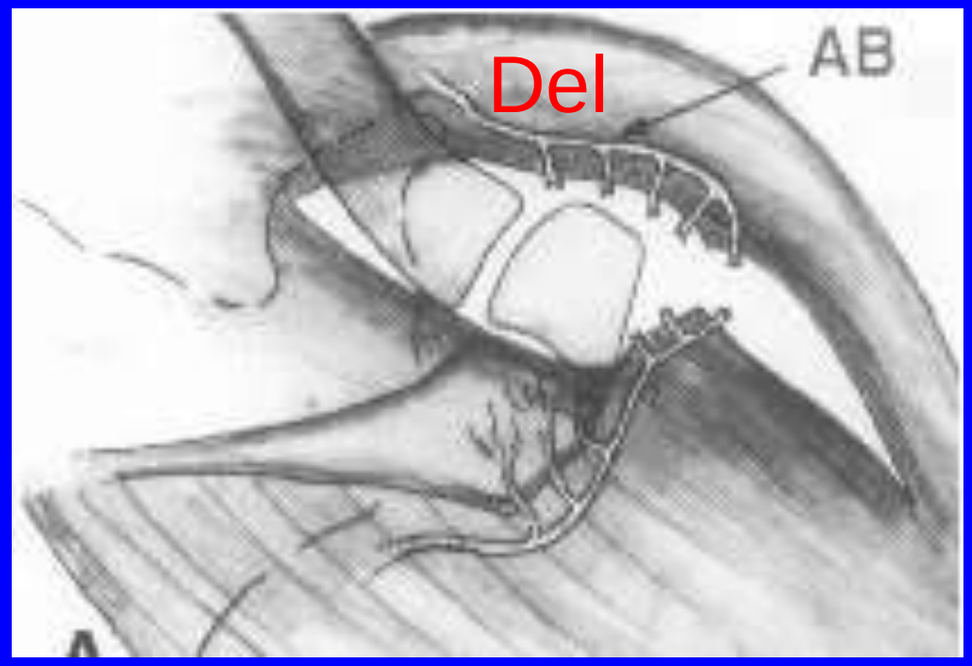
II. TransAcromial reduction/fixation
   - Less likely to result in nonunion
   - Terminal branch of Thoracoacromial artery preserved
   - Better rates of fusion

Axillary Artery

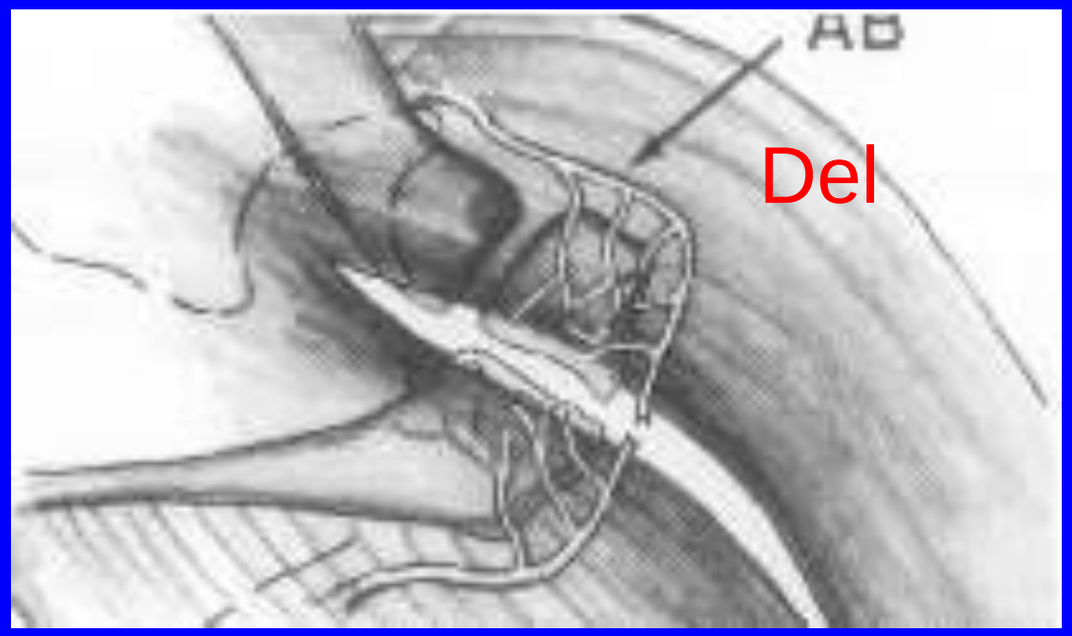




Acromioal branch of Thoracoacromial artery



Anterior Deltoid off approach



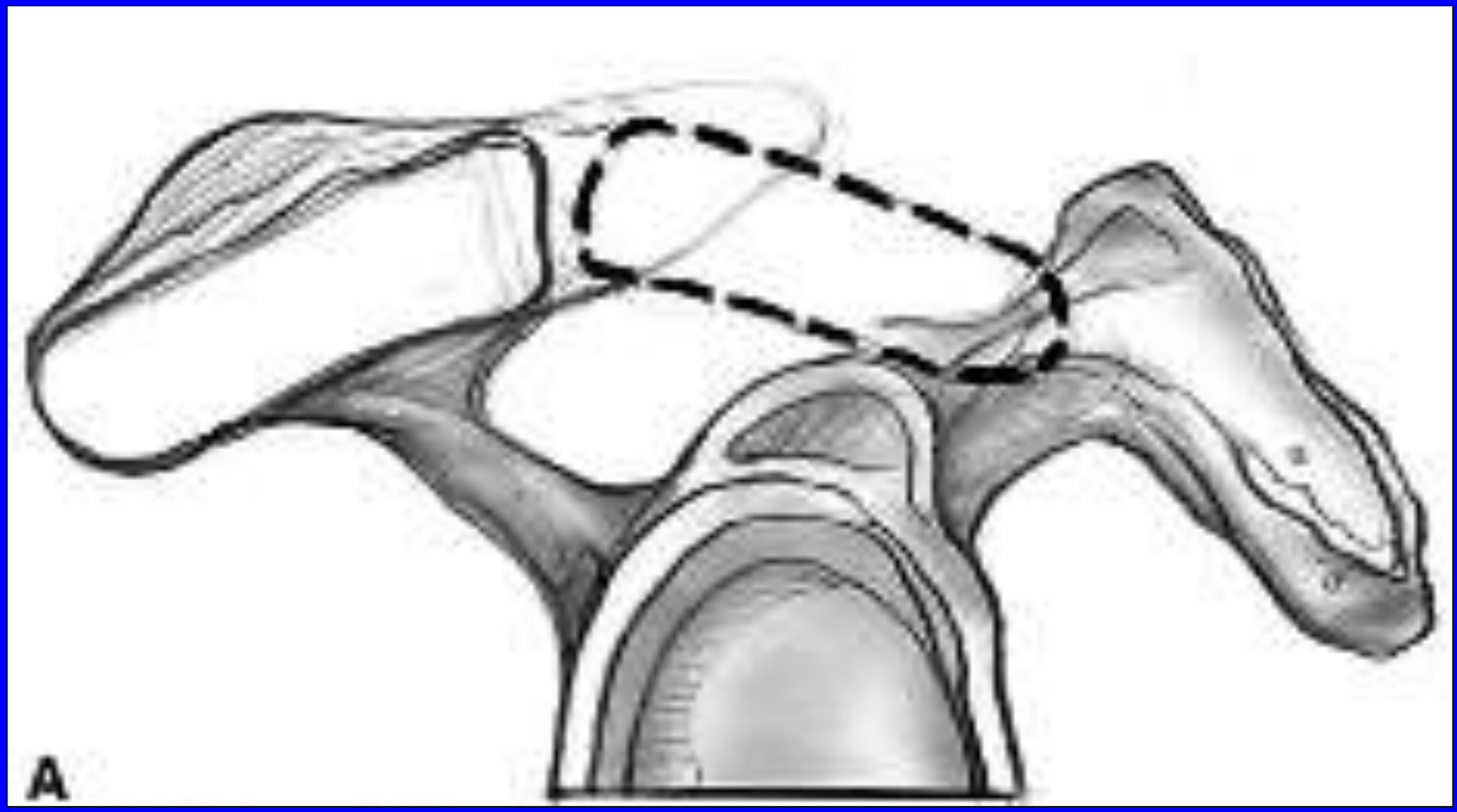
Trans Acromial approach

I. Split deltoid over basiacromion

II. preserve acromial branch of ThAc artery

Hertel et al. Transacromial approach to obtain fusion of unstable 0s acromiale. *J Shoulder Elbow Surg* Vol 7, Number 6

Os Acromiale (OAc): Impingement and RTC tears



Ortiguera CJ et al. Surgical management of the symptomatic os acromiale. *J Shoulder Elbow Surg* 11:521-8; 2002

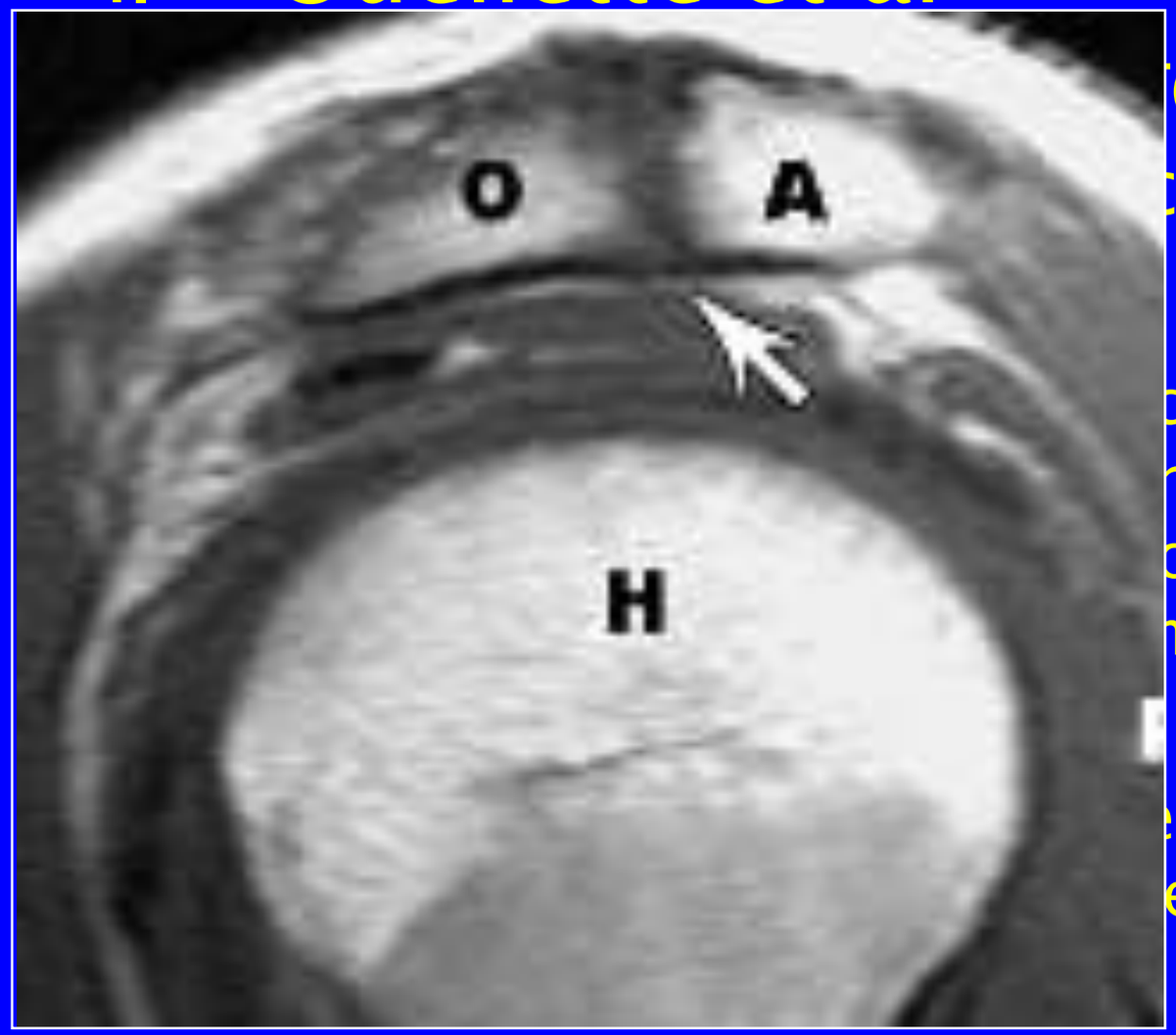
Os Acromiale (OAc): Impingement and RTC tears

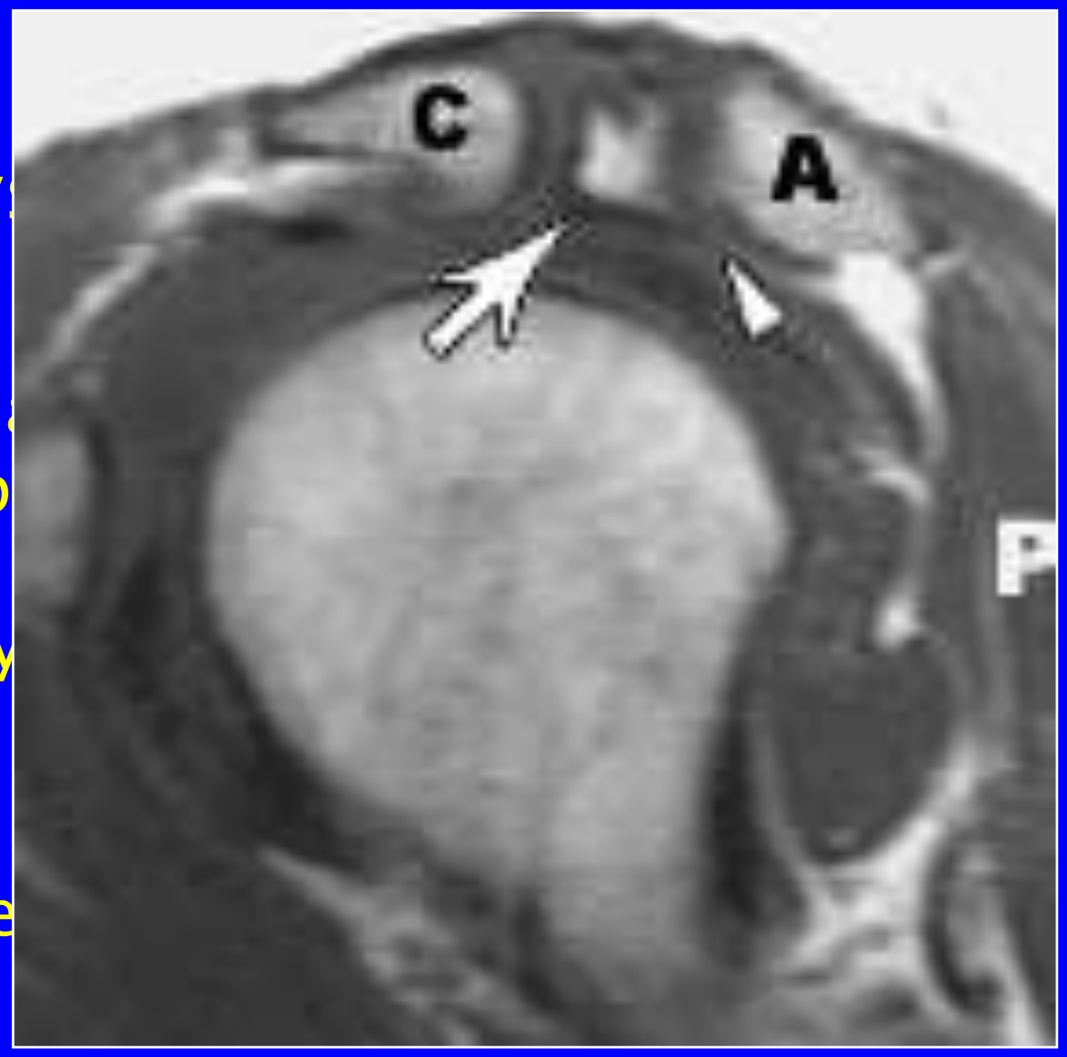
I. Boehm et al
   - 1000 pts RTC repair, 6.2% had OAc
   - Age of pts, avg number tendons involved in tears not statistically different in OAc vs non

II. Ouellette et al
   - Shoulder MR of 42 OAc pts reviewed
   - age/gender matched random controls with MR
   - MR, Arthroscopy correlation

Os Acromiale (OAc): Impingement and RTC tears

1. Ouellette et al





Oullette H et al. Re-examining the association of os acromiale with supraspinatus and infraspinatus tears. *Skeletal Radiol* (2007) 36:835–839

Os Acromiale (OAc): Impingement and RTC tears

1. Ouellette et al
   - No statistically significant difference in occurrence of RTC tears (MR, Arthroscopy) when compared OAc with control
   - No significant correlation between
     - 1. Presence of edema (31/42) near synchondrosis and RTC tear
     - 2. OAc subtype and presence of RTC tear on MR imaging

Ouellette et al Limitations…

I. Small sample size
   - OAc and control groups n<50
   - Establishing causal relationship (RTC tear, OAc) with small sample size difficult

II. Retrospective data analysis
   - Demonstrating causal relationship difficult

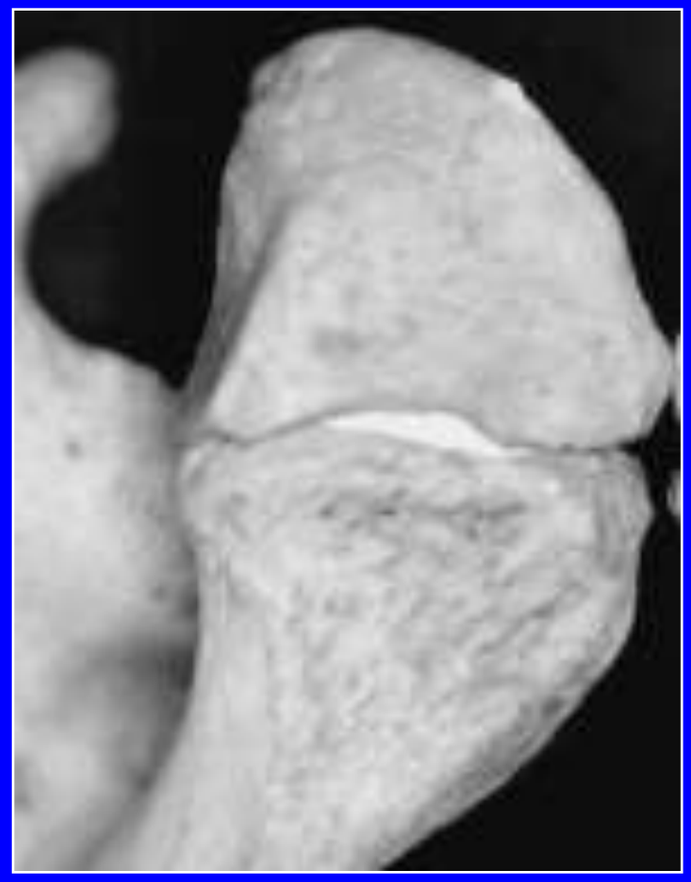
III. Selection bias
   - OAc and CTRL groups included pts examined for shoulder symptoms

IV. Variability
   - Different arthroscopists, MR protocols
   - Less than half OAc/CTRLpts had arthroscopic correlation

Apophysis

I. Crescent shaped proximal border
II. bone spicules interdigitate

Os



I. Linear joint
II. Smooth margins

Sammarco VJ. Os Acromiale: Frequency, Anatomy, and Clinical Implications. *J Bone Joint Surg Am.* 2000;82:394-400.

Extrinsic Subacromial Impingement: Osseous causes

I. Acromion Morphology

II. **AC Joint distal clavicle osteophytes**

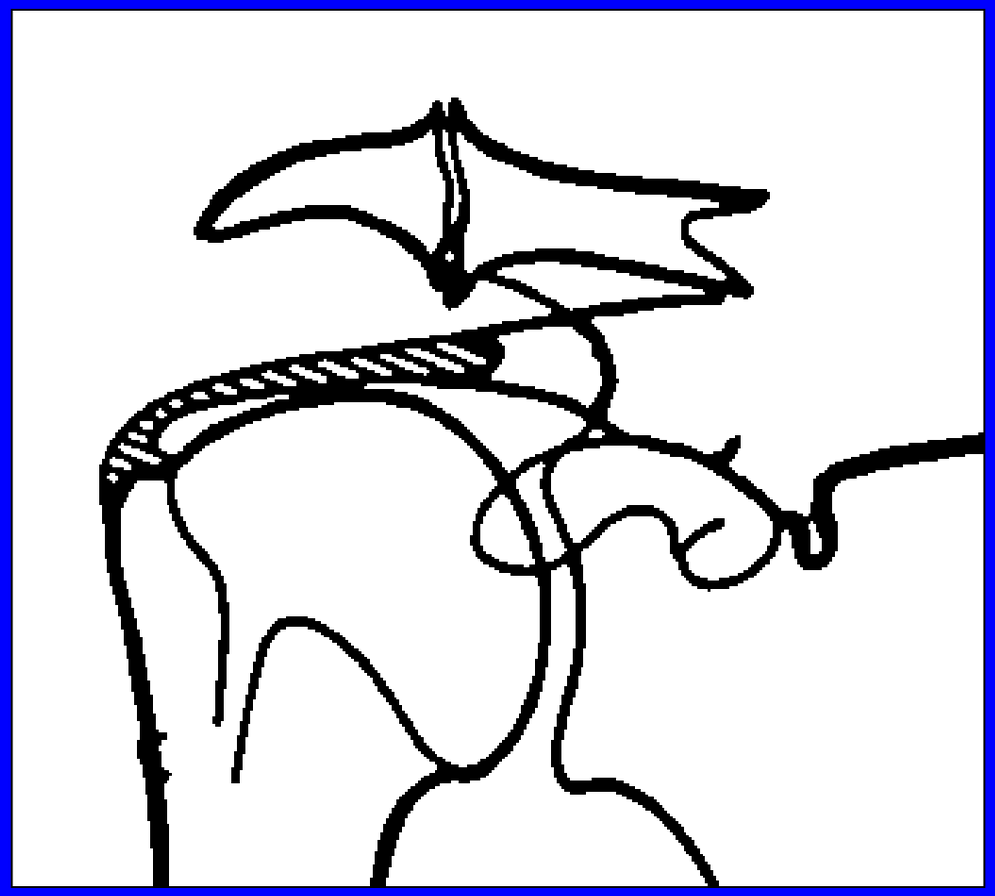
III. Trauma
   - Greater Tuberosity Fracture mal/nonunion)

Chung CB, Steinbach LS. MRI Of The Upper Extremity: Shoulder, Elbow, Wrist And Hand. Lippincott Williams & Wilkins Nov 2009 p 246-254

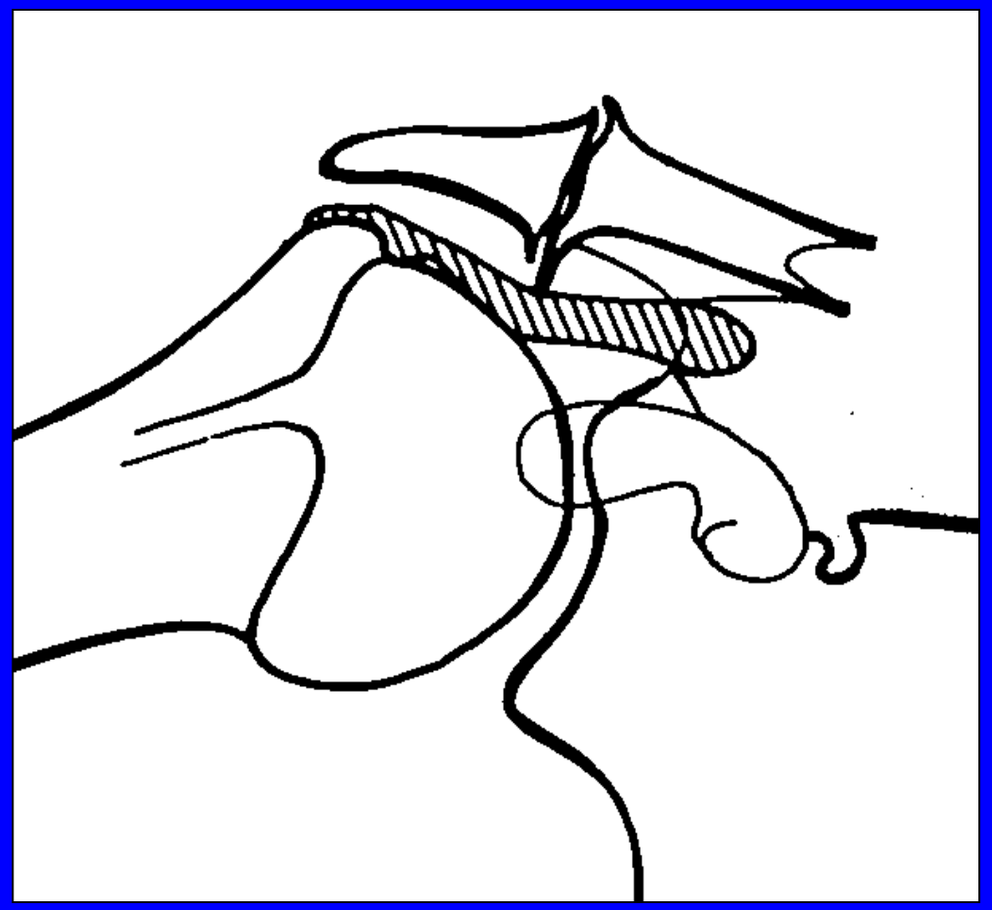
AC Jt OA, Impingement, RTC tears

I. 95% pts with AC jt OA also have GH jt derangements
II. AC Jt OA often occurs alongside RTC pathology, advanced age
III. Downgoing distal clavicle osteophytes may be implicated in extrinsic Impingement and RTC tears
IV. Others have downplayed AC joint in RTC tear pathogenesis

AC Jt Osteophytes and RTC tears



Neutral



60 Abduction

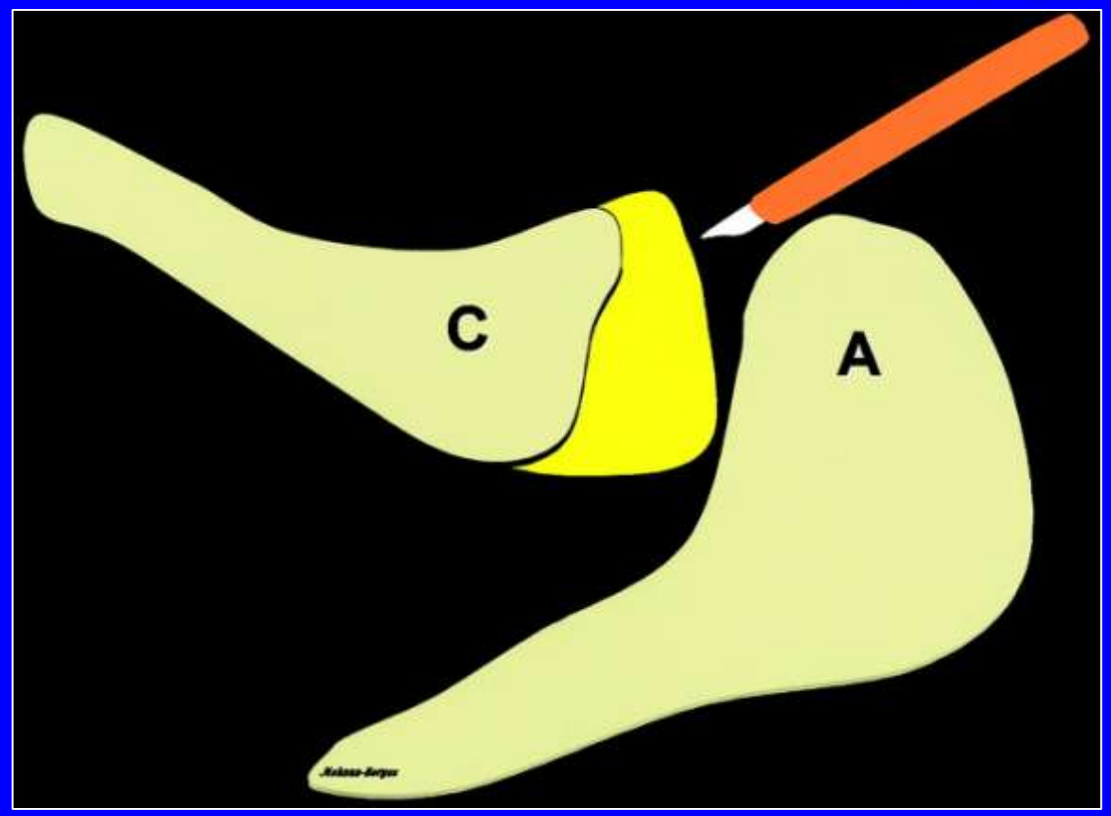
Petersson and Gentz demonstrated inferior AC jt osteophytes were significantly associated with SupraST rupture, even without acromion undersurface spur.

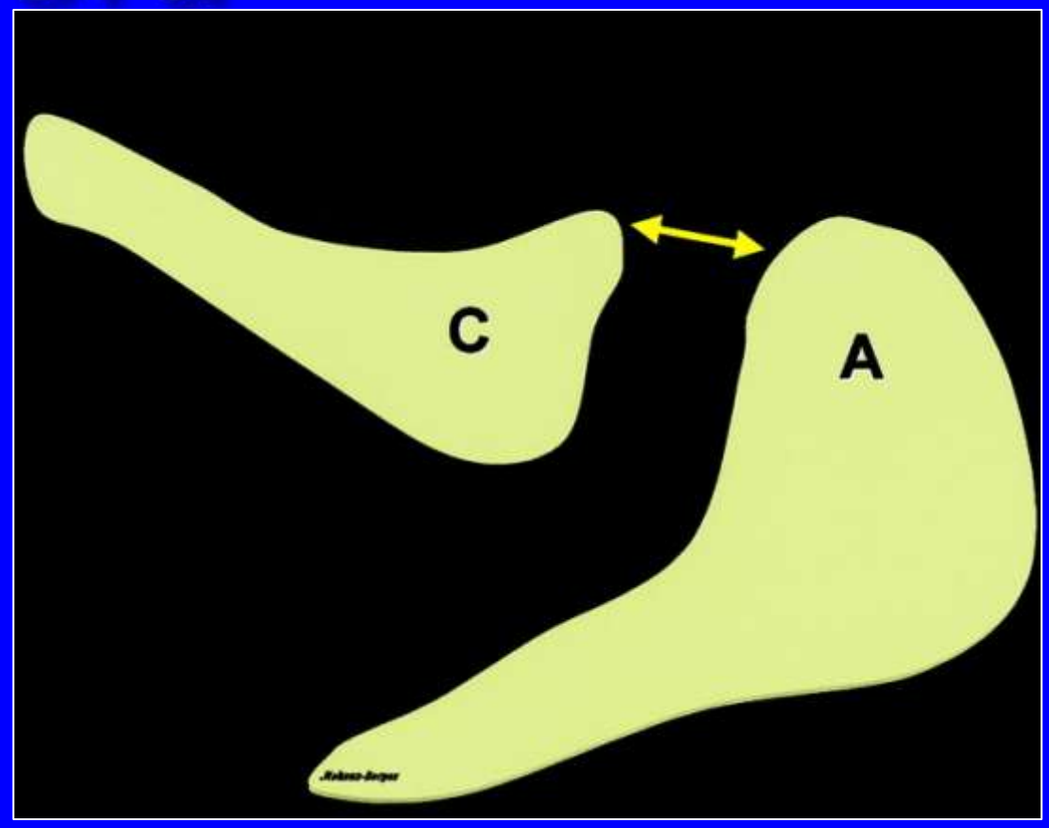
Fig A, B from Petersson CJ, Gentz CF. Ruptures of the supraspinatus tendon. The significance of distally pointing acromioclavicular osteophytes. *Clin Orthop Relat Res* 1983 Apr; (174):143-8

AC OA Impingement:Treatment

I. Conservative Tx at least 6 months
II. Surgical
    - Preop intrarticular steroid/anesthetic injection
    - Mumford distal clavicle resection
    - SubAcromial Decompression, distal clavicle resection (mainly for impingement)
    - Coplaning (mainly for impingement)

AC OA Impingement Tx: Mumford





I. Limits abutment of distal clavicle and medial aspect of acromion (mainstay)

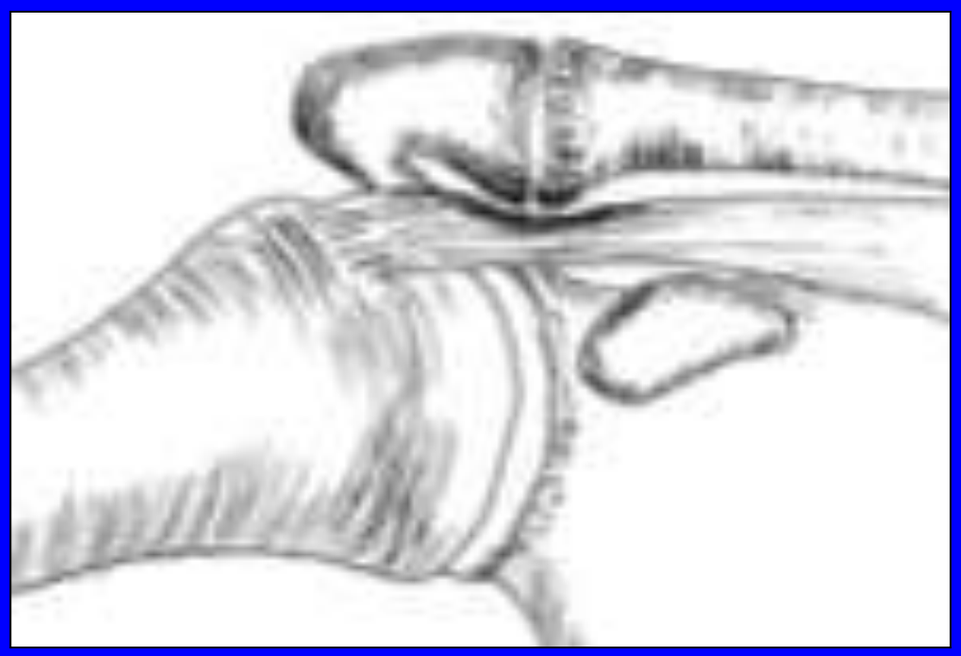
II. Usually excise distal 10-20 mm distal clavicle

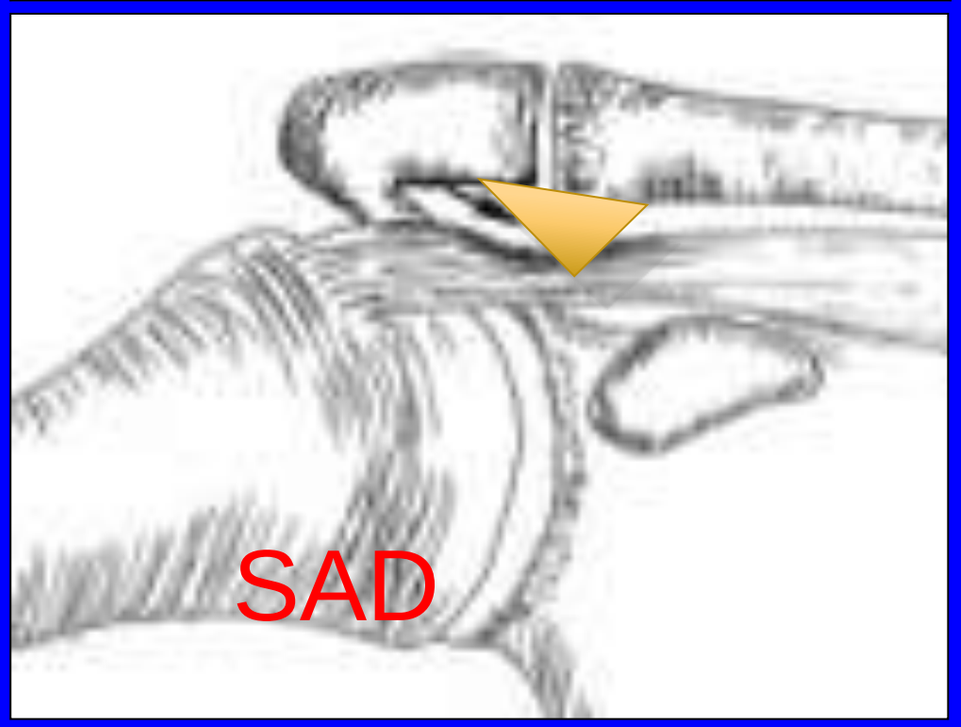
Mohana-Borges A V R et al. Radiographics 2004;24:69-85

©2004 by Radiological Society of North America

RadioGraphics

AC OA Impingement Tx: Coplaning

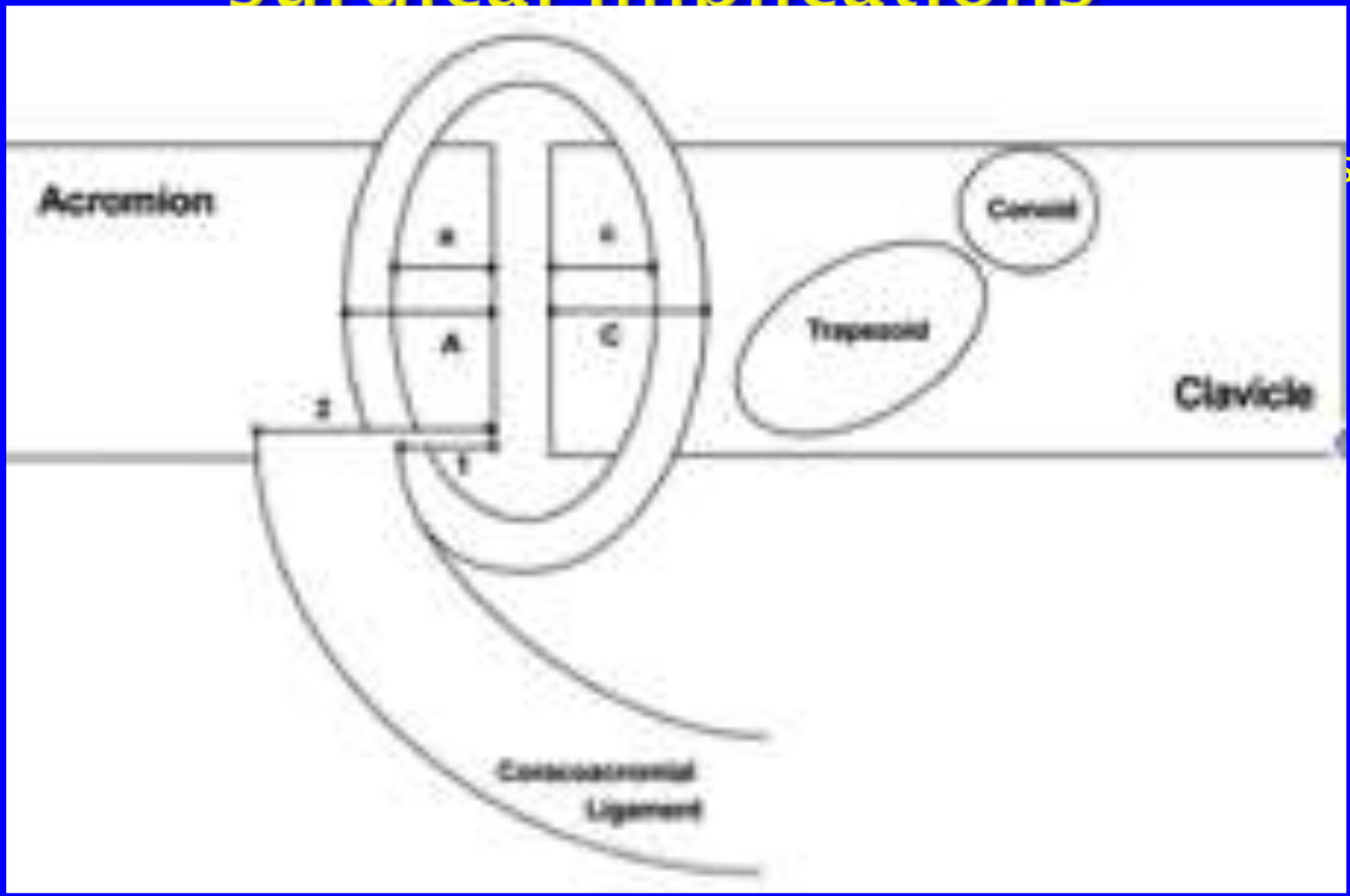




I. With subacromial decompression, prominent inferior clavicular spurs not removed my remain symptomatic
II. Inferior clavicle resection +/- inf capsule referred to a coplaning
III. May be a better alternative than mumford

Barber A. Coplaning of the Acromioclavicular Joint. *Arthroscopy: The Journal of Arthroscopic and Related Surgery, Vol 17, No 9 (November-December), 2001: pp 913-917*

Impingement, capsule anatomy surgical Implications



Stine IA, Vangsness CT. Analysis of the capsule and ligament insertions about the Acromioclavicular Joint: A Cadaveric study. *Arthroscopy*. Vol 25 No 9 (September). 2009 pp 968-974

Impingement, capsule anatomy surgical Implications

I. CA Ligament
- Complex anatomy
- Medial acromial attachment confluent with inferior AC ligament/capsule
- Attaches 3-4 mm from medial acromial articular surface
- May be removed during DCE, SAD, Coplaning

II. Trapezius fascia
- Confluent with posterosuperior AC jt capsule

Learning Objectives

- ✓ ~~Review the clinical features and significance of AC joint injury~~
- ✓ ~~Review normal AC Joint anatomy~~
- ✓ ~~Become familiar with basic AC joint biomechanics~~
- ✓ ~~Be able to classify AC joint injuries based upon modified Rockwood Classification~~
- ✓ ~~List common causes of extrinsic subacromial impingement~~
- ✓ **Review common AC joint arthritides**
- ✓ Bonus round

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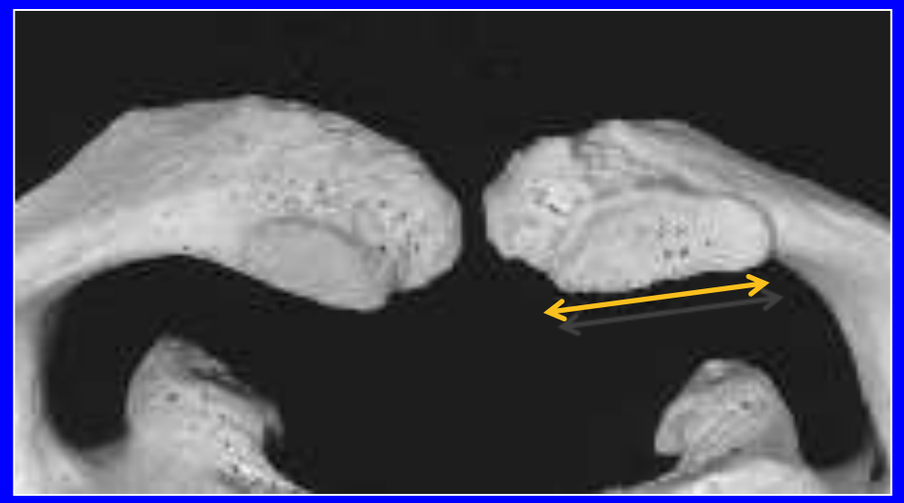
AC Jt Osteoarthritis

I. Most common cause of AC jt pain
II. Common in both symptomatic and asymptomatic pts >50 yo alike
III. Prevalence of asymptomatic AC OA may be up to 50-80% pts
IV. Jordan et al. reported no association between MRI and clinical findings 116 pts
V. Primary vs post Traumatic OA

AC Jt OA osseous manifestations

I. AP elongation of acromial facet (posteriorly mainly)



I. End stage Ball and socket appearance

Edelson JG. Patterns of degenerative change in the acroioclavicular joint. J Bone Joint Surg [Br] 1996; 78-B:242-3

AC Jt Osteoarthritis

I. Mass effect upon RTC by associated with signal changes in RTC

II. MR more sensitive than radiographs
   - More accurately judge severity of dz
   - Capsule soft tissue proliferation, Rx marrow changes
   - RTC mass effect, tendon signal alteration

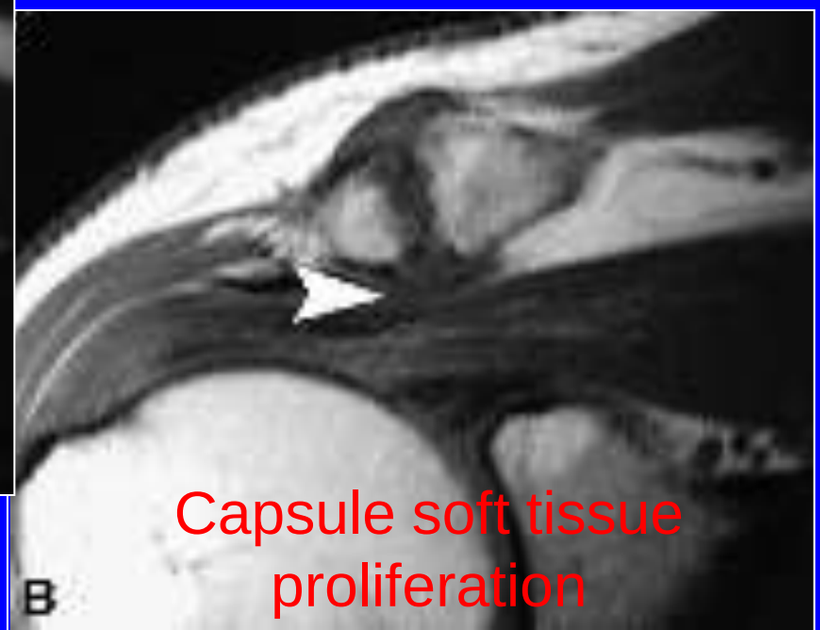


Fig A, B, C. De Abreu MR, Chung CB, Wessely M, Jin-Kim H, Resnick D. Acromioclavicular joint osteoarthritis: Comparison of findings derived from MR imaging and conventional radiography. *Journal of Clinical Imaging* 29 (2005) 273-277

AC OA: Capsule, Effusion significance

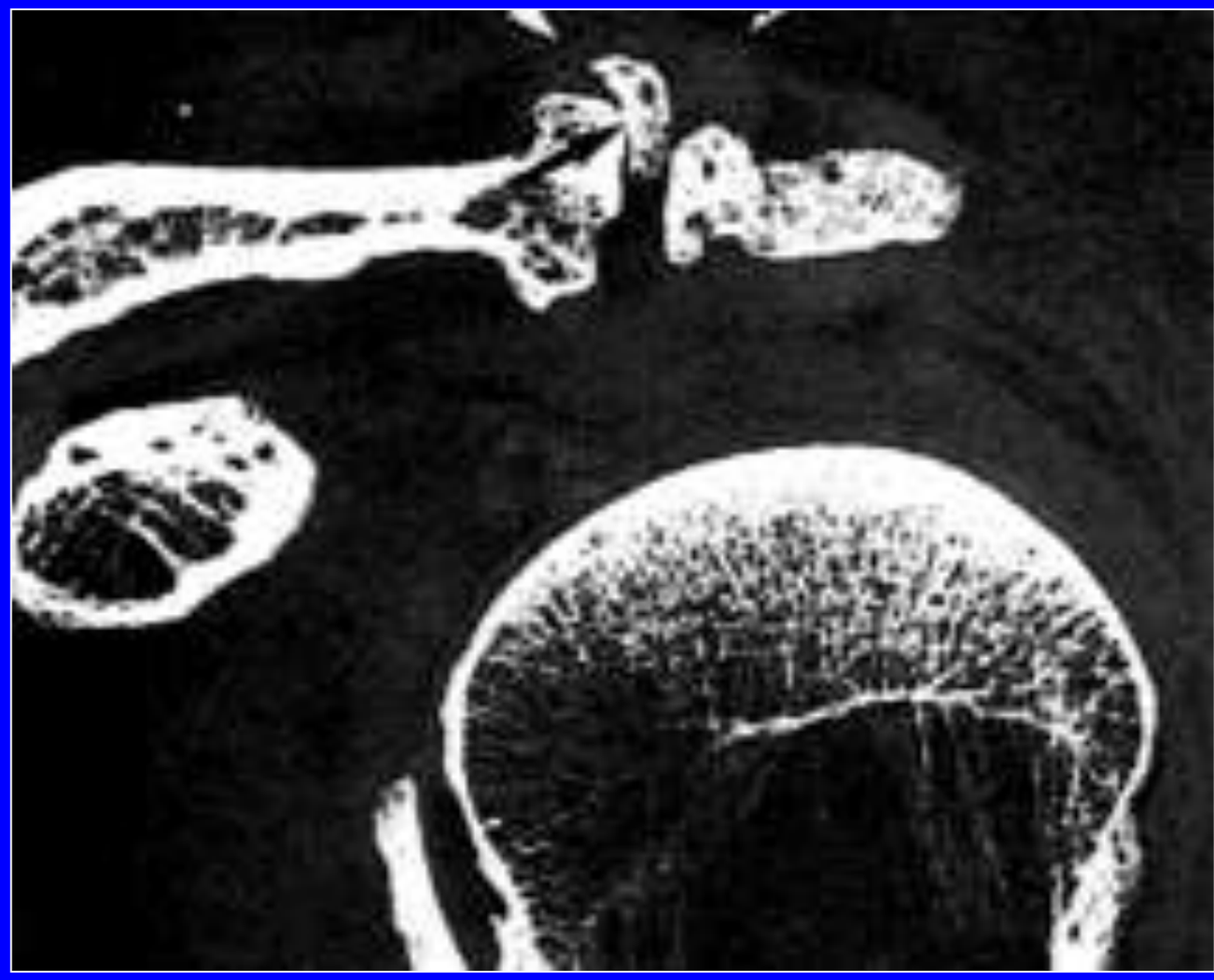
I. MR Predictors of pain relief after steroid injection (Strobel et al)
   - Pts who responded best to injection all had capsular hypertrophy (3mm)

II. Jordan et al however found capsular hypertrophy in 65% of sympomatic and 48% of asymptomatic patients

III. Joint Fluid = Asymptomatic manifestation of OA
   - IS assoc with advanced age, severity of osteophytes
   - NOT associated with local pain, sex, impingement/RTC tear

Meniscle Ossicle

I. Rarely Intraarticular disk may ossify
II. Forms an intercalate ossicle
III. Remote trauma vs degen



Huang GS, Bachmann D, Taylor JA, Marcelis S, Haghighi P, Resnick D. Calcium pyrophosphate dihydrate crystal deposition disease and pseudogout of the acromioclavicular joint: radiographic and pathologic features. J Rheumatol. 1993 Dec;20(12):2077-82.

AC OA Treatment

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II. Surgical
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    - Mumford distal clavicle resection
    - SubAcromial Decompression, distal clavicle resection (mainly for impingement)
    - Coplaning (mainly for impingement)

Rheumatoid Arthritis

I. Most common inflammatory arthropathy
II. Type III hypersensitivity immune complex dz
III. 0.5 -1% population; F>M
IV. Synovial hyperemia, hypertrophy, pannus, TNF, other cytokines cause proinflammatory cascade
V. Proteases/collagenases destroy articular cartilage, joints, tendons ligaments and bone

Resnick D. Common disorders of synovial- lined joints. Pathogenesis, Imaging Abnormalities and Complications. A**JR** 151:1079-1093,December 1988

Rheumatoid Arthritis

I. Synovitis, effusion

I. Widened AC Jt
- Distal clavicle, acromial erosions
- Tapered distal clavicle margin

II. Superficial resorption distal clavicle undersurface
- coracoclavicular ligament attachments
  - **may be more commonly seen in seronegative arthropathy (Ankylosing spondylitis)

Lehtinen JT et al. Coracoclavicular Involvement: an Atypical Manifestation in Rheumatoid Arthritis *Scand J Rheumatol* 1999;28:252-3

Rheumatoid Arthritis

Farid N, Bruce D, Chung CB. Miscellaneous conditions of the shoulder: Anatomical, clinical, and pictorial review emphasizing potential pitfalls in imaging diagnosis. European Journal of Radiology 68 (2008) 88–105

I. Distal clavicle erosion

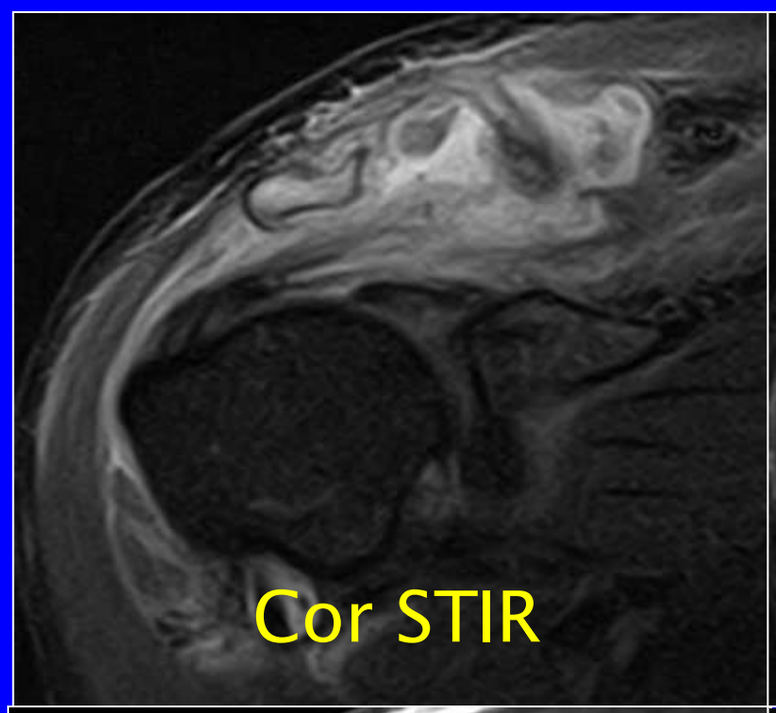
II. Large humeral head erosions

III. Loss of Acromiohumeral distance c/w full thickness RTC tear

AC Jt Septic Arthritis

I. 90% Monarticular
II. ESRD, IVDA, DM, HIV, Organ Transplant, CA pts can develop in unusual locations
III. Knee (50%), hip (20%), shoulder (8%), ankle (7%), wrist (7%)
IV. AC joint involvement rare even with ↓ immunity
V. Staph aureus most common
    - Strep pneumoniae/viridans/bovis/group D
    - MAI, TB
VI. Dx Arthrocentesis (fluoro, US)
    - 80,000-200,000 > 75 % polymorphs
VII. Typical duration of IV Abx 6-8 weeks

51 yo F Hx subacromial decompression and
distal clavicle resection 2 ½ mo ago.
Reinjury, pain with overhead lifting and reaching.
Cortisone injection w/out relief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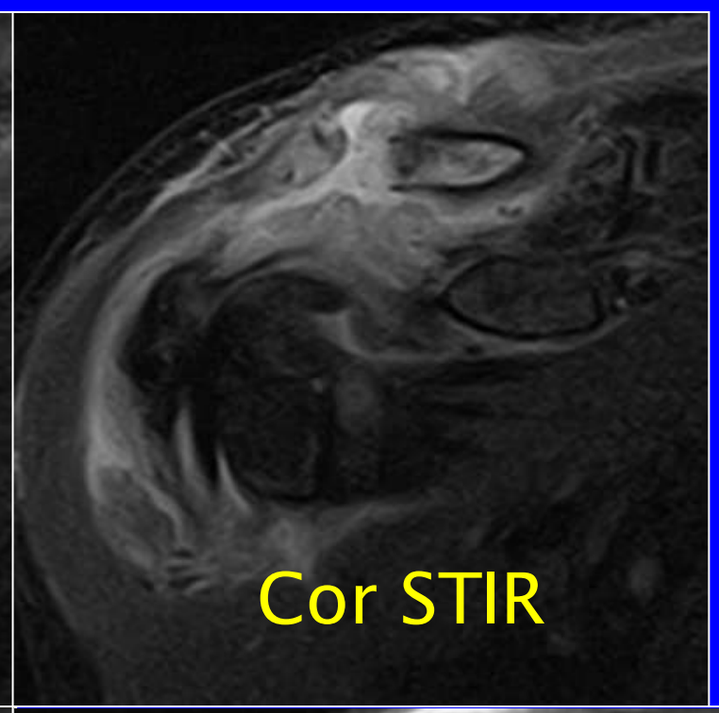
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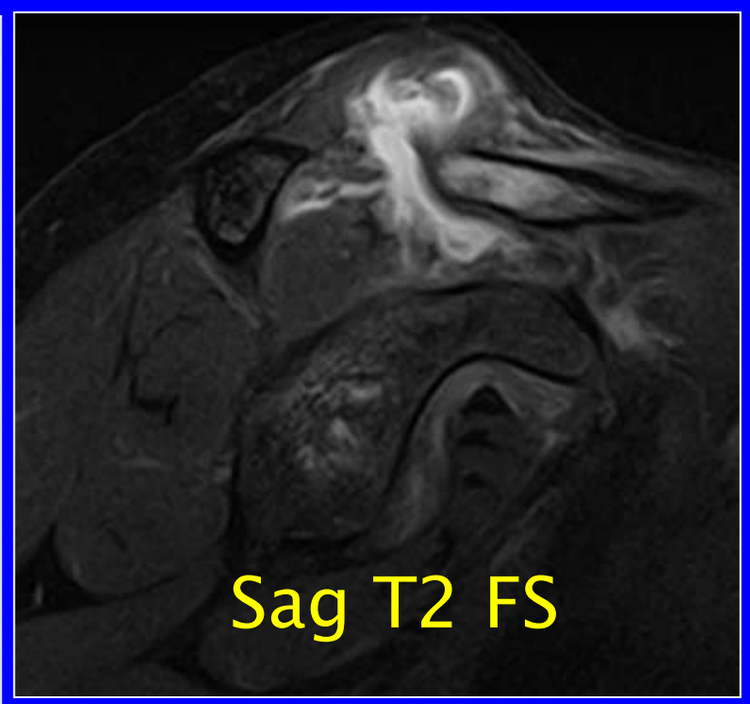
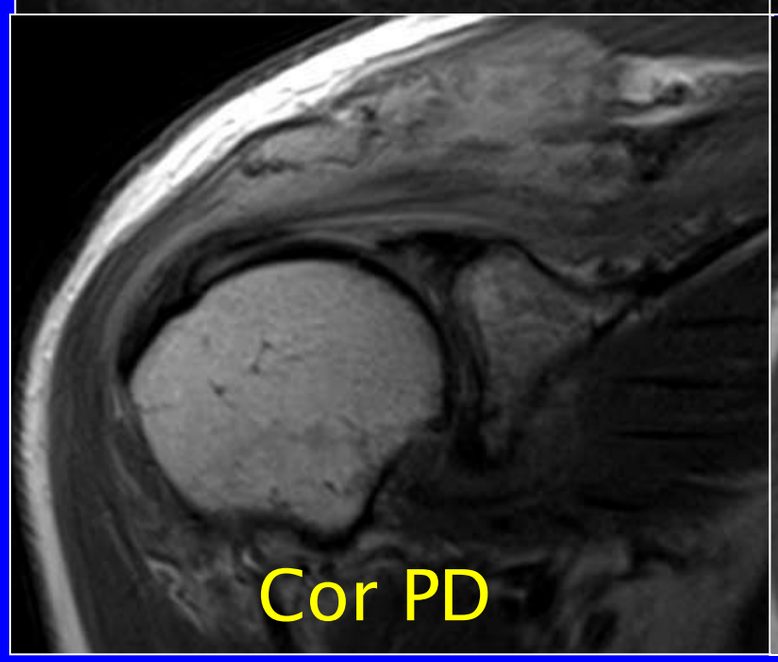
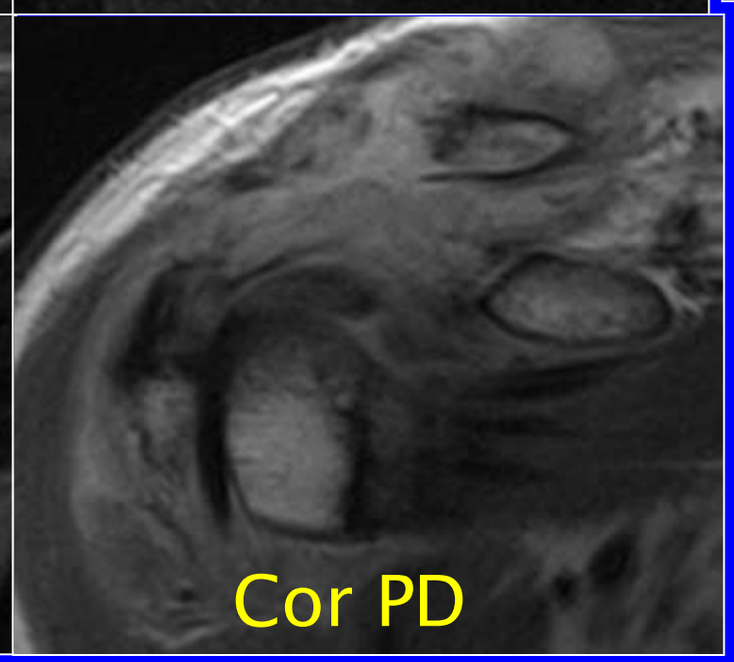

Sag T2 FS

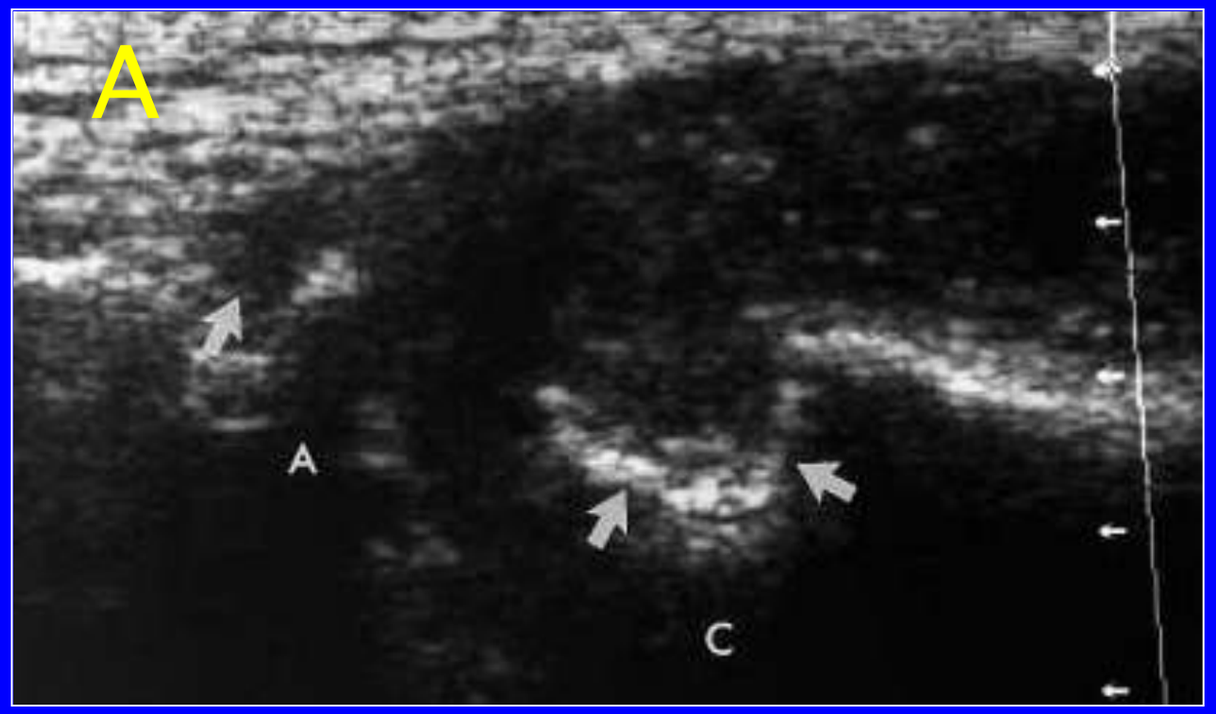

Cor PD

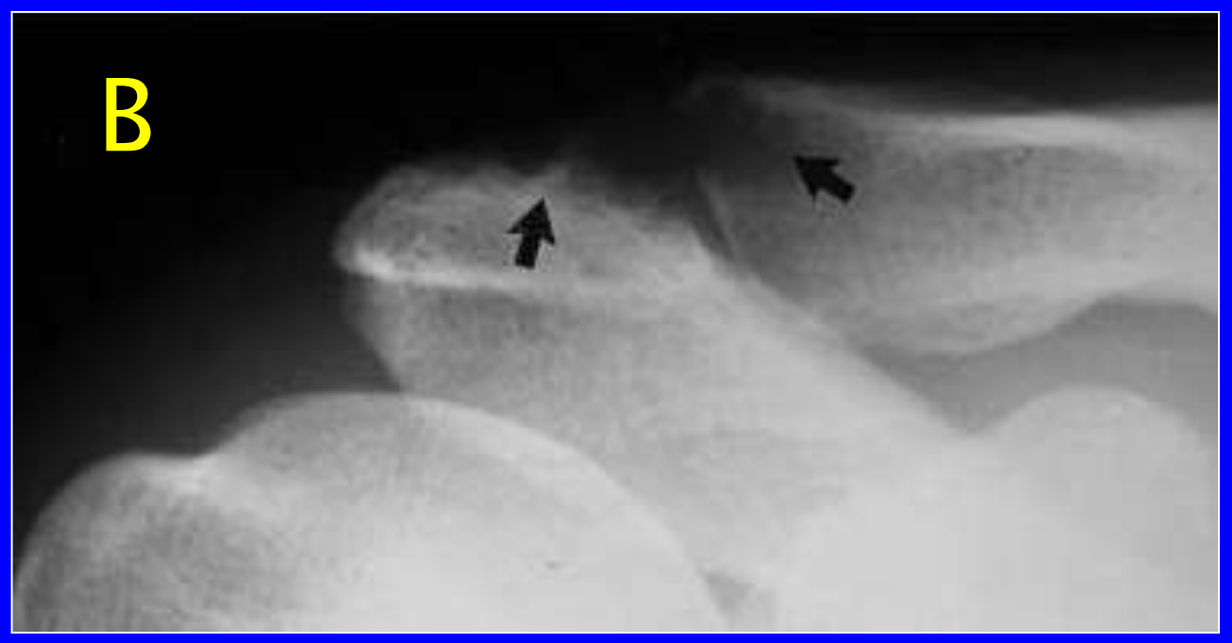

Cor PD

- ✓Evidence of SAD, DCE
- ✓Marrow edema
- ✓Large AC jt effusion
- ✓AC Capsule distention
- ✓Periarticular soft tissue edema
- ✓SubAc/SubD Bursitis

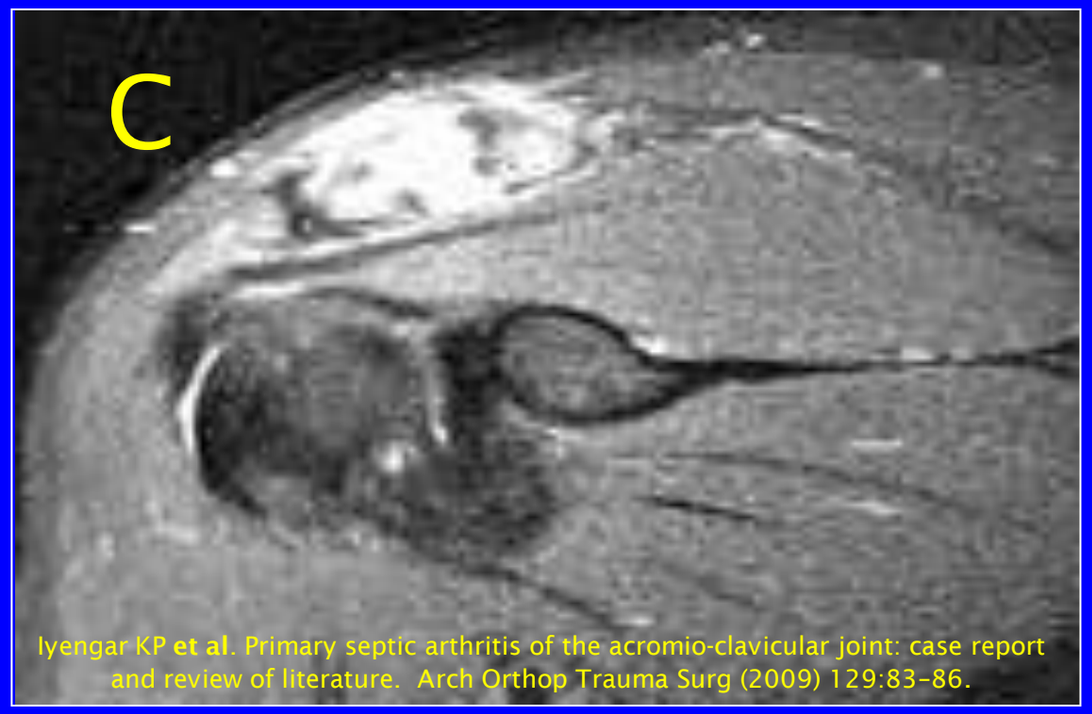
Case courtesy of Scott Yochim MD

AC Jt Septic Arthritis





Widman DS, Craig JG, van Holsbeeck MT. Sonographic detection, evaluation and aspiration of infected acromioclavicular joints. *Skeletal Radiol* (2001) 30:388–392



Iyengar KP **et al**. Primary septic arthritis of the acromio-clavicular joint: case report and review of literature. Arch Orthop Trauma Surg (2009) 129:83–86.

A. Coronal US AC jt fluid distention with erosions along superior aspect of distal clavicle and acromion

B. Radiograph Rt shoulder. Erosions along superior aspect of distal clavicle and acromion

C.Post Gad Fat sat Cor T1WI. AC jt widened by erosions, joint fluid, enhancement of capsular/pericapsular soft tissues.

Gout

I. Joint effusion
II. Periarticular STS
III. Joint space, bone mineralization often preserved till the end
IV. Eccentric erosions with sclerotic margins
V. Juxtarticular soft tissue masses
VI. Lower extremity, Extensor tendon predilection

AC jt erosions, soft tissue swelling

Case courtesy of Tudor Hughes MD

Gout

I. Monosodium urate crystal deposits in periarticular soft tissues

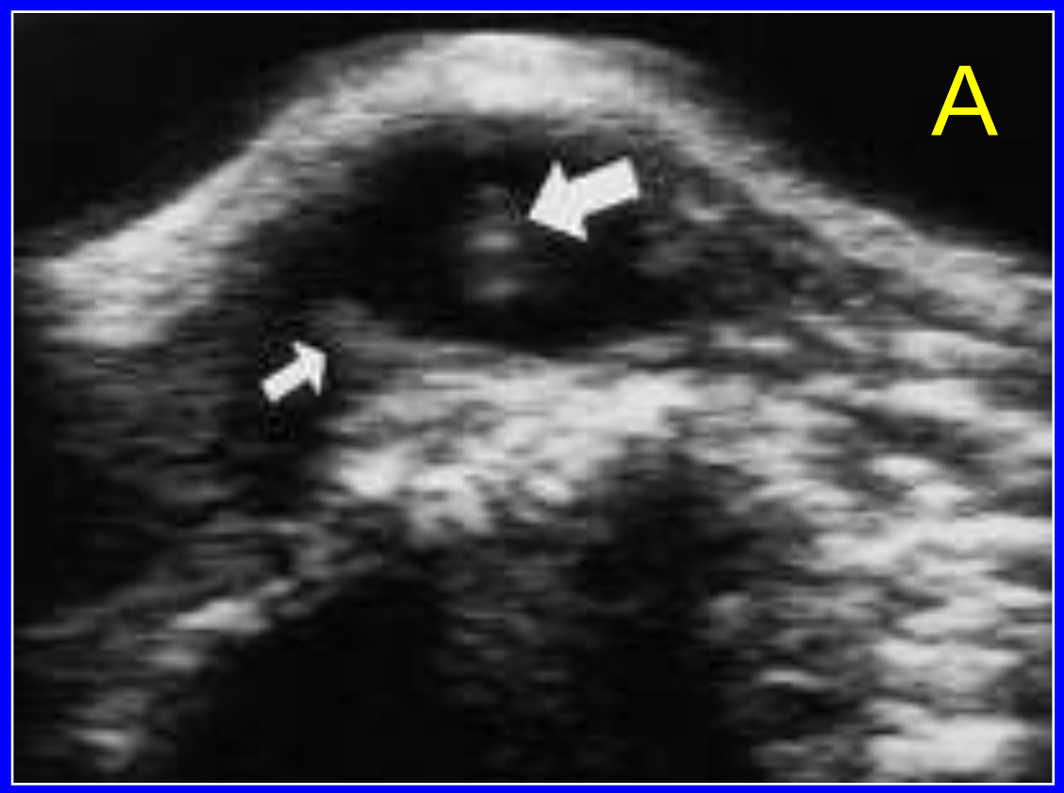
II. Urate crystals
- strongly birefringent on
- Look like needles
- Often inside WBC in acut

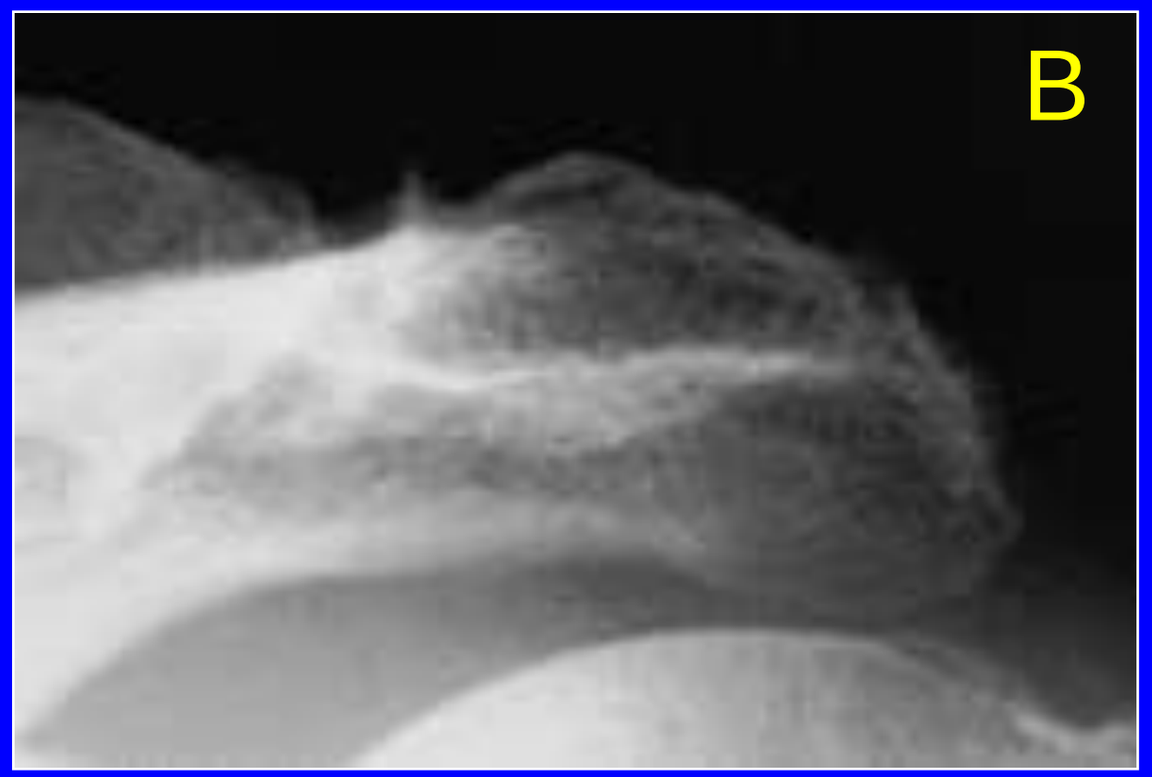
III. MC Idiopathic, M>>F

IV. Forms
- Asymptomatic hyperuric
- Acute Gouty Arthritis (90
- Chronic tophaceous Arth
- Gouty nephropathy

Phelps P et al. Compensated Polarized Light Microscopy:Identification of Crystals in Synovial Fluids From Gout and Pseudogout. *JAMA* 1968 203 (7);508-511

75 M with Hx Gout Rt shoulder swelling 3 months





A. Coronal US AC Jt. Effusion, capsule distension and clustered urate crystals in jt effusion. No RTC tear.

B. Radiograph. May sometimes see bony outgrowths in association with erosions (more often in lower extremities)

A,B. From De Santis D et al. Acromioclavicular cyst and 'porcupine shoulder' in gout. *Rheumatology* 2001; 40: 1320-1321

C. http://pandazen.files.wordpress.com/2007/12/mini-baby-porcupine.jpg

AC Jt CPPD

I. Rare

II. Calcium pyrophosphate dihydrate crystals
   - Weakly (less colorful) bir
   - Look like needles
   - May also be seen within

III. Periarticular calci

IV. Calcified, superic

V. Soft tissue swelli
   assoc with displa

VI. OA mimic
   - Jt space narrowing, subc

Phelps P et al. Compensated Polarized Light Microscopy:Identification of Crystals in Synovial Fluids From Gout and Pseudogout. *JAMA* 1968 203 (7);508-511

CPPD: Periarticular calcification

Steinbach LS, Resnick D. Calcium Pyrophosphate Dihydrate Crystal Deposition disease Revisited. Radiology 1996; 200:1-9

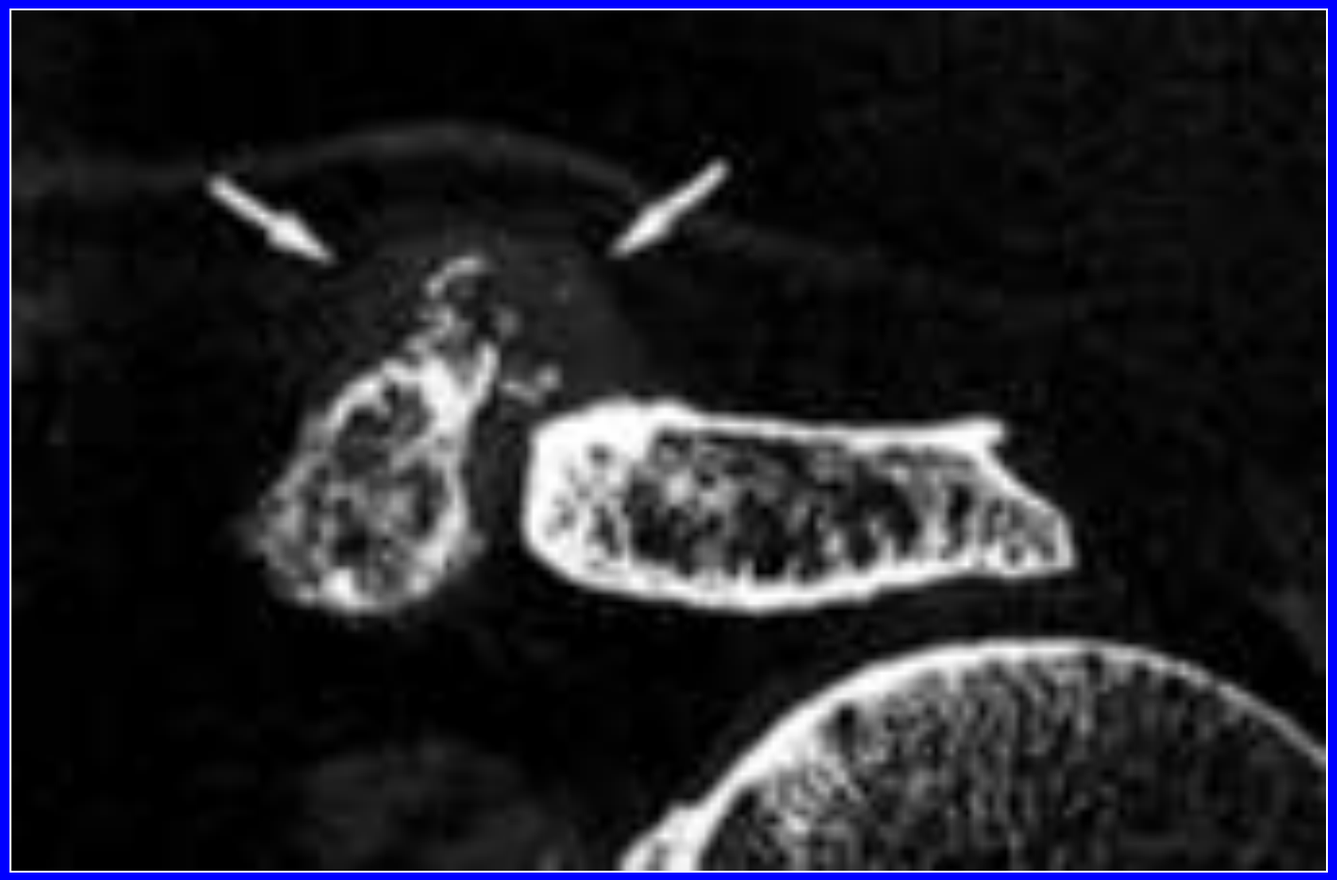
Pseudogout

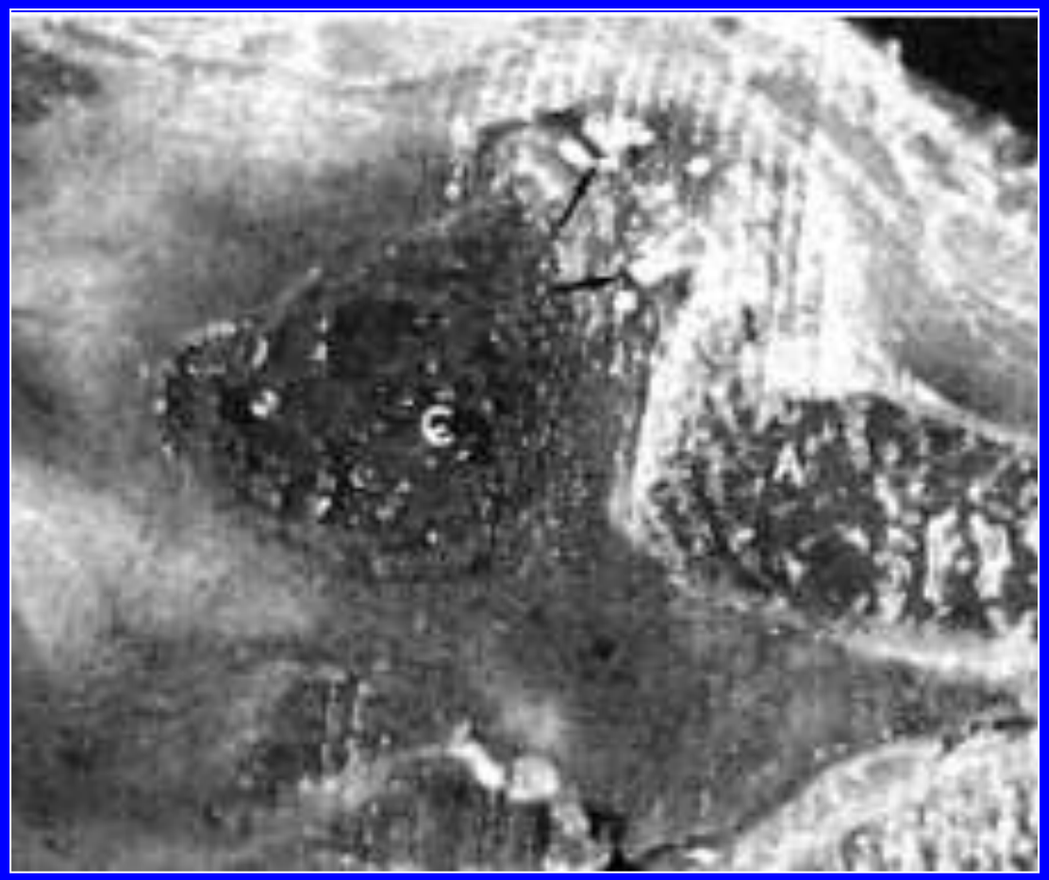
I. Septic Jt/gout mimic-Fever, ESR elev, may present as monarthritis
II. CPPD crystal deposition into hyaline and fibrocartilage
III. Acute, episodic crystal induced synovitis
IV. Host response to crystal release into synovium
V. 65-75 yrs
VI. Self limited, resolve 1-3 wks
VII. Tx NSAIDs, Colchocine, glucocorticoids
VIII. LT low dose colchicine limits recurrences

CPPD: disk chondrocalcinosis

Cooper et al. Calcium pyrophosphate deposition disease-Involvemnt of the acromioclavicular joint with pseudocyst formation. *British Journal of Rheumatology 1993;32:248-250*

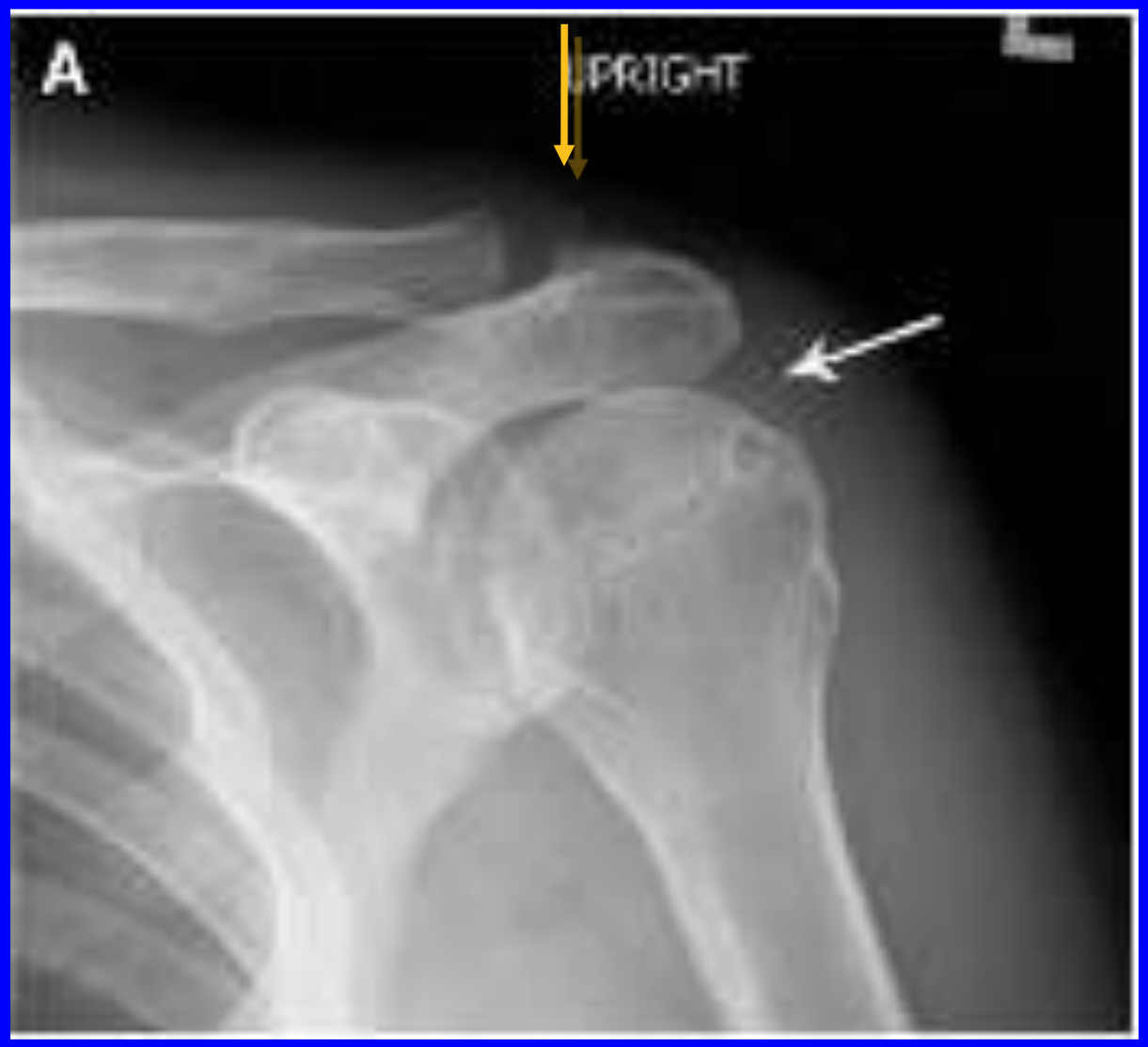
CPPD: Periarticular calcification



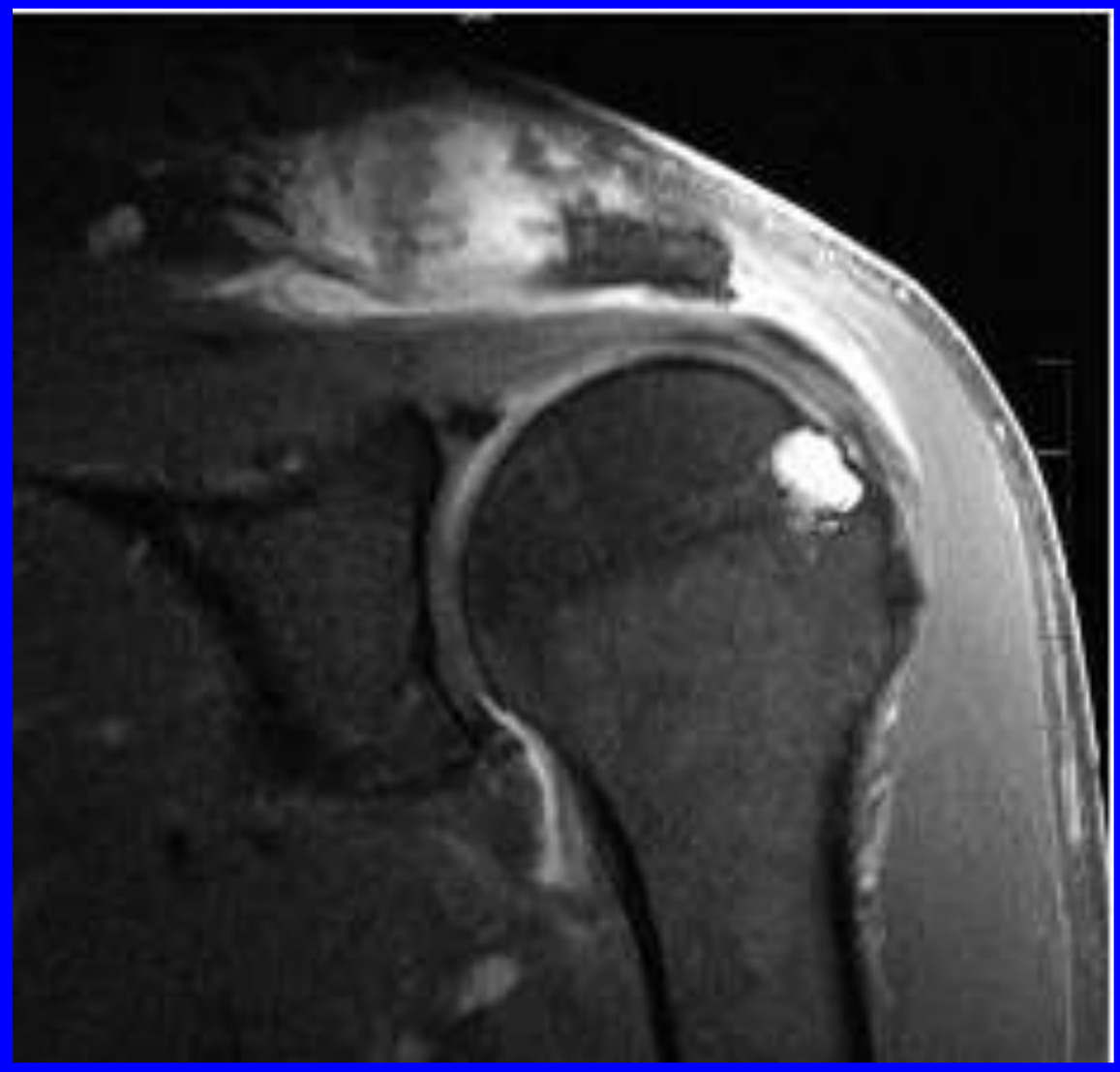


Huang GS, Bachmann D, Taylor JA, Marcelis S, Haghighi P, Resnick D. Calcium pyrophosphate dihydrate crystal deposition disease and pseudogout of the acromioclavicular joint: radiographic and pathologic features. J Rheumatol. 1993 Dec;20(12):2077-82.

AC Jt Hemochromatosis



HH articular cartilage chondrocalcinosis (white)
AC Jt periarticular calcification (yellow)



Post Gad Fat sat Cor T1WI
AC Jt erosions with synovitis
subAcr/subDeltoid bursitis
humeral head erosion

Farpour et al. Enhanced MR imaging of the shoulder, and sternoclavicular and acromioclavicular joint arthritis in primary hemochromatosis. *Rheumatol Int*. 2009 Oct 14

AC Jt Hemochromatosis

I. AR, chromosome 6 locus
II. 4/1000 europe, north american prevalence
III. Increased GI Fe absorption
IV. Progressive iron accumulation
V. Arthropathy develops in 50-80% pts
VI. May have difficulty differentiating from CPPD, Gout, OA

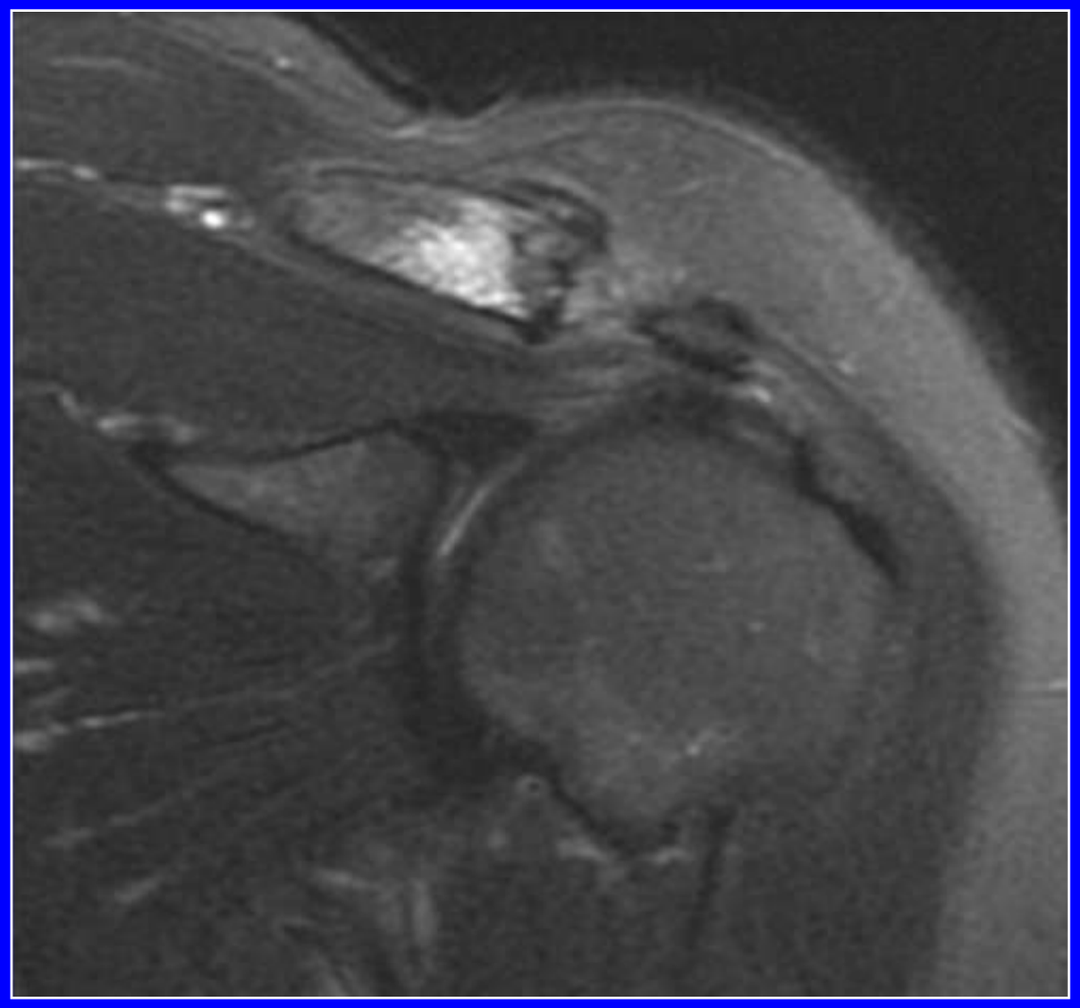
AC Jt Hemochromatosis

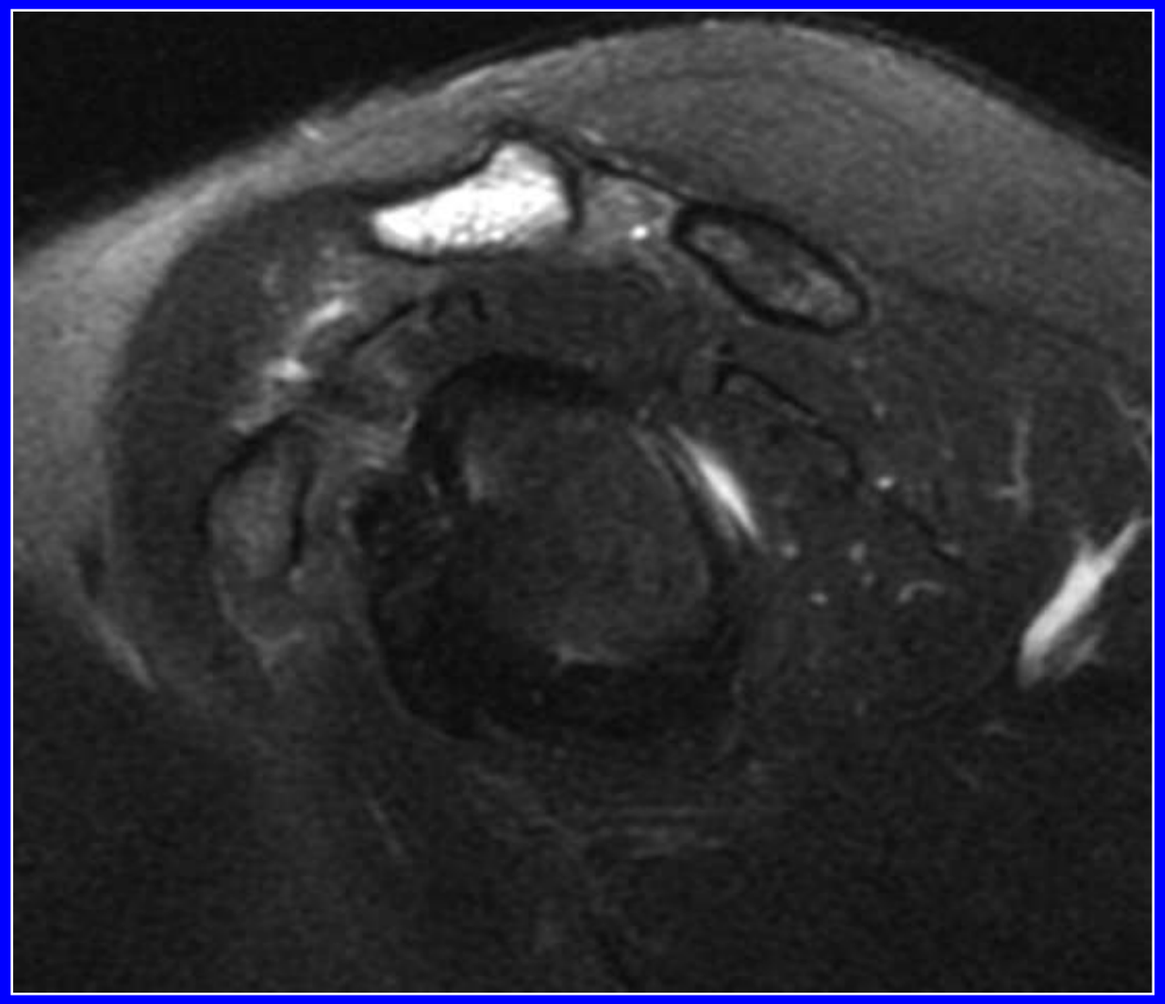
I. Starts small (wrist/hand)
   - 2nd, 3rd MCP and PIP suggestive
II. Later large jts (hip, knee, shoulder)
III. Chondrocalcinosis, jt narrowing, cystic erosions, hook like osteophytes, synovitis
IV. Fe/hemosiderin joint deposit
V. Fe salts promote formation, deposition of chondrocalcinosis by:
   - Inhibit synovial activity of synovial pyrophosphatases
   - Decrease clearing of intrarticular immune complexes

Learning Objectives

- ✓ ~~Review the clinical features and significance of AC joint injury~~
- ✓ ~~Review normal AC Joint anatomy~~
- ✓ ~~Become familiar with basic AC joint biomechanics~~
- ✓ ~~Be able to classify AC joint injuries based upon modified Rockwood Classification~~
- ✓ ~~List common causes of extrinsic subacromial impingement~~
- ✓ ~~Review common AC joint arthritides~~
- ✓ **Bonus round**

30 yo with AC Jt pain





Case courtesy Dean Ascher MD

Distal Clavicular Osteolysis (DCO)

I. May occur after single post traumatic event or chronic repetitive stress (weight lifters, young athletes)

II. Trauma usually minor (often no Fx or Dx)

III. Clinical Presentation
   - Slow onset (weeks to months) AC jt pain
   - Soft tissue swelling

Distal Clavicular Osteolysis Variable course

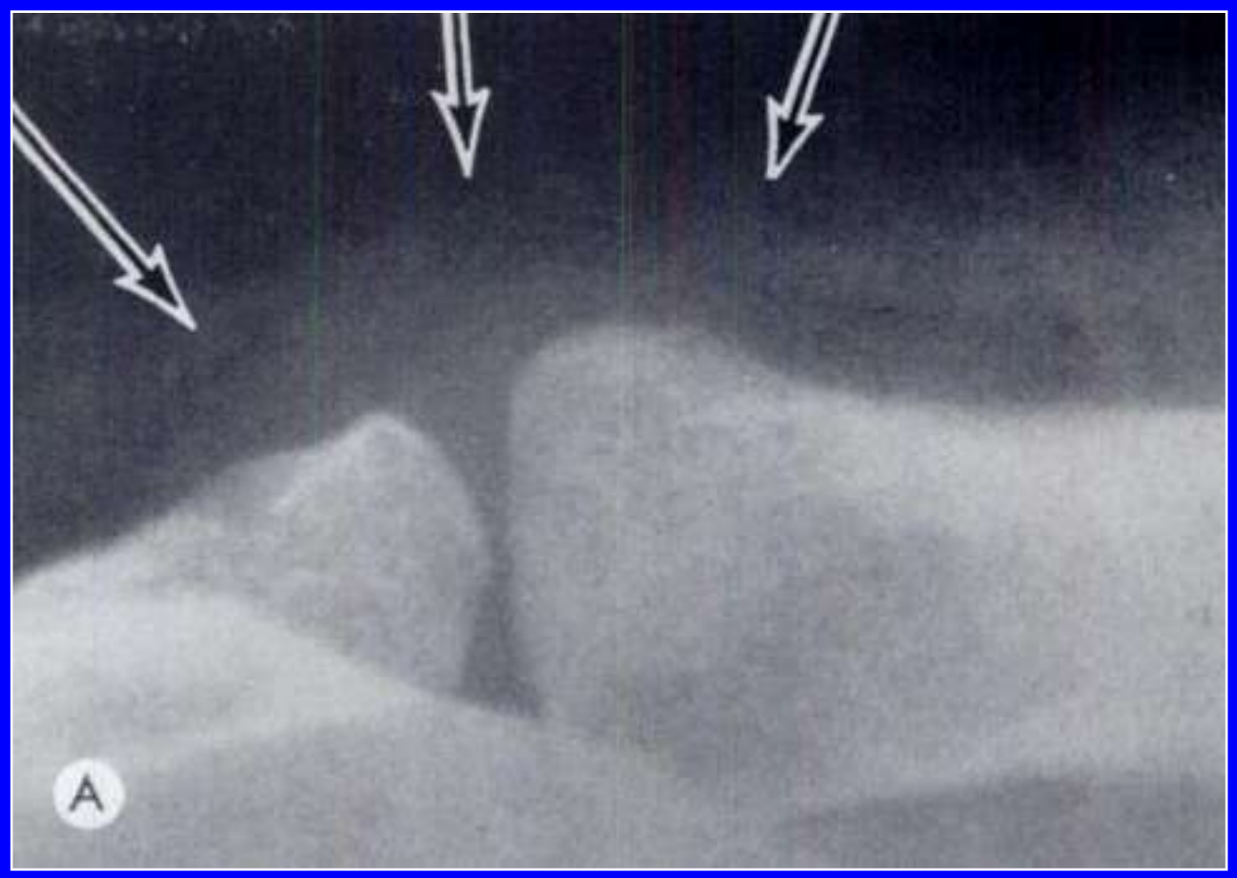
I. Lytic phase (12-18 mo)
   - Distal clavicle osteopenia, loss subchondral bone detail
   - AC Jt widened, subcondral cysts, erosions
   - Dystrophic calcification

II. Reparative phase (4-6 mo)
   - Erosion of distal clavicle margin better defined

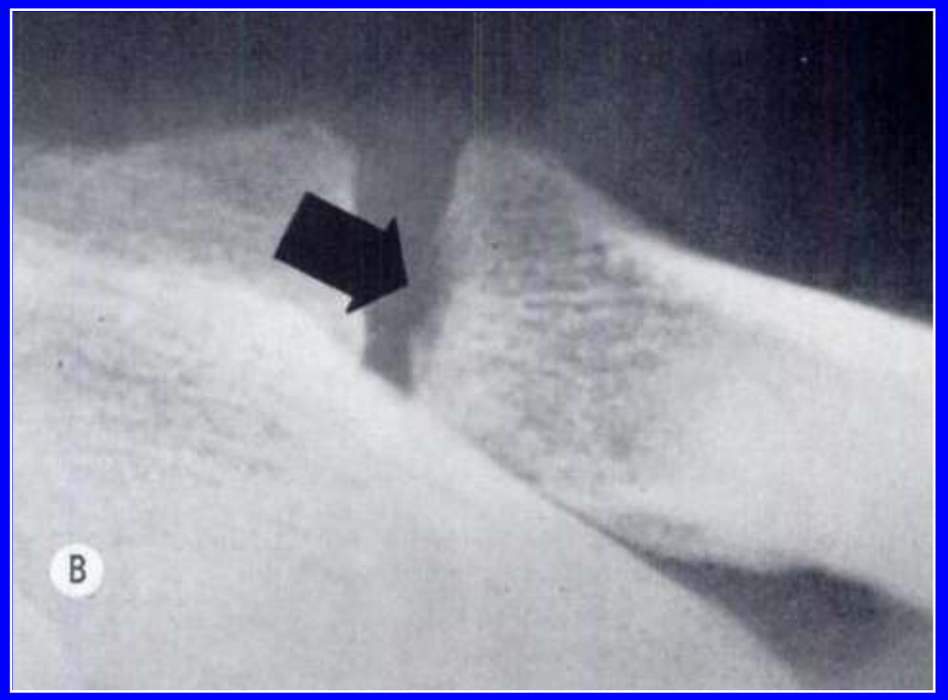
Greenway GD, Danzig LA, Resnick D, Haghighi P.The Painful *shoulder.Medical Radiography and Photography*. Vol 58 (2) 1982 (pp22-67)

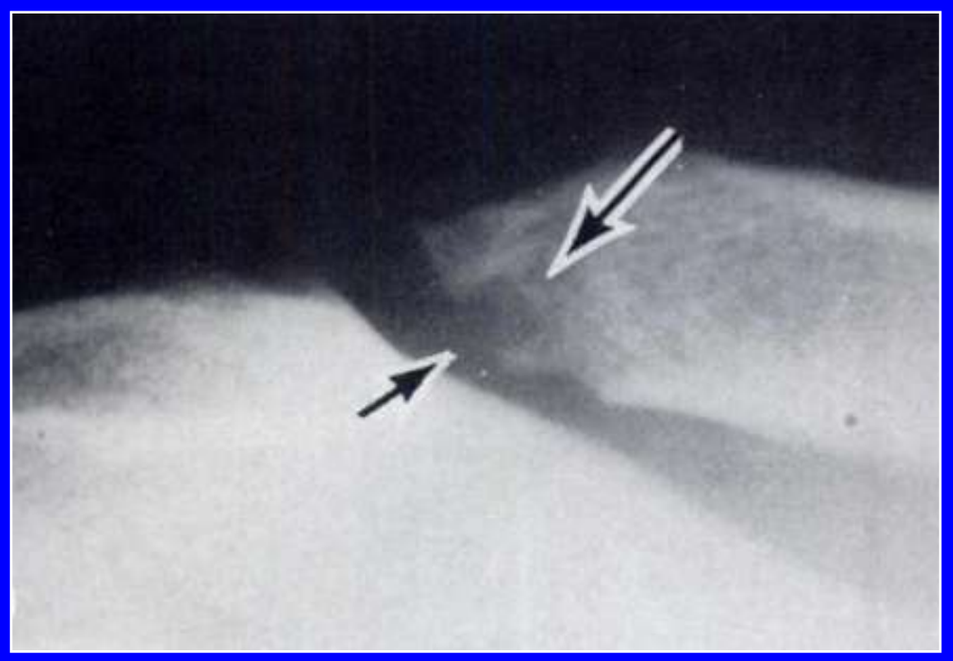
Distal Clavicular Osteolysis

Initial injury



2.5 wks after injury

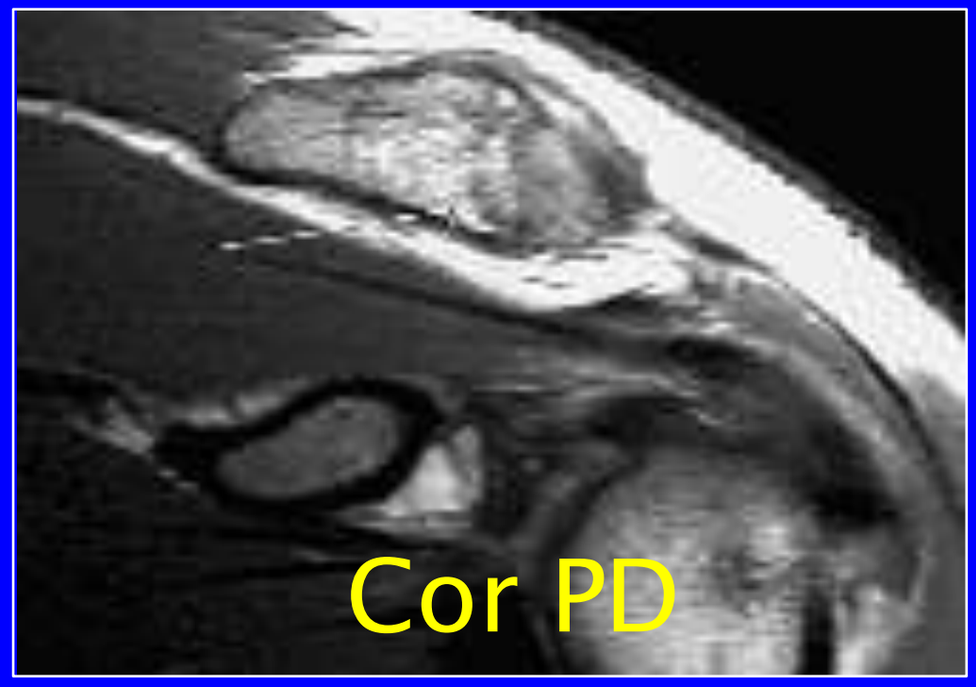




A. Capsular STS
B, C. Subchondral erosions

Levine AH et al. Post traumatic osteolysis of the distal clavicle with emphasis on early radiologic changes. AJR. 127;781-784 1976

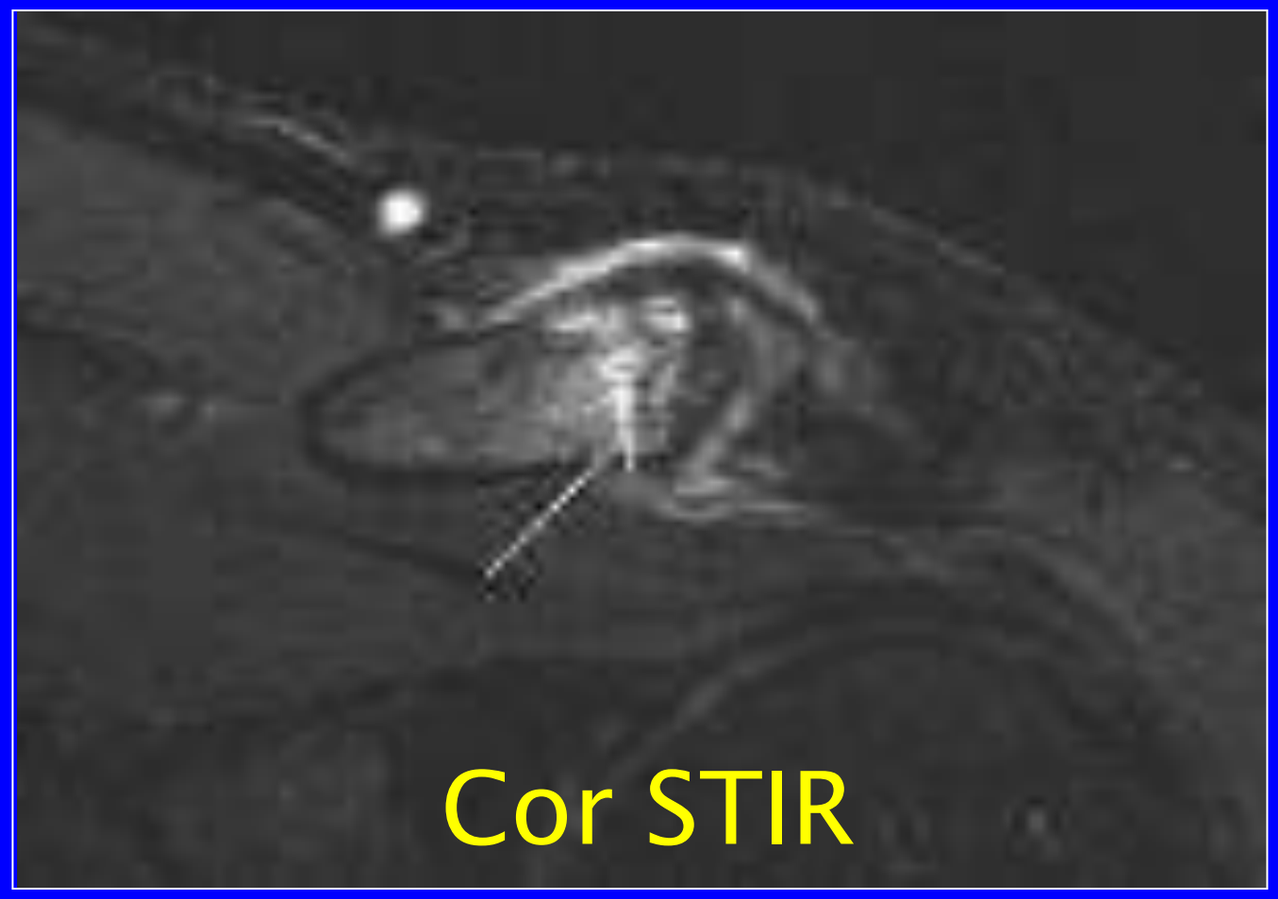
DCO Subchondral Fracture

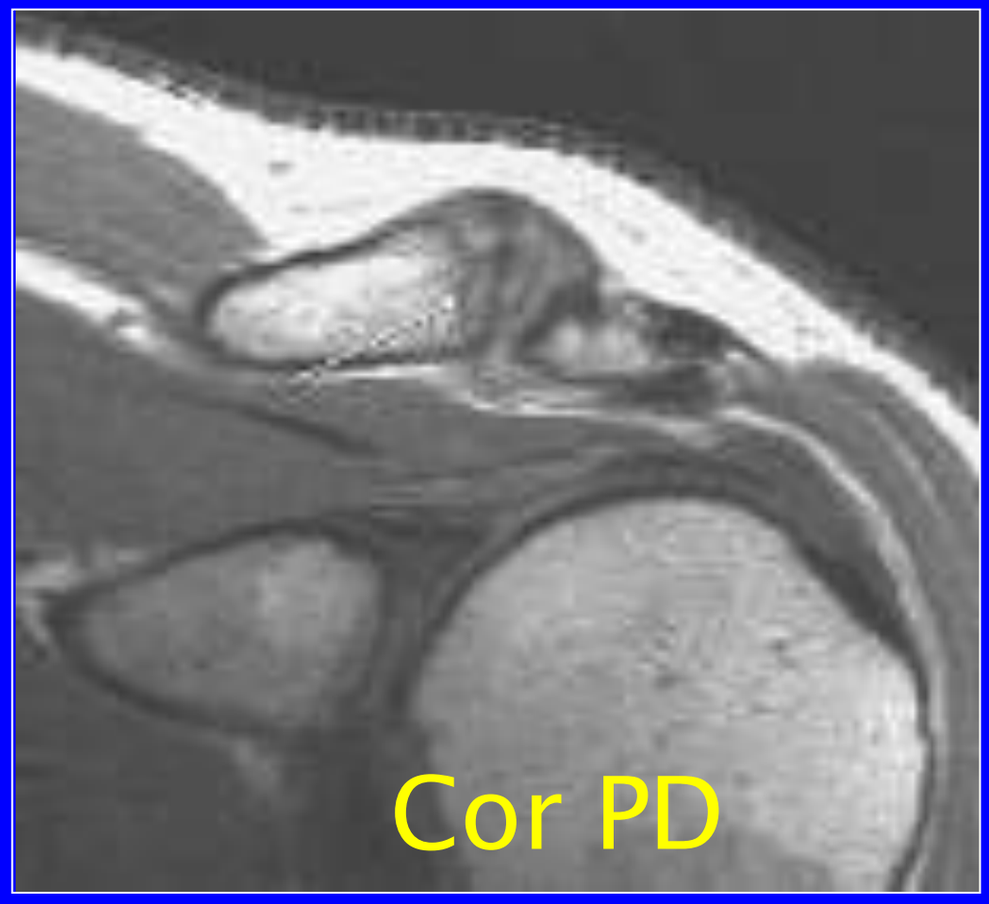


Kassarjian A, Llopis E and Palmer WE. tal clavicular osteolysis: MR evidence for subchondral fracture Skeletal Radiol (2007) 36:17–22

DCO Etiology

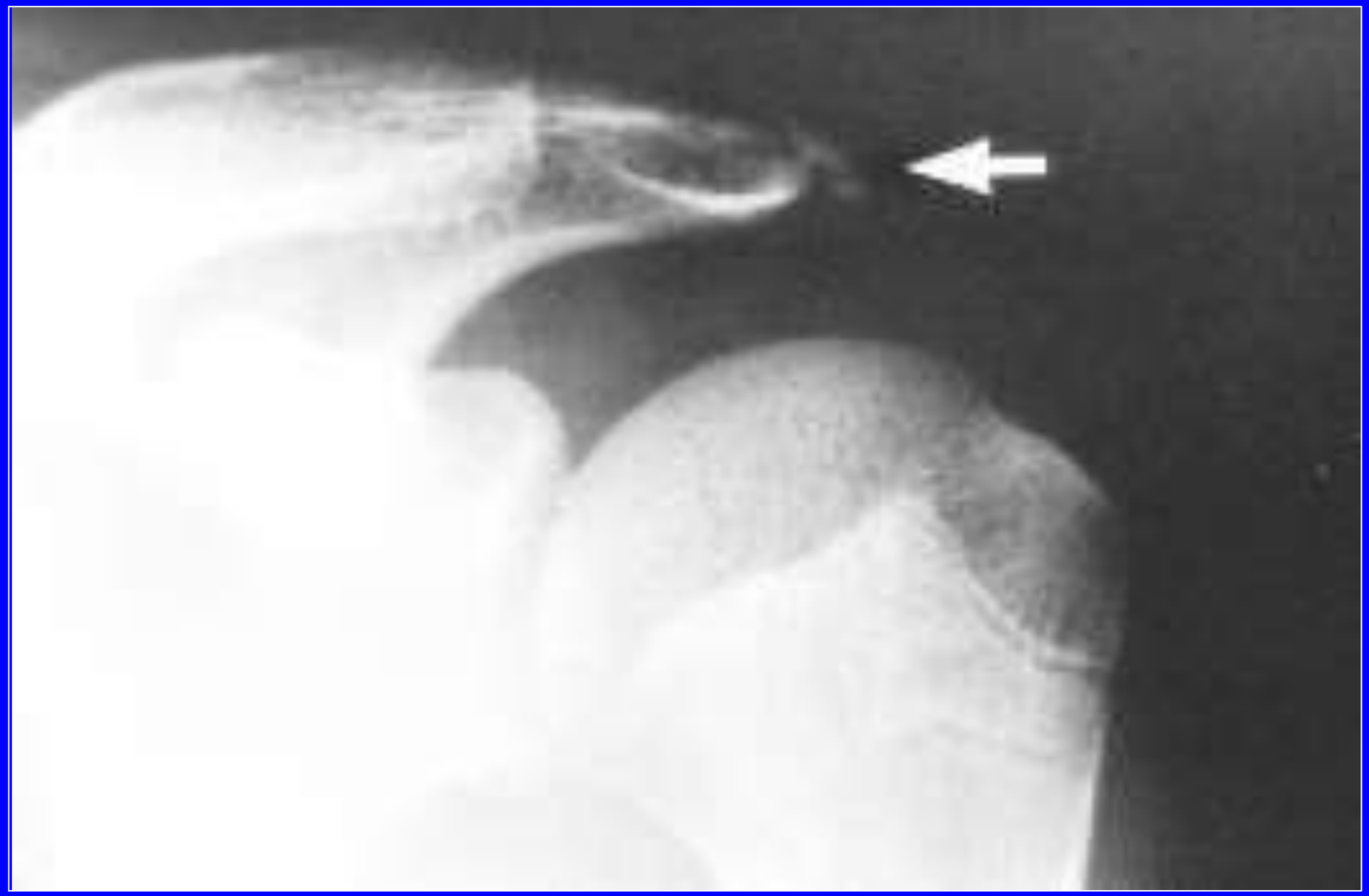
I. Subchondral fracture
II. Post traumatic synovitis





Kassarjian A, Llopis E and Palmer WE. tal clavicular osteolysis: MR evidence for subchondral fracture. Skeletal Radiol (2007) 36:17–22

14 yo M shoulder pain while throwing



Morisawa K et al. Apophysitis of the acromion. *J SHOULD ER ELBOW SURG 1996;5: 153-6*

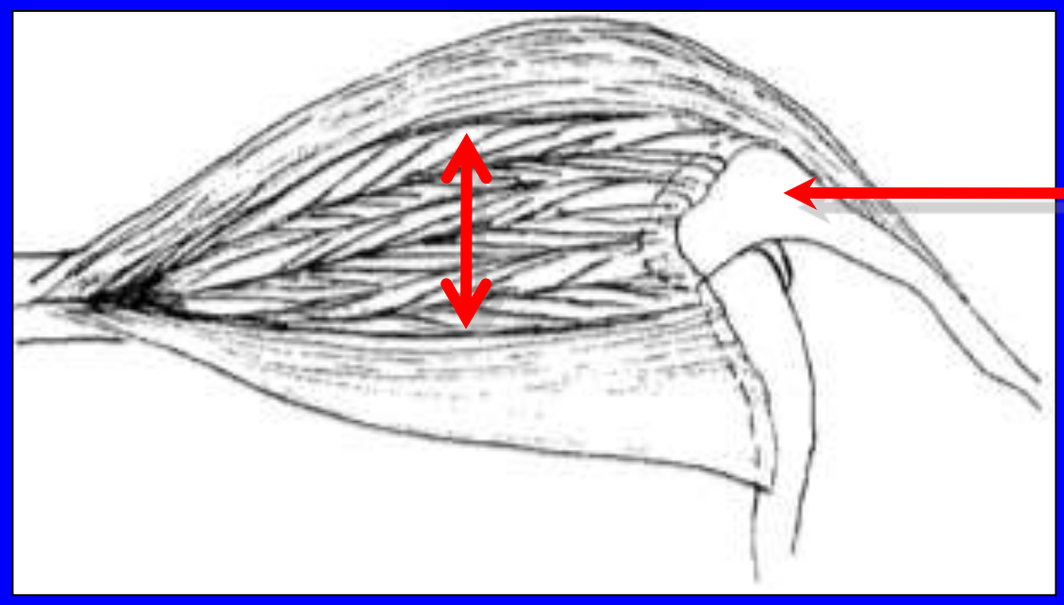
Acromial Apophysitis

1. Repeated throwing motion causes overuse stress from vigorous deltoid contraction
   - Stress at deltoid origin and insertions

Morisawa K et al. Apophysitis of the acromion. *J SHOULD ER ELBOW SURG 1996;5: 153-6*

Acromial Apophysitis

I. Deltoid has wide origin and insertion
II. Growing child/adolescent, the acromial apophysis is the weakest link
III. Central muscle fibers (strongest, shortest) of deltoid attach to the apophysis



Morisawa K et al. Apophysitis of the acromion. *J SHOULD ER ELBOW SURG 1996;5: 153-6*

Acromial Apophysitis: Clinical diagnosis

I. Pinpoint tenderness at acromial apophysis

II. Mild overlying erythema

III. Pain at max or resisted abduction

IV. Imaging correlate

Morisawa K et al. Apophysitis of the acromion. *J SHOULD ER ELBOW SURG 1996;5: 153-6*

Acromial Apophysitis

I. Imaging findings
   - Irregular acromial contour, sclerosis
   - Avid uptake on MDP bone scan

Morisawa K et al. Apophysitis of the acromion. *J SHOULD ER ELBOW SURG 1996;5: 153-6*

Tx of Acromial Apophysitis

I. Try to prevent overuse
II. Conservative Tx-ice massage
III. When pain decreases, encourage muscular stretching
IV. Muscle stretching before and after may be effective protection against overuse injuries

Shoulder Pain

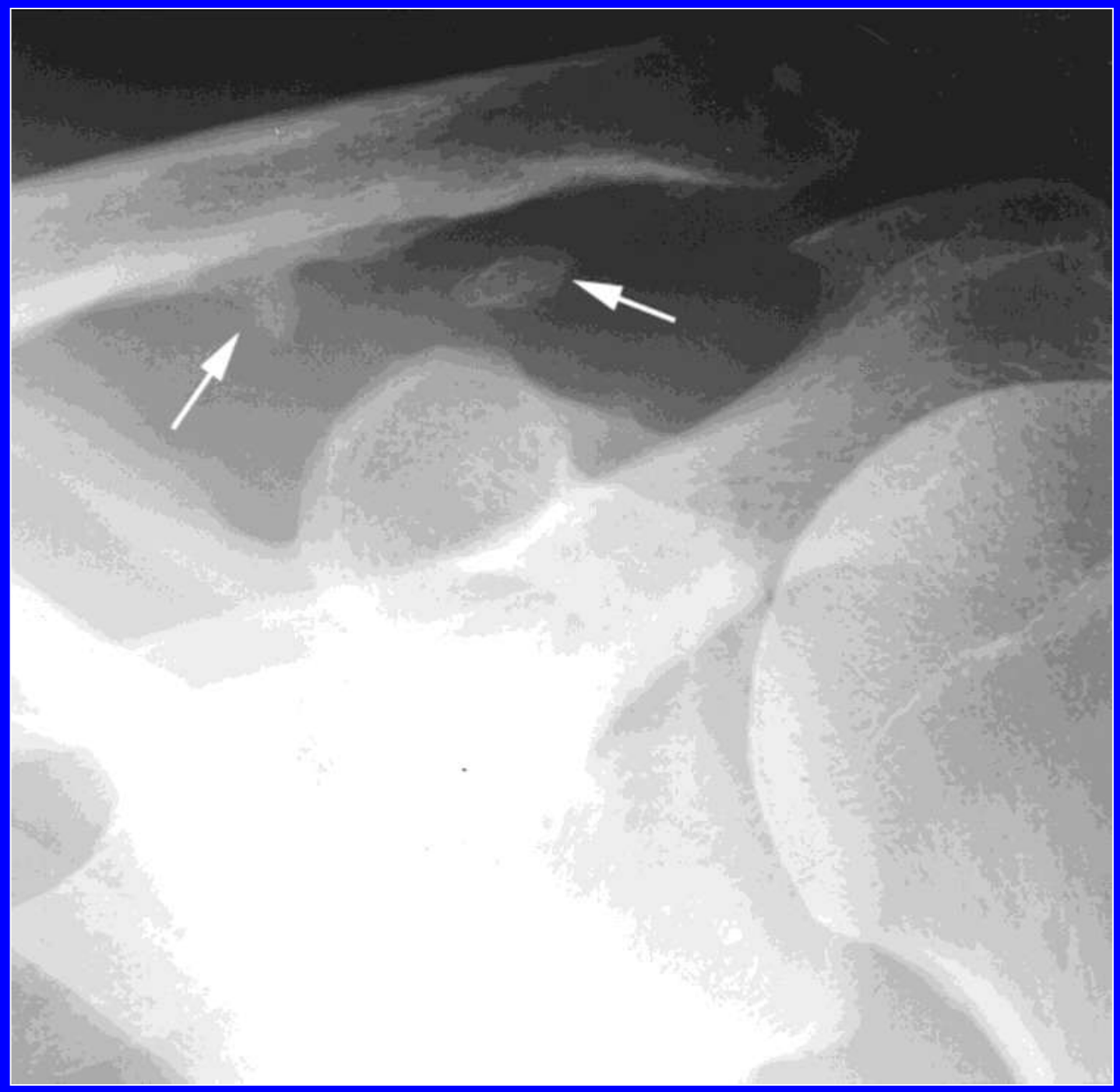
Bureau NJ et al. Imaging of bursae around the shoulder joint. *Skeletal Radiol* (1996) 25:513–517

Coracoclavicular Calcific bursitis

Amorphous calcification above coracoid process and below clavicle

Bureau NJ et al. Imaging of bursae around the shoulder joint. *Skeletal Radiol* (1996) 25:513–517

Ddx: Coracoclavicular ligament ossification
Man with prior AC Jt Dx



Antonio, G. E. et al. Am. J. Roentgenol. 2003;180:1103-1110

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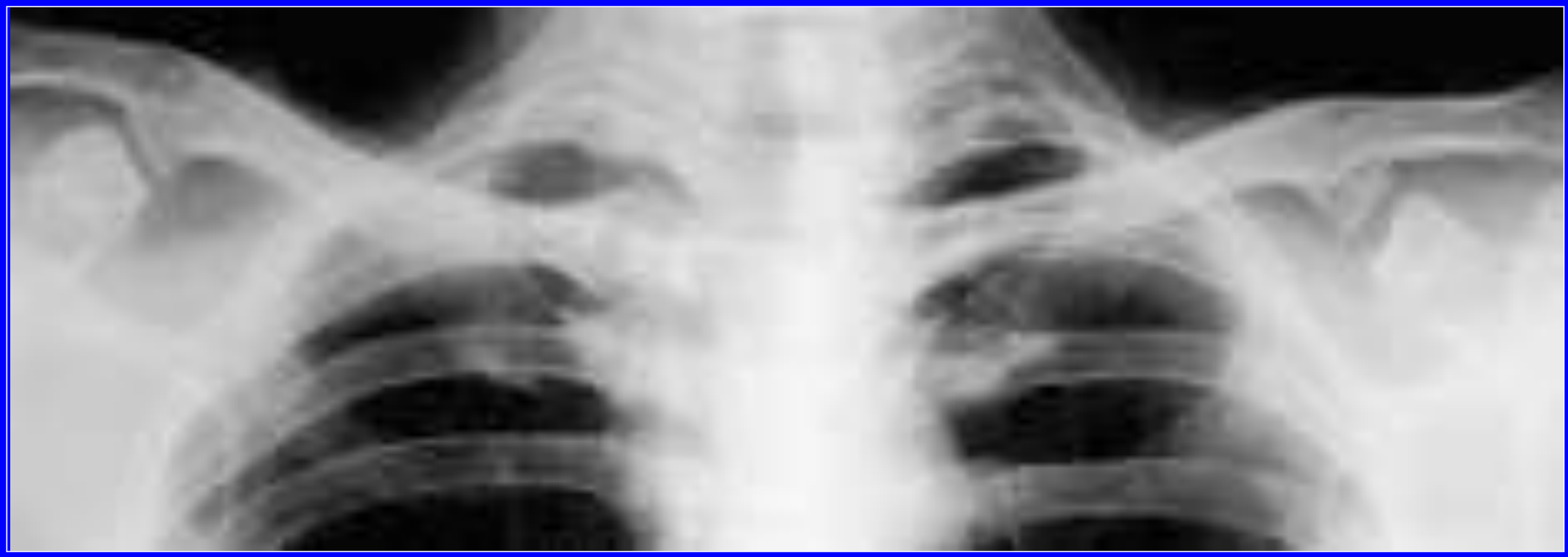
Shoulder pain



Nahme A et al. Coracoclavicular joints. Reflections upon incidence, pathophysiology and etiology of the different forms. *Surg Radiol Anat* (2004) 26: 33–38

Coracoclavicular Joint

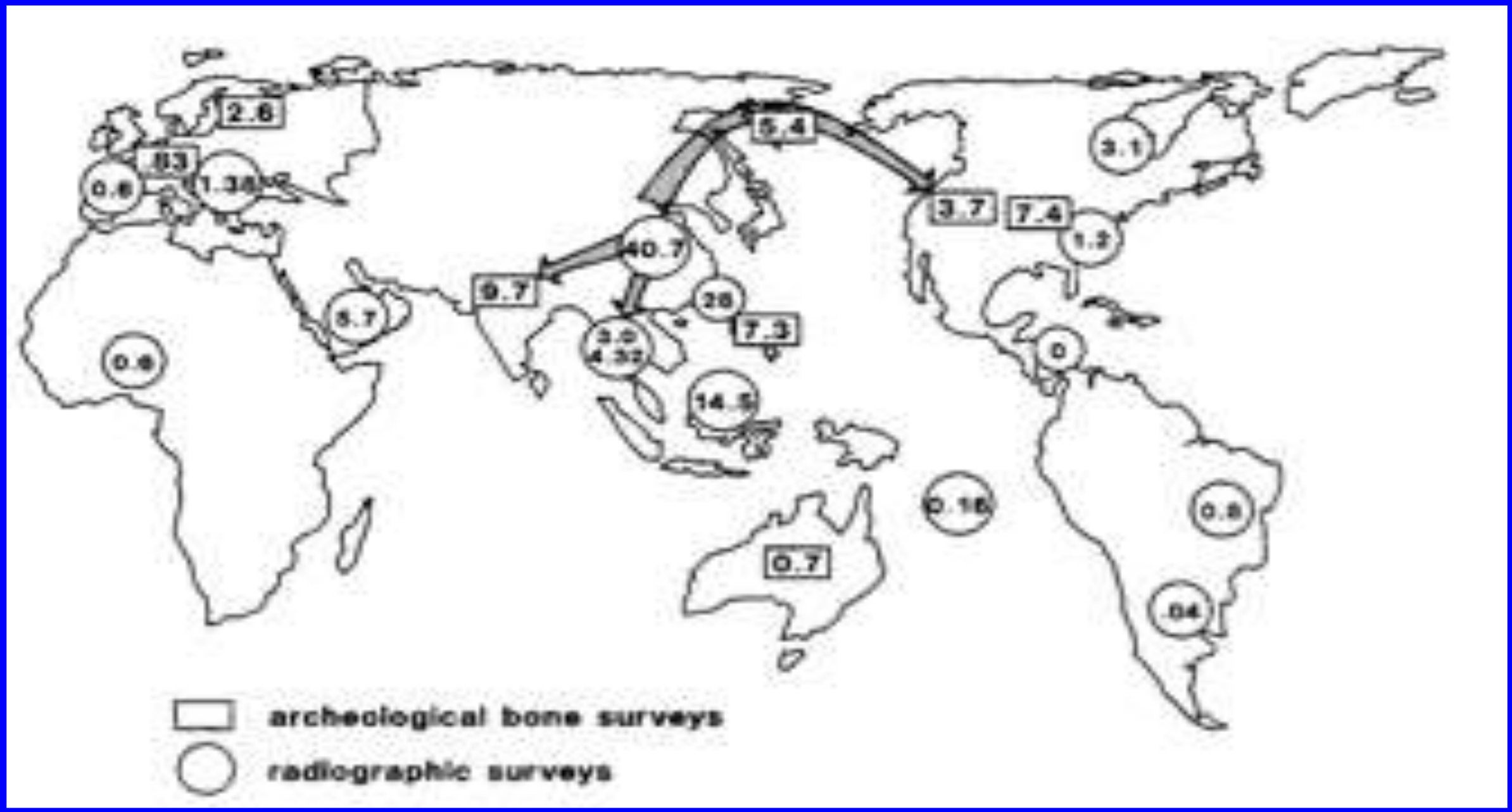
Gumina S et al. Coracoclavicular joint: osteologic study of 1020 human clavicles. *J. Anat.* (2002) 201, pp513-519

Coracoclavicular Joint

I. First described by Gruber 1861
II. Uncertain etiology (inheritable?)
III. Rare anomalous diarthrodial synovial jt
    - Incidence 0.04 – 27%
    - Most common in SE Asia
    - Frequency decreases as go farther from China
    - Normal variant adults and primates
    - Uncommonly symptomatic
        - May become symptomatic with injury
IV. Not cone shaped conoid ligament ossification or HADD in CC bursa

Gumina S et al. Coracoclavicular joint: osteologic study of 1020 human clavicles. *J. Anat.* (2002) 201, pp513–519

Relative Frequency CC Jt

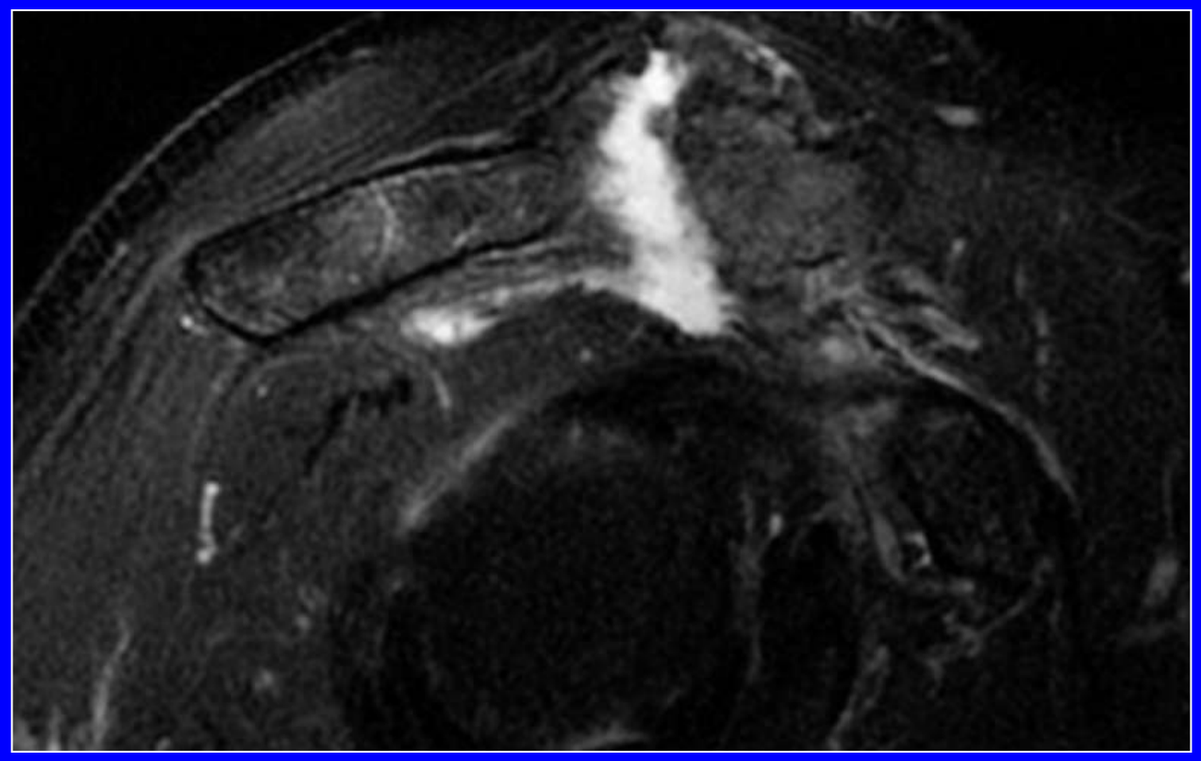


Cockshott WP.The geography of the coracoclavicular joint. Skeletal Radio1 (1992) 21:225-227

AC Jt Masses

Tshering Vogel DW, Steinbach LS, Hertel R, Bernhard J, Stauffer E, Anderson SE. Acromioclavicular joint cyst: nine cases of a pseudotumor of the shoulder. Skeletal Radiol 2005;34(5):260-5

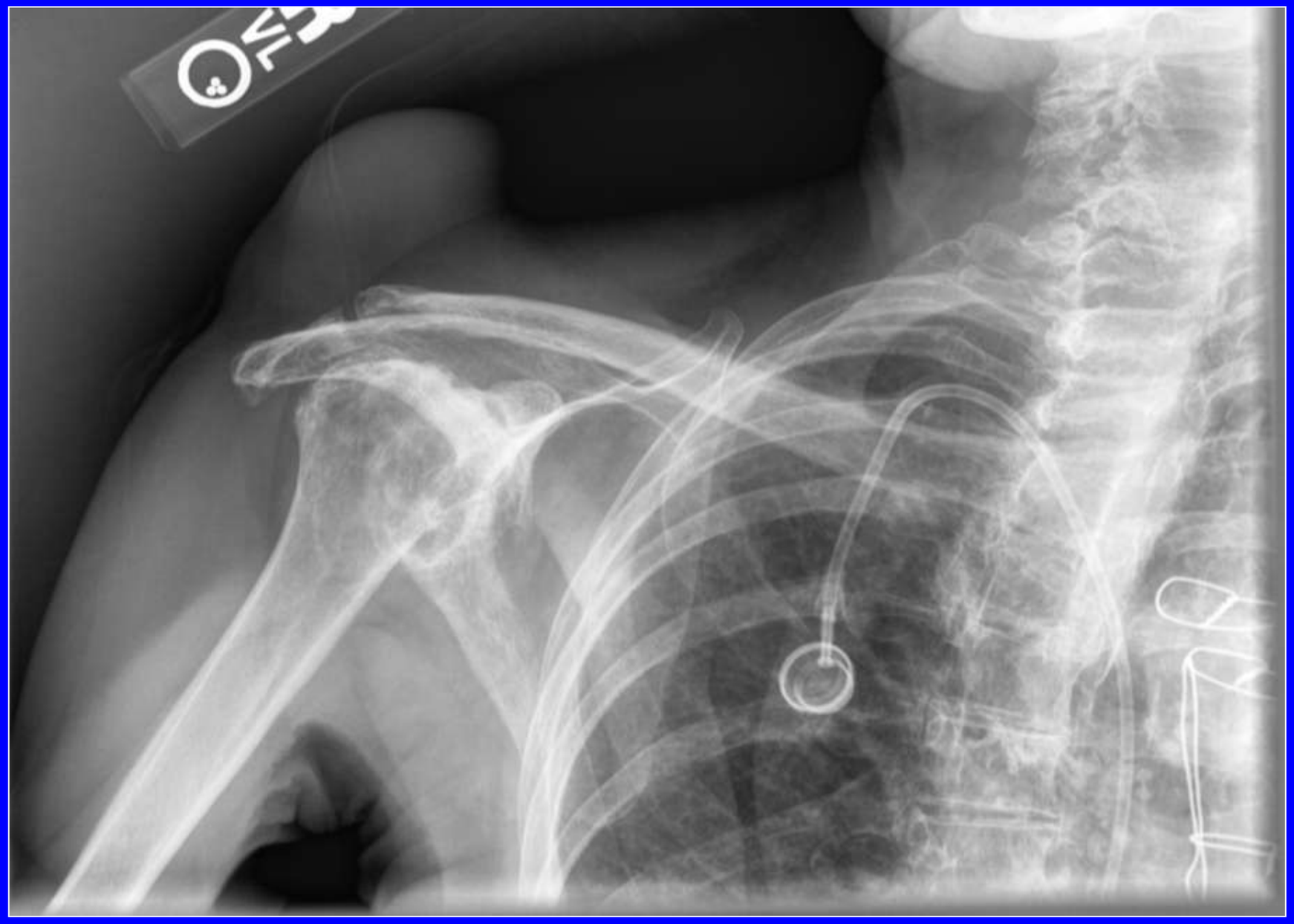
Geyser Phenomenon



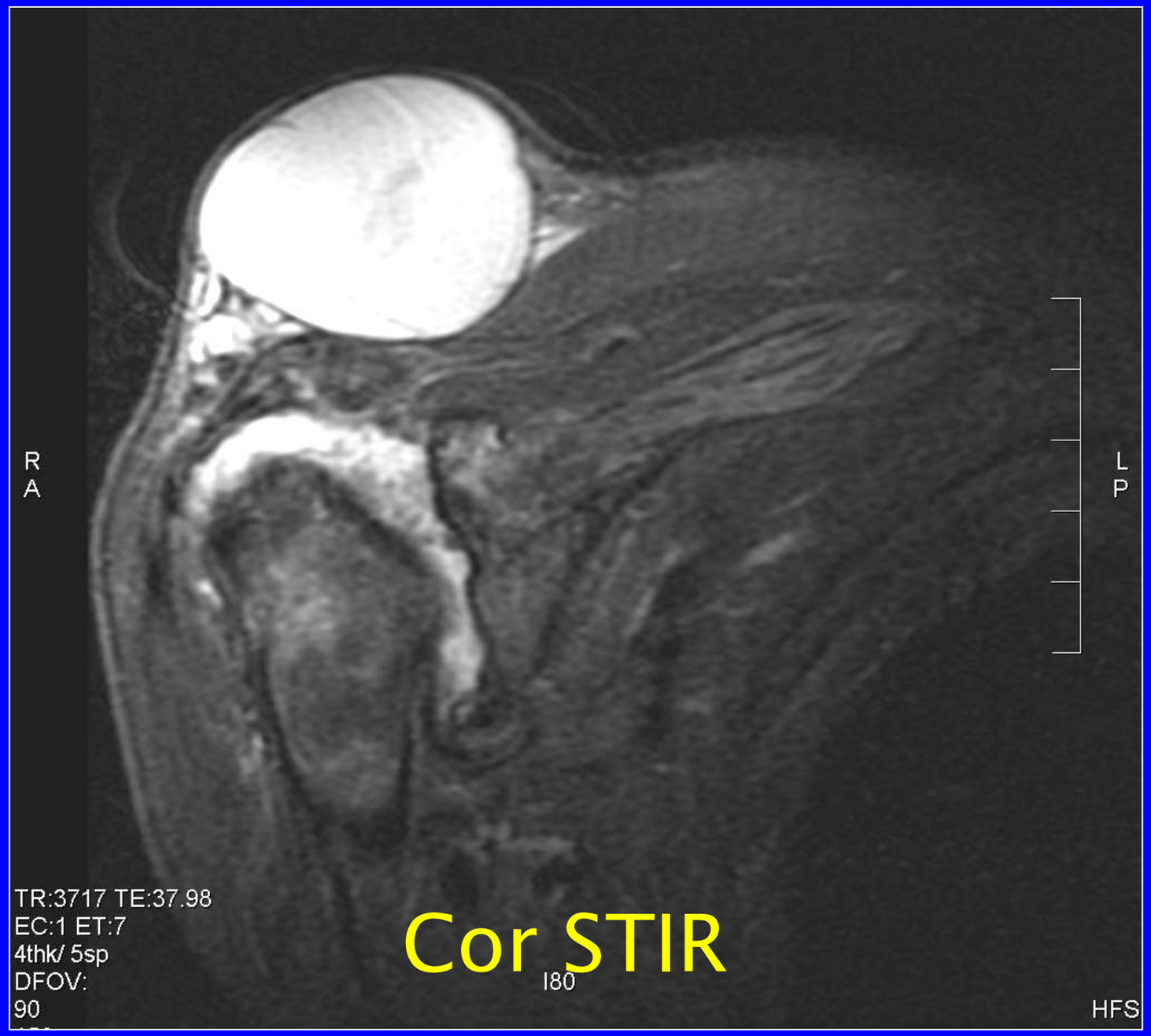
GH jt, SubAc/Deltoid bursal fluid communicates through cuff tear and through torn inferior AC jt capsule

Case Courtesy Tudor Hughes MD

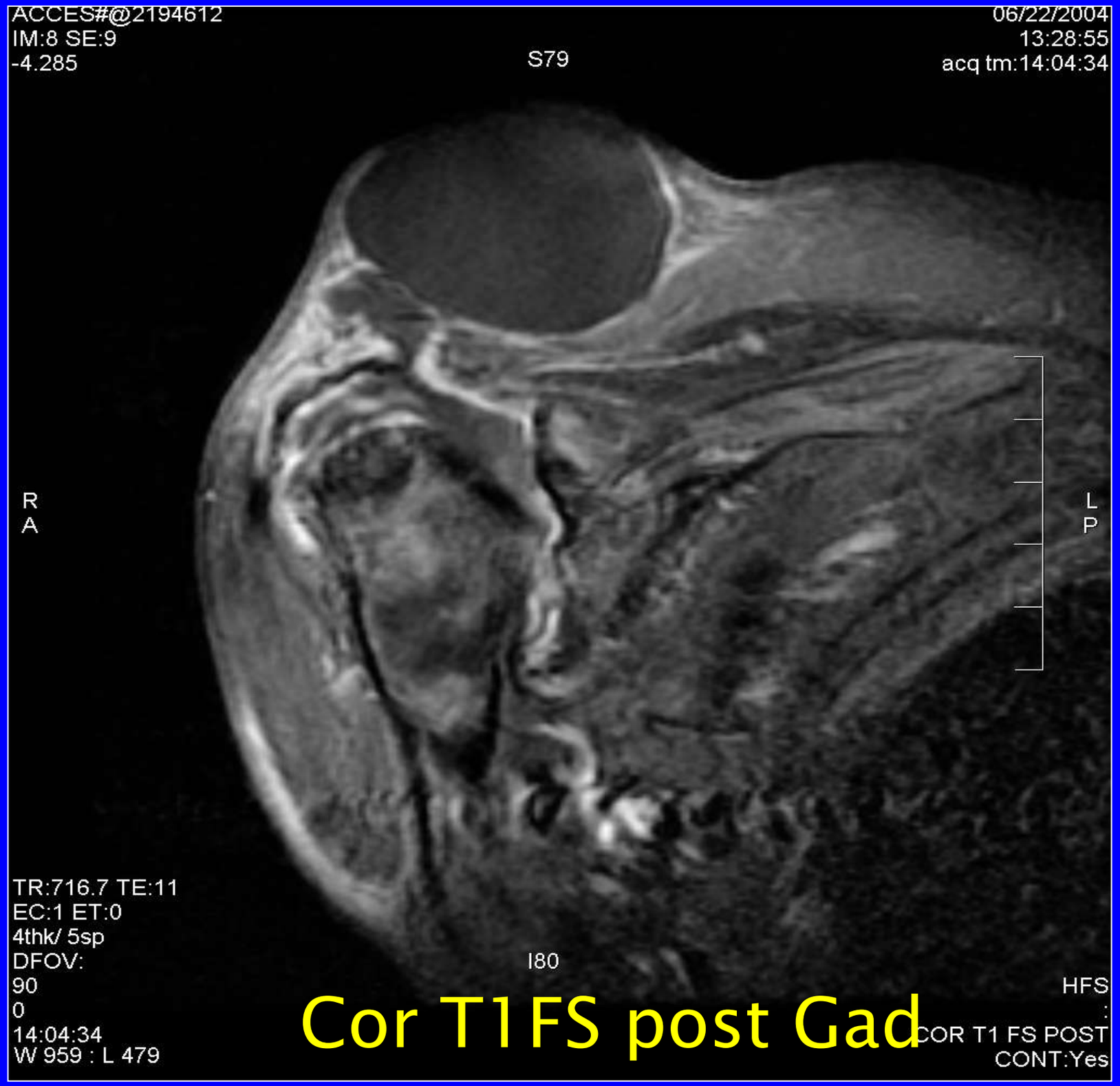
Rt Shoulder mass



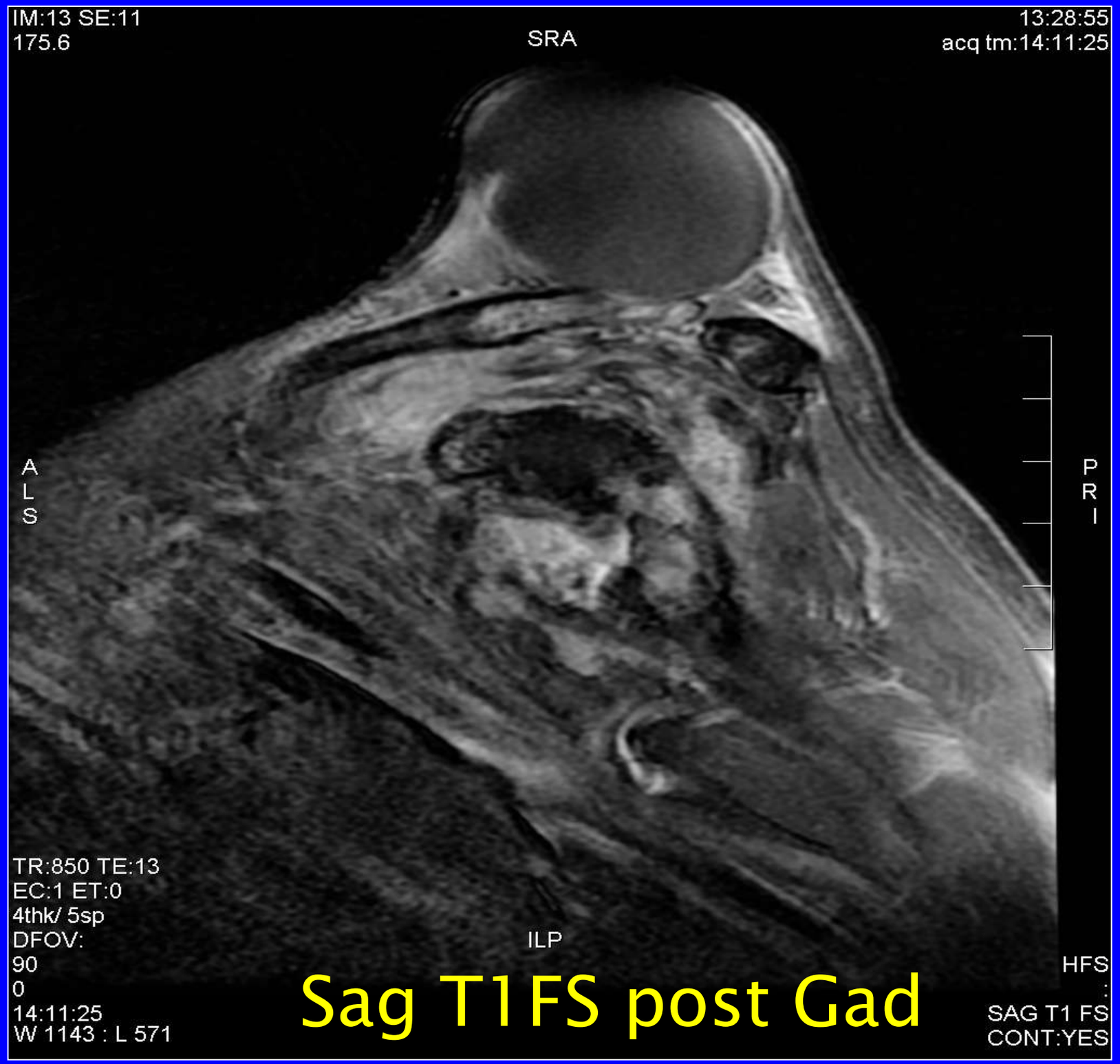
Case Courtesy Tudor Hughes MD



Case Courtesy Tudor Hughes MD



Case Courtesy Tudor Hughes MD



Case Courtesy Tudor Hughes MD

AC Joint Synovial Cyst

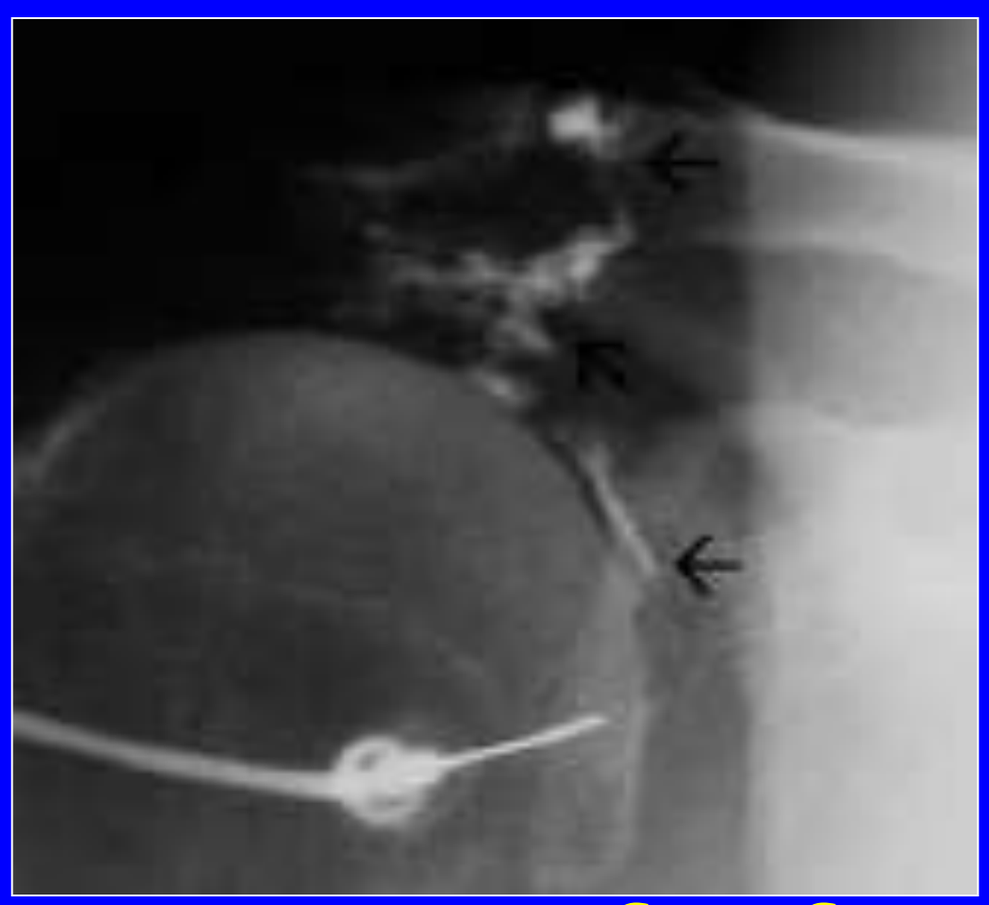
I. Result of massive rotator cuff tear
   - Idiopathic, rheumatoid arthritis, crystalline arthropathy or neuropathic joint

II. RTC tears associated with GH joint effusions which communicate through tear and access subacromial/subdeltoid bursa.

III. Fluid protrudes through the degenerated/attenuated AC joint capsule, creating a large soft tissue mass

AC Joint Synovial Cyst

I. Dx is made by showing communication of cystic mass with AC joint
II. May have faint thin peripheral enhancement post gad



Cases Courtesy Tudor Hughes MD

AC Joint Synovial Cyst

I. Rare complication of rotator cuff tears

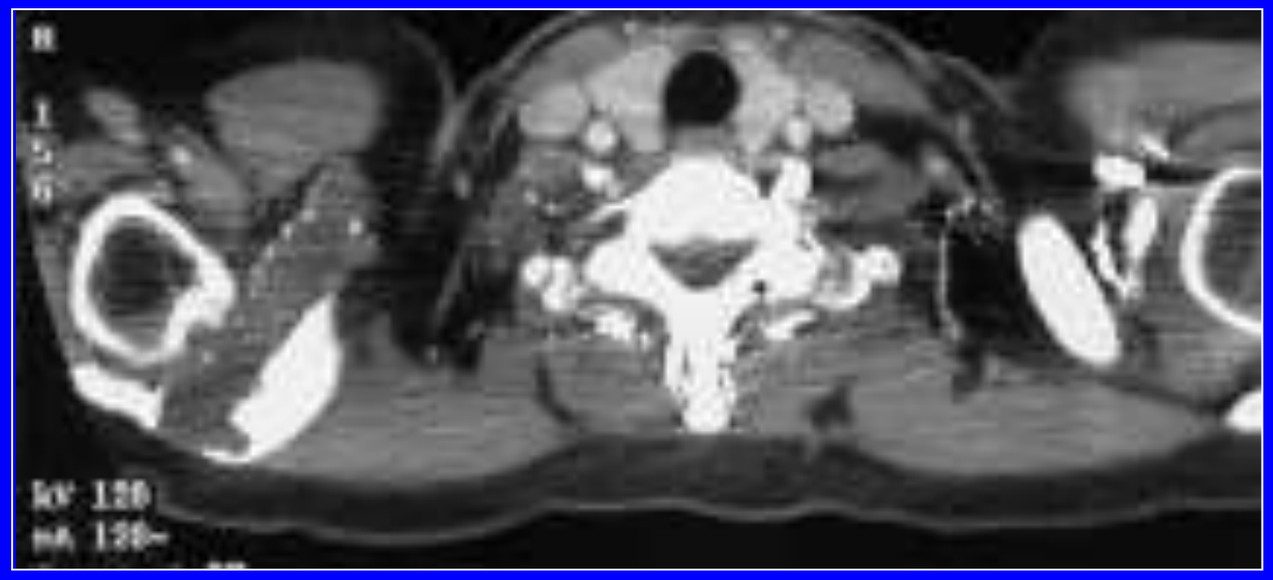
II. Usually elderly pts presenting with STS over the shoulder

III. Shoulder may be painless, RTC tear compensated for

IV. High recurrence after simple excision of cyst if RTC tear and joint pathology not also treated

53 F with painless swelling along Rt chest wall x3 yrs

Rt shoulder radiograph. Punctate calcifications adjacent to distal clavicle undersurface and AC jt erosions.



Enhanced axial CT. Peripherally calcified, low density tubular rt subclavicular space mass.

Kudawara I et al. Synovial chondromatosis of the acromioclavicular joint. *Skeletal Radiol* (2004) 33:600–603

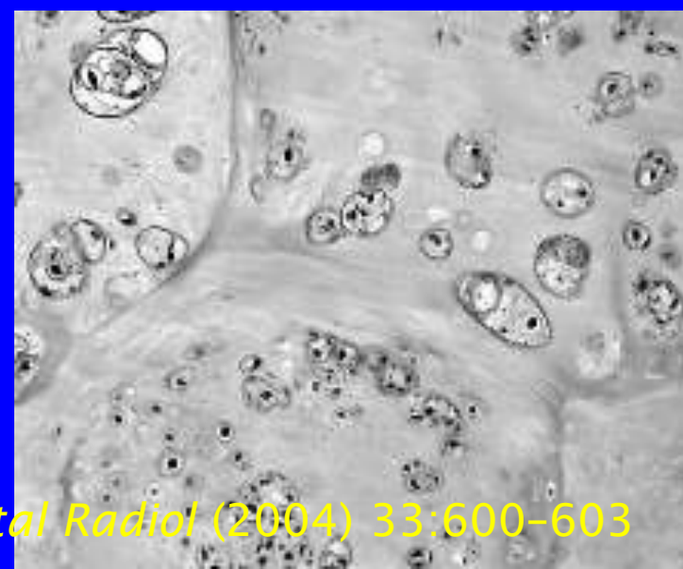
MR

Iso T1, Hetero hyper T2
Lobular mass extends along distal clavicle, AC jt erosion, extends into anterior chest wall subQ, posterior deltoid

Kudawara I et al. Synovial chondromatosis of the acromioclavicular joint. *Skeletal Radiol* (2004) 33:600–603

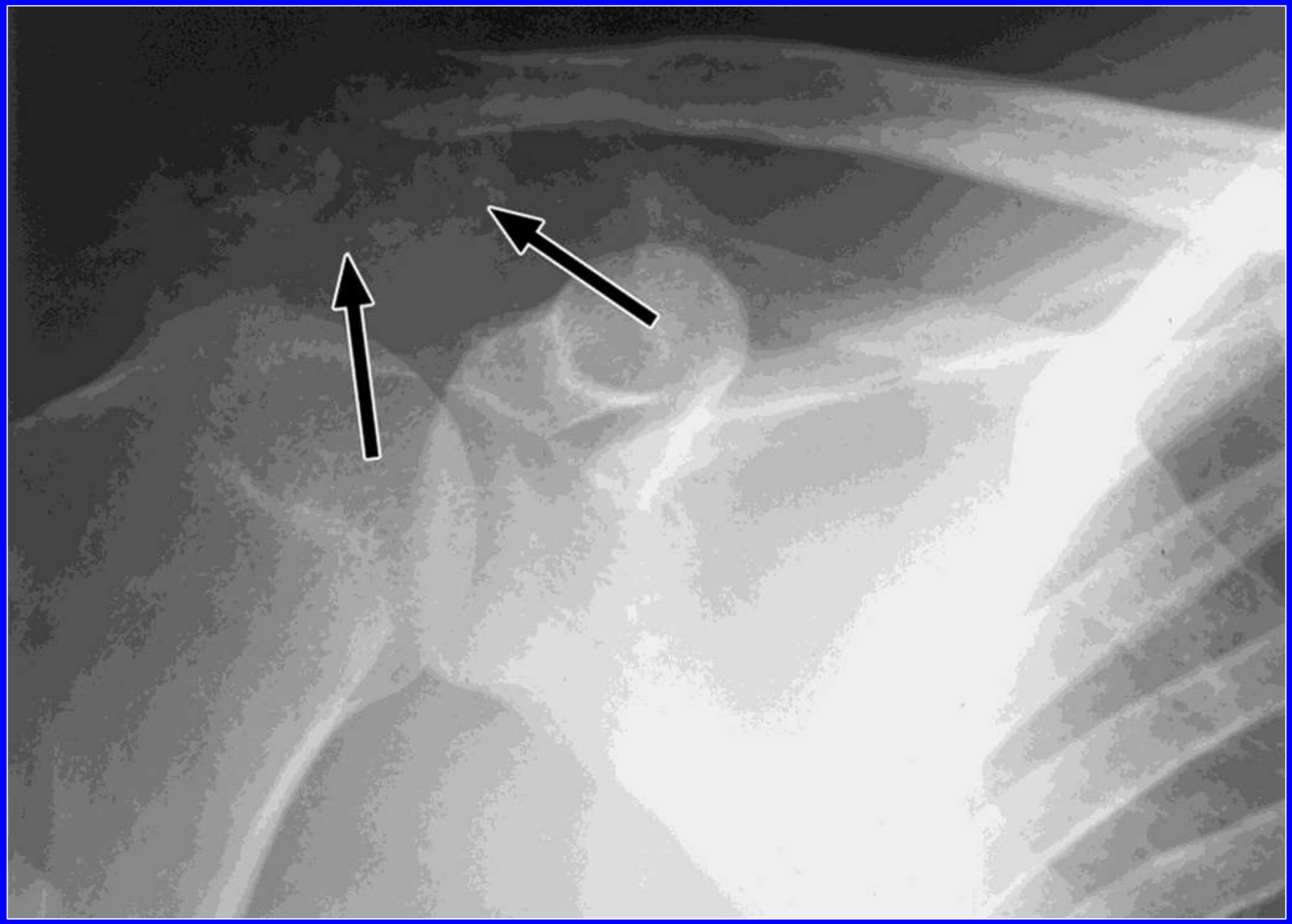
Synovial chondromatosis

I. Benign cartilagenous synovial metapasia
II. Composed of mature chondrocytes and matrix
III. Rare-3 case reports
IV. Synovial chondrosarcoma also rare
    - Pain, histopathologic changes (mitoses, myxoid change, necrosis, trabecular permeation)



Kudawara I et al. Synovial chondromatosis of the acromioclavicular joint. *Skeletal Radiol* (2004) 33:600–603

30-year-old man with right shoulder pain for 1 year.



Murphey M D et al. Radiographics 2003;23:1245-1278

RadioGraphics

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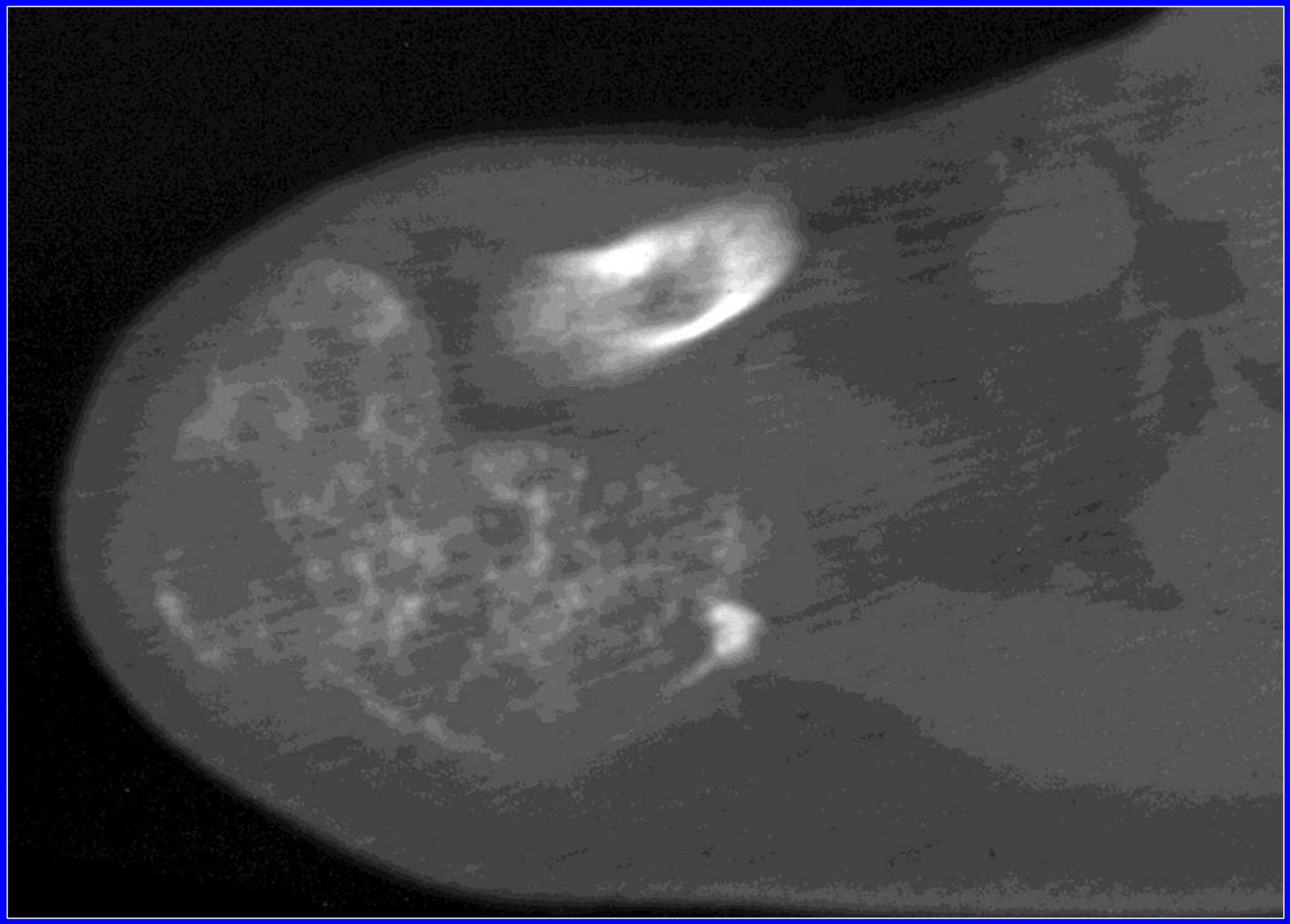

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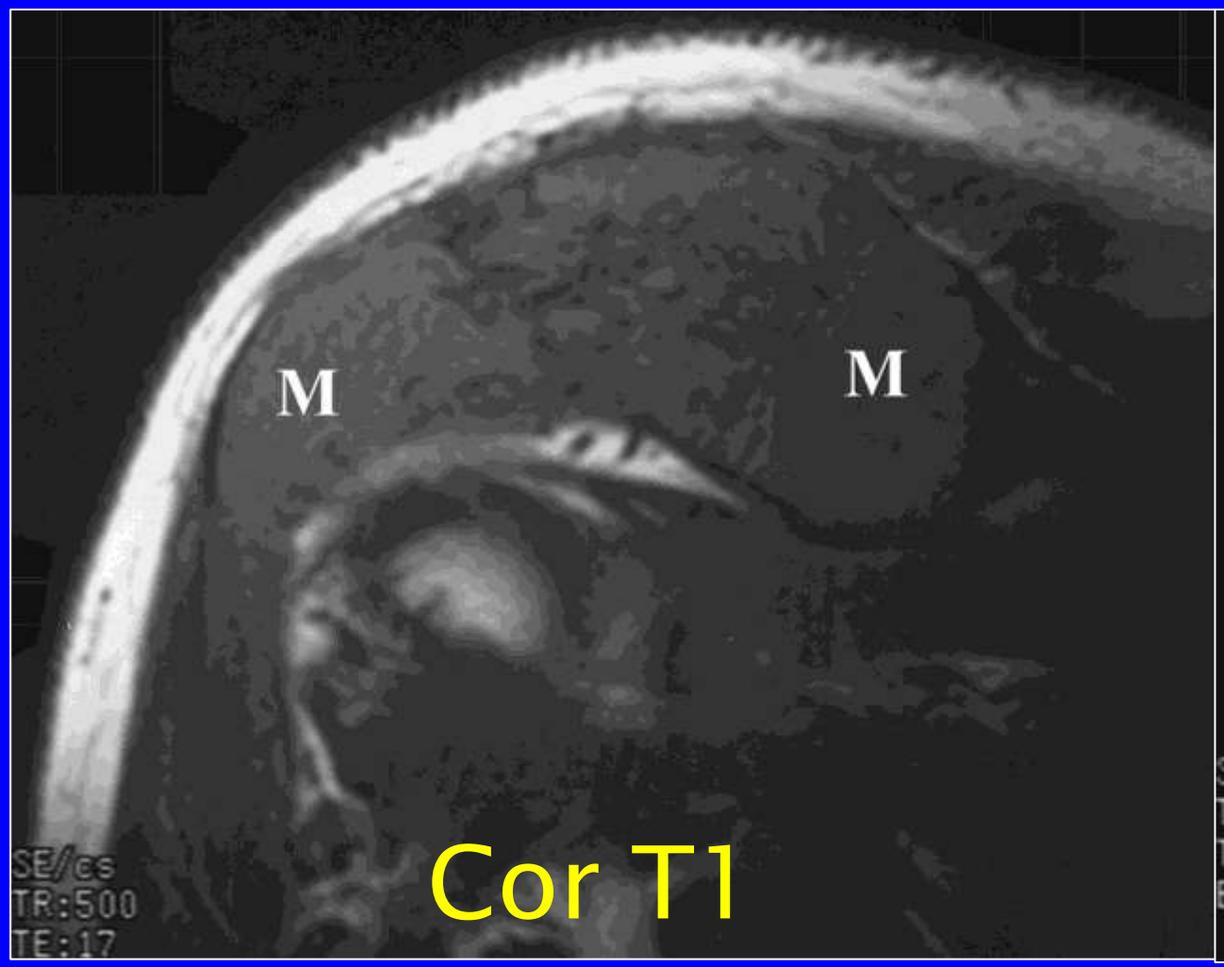

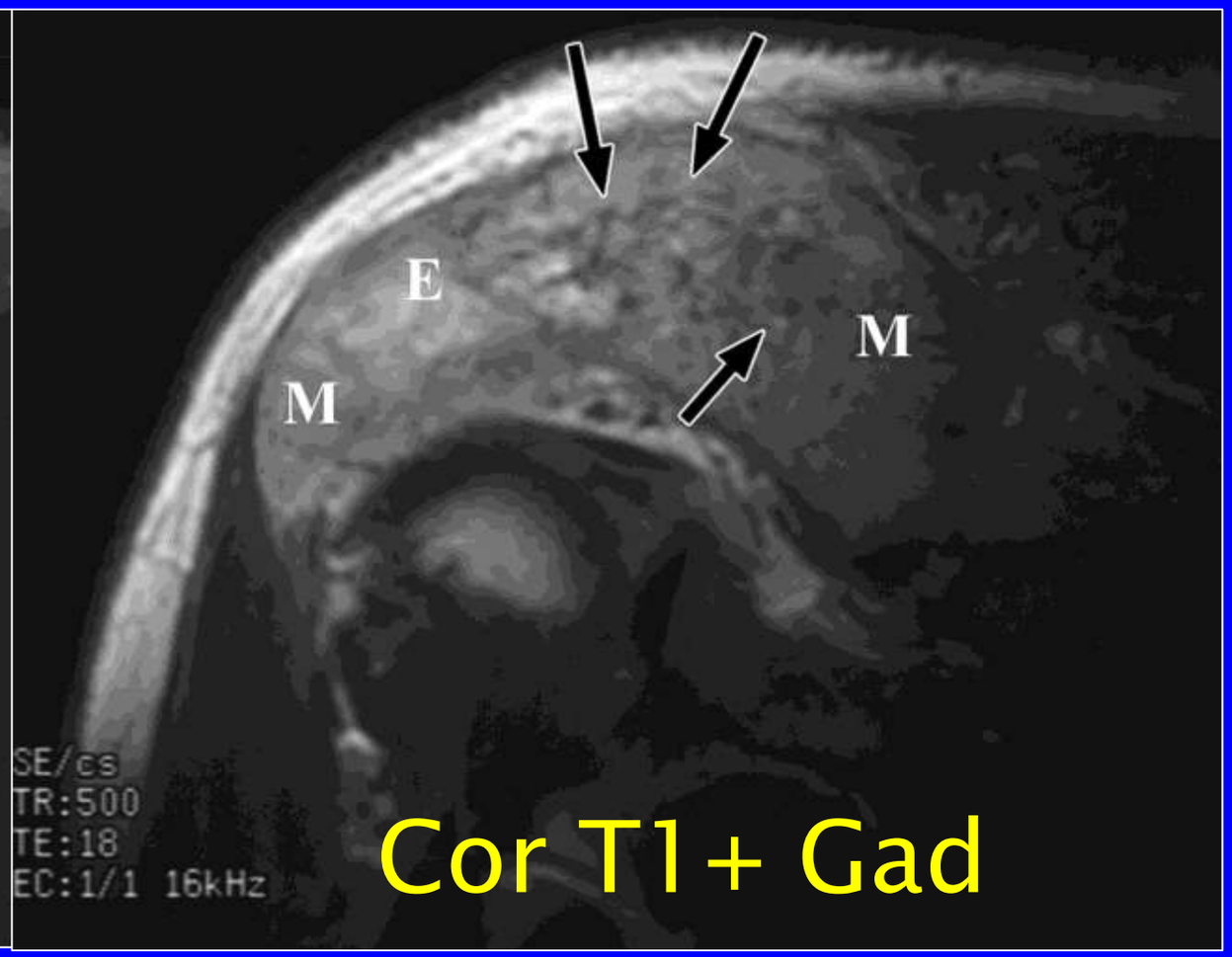

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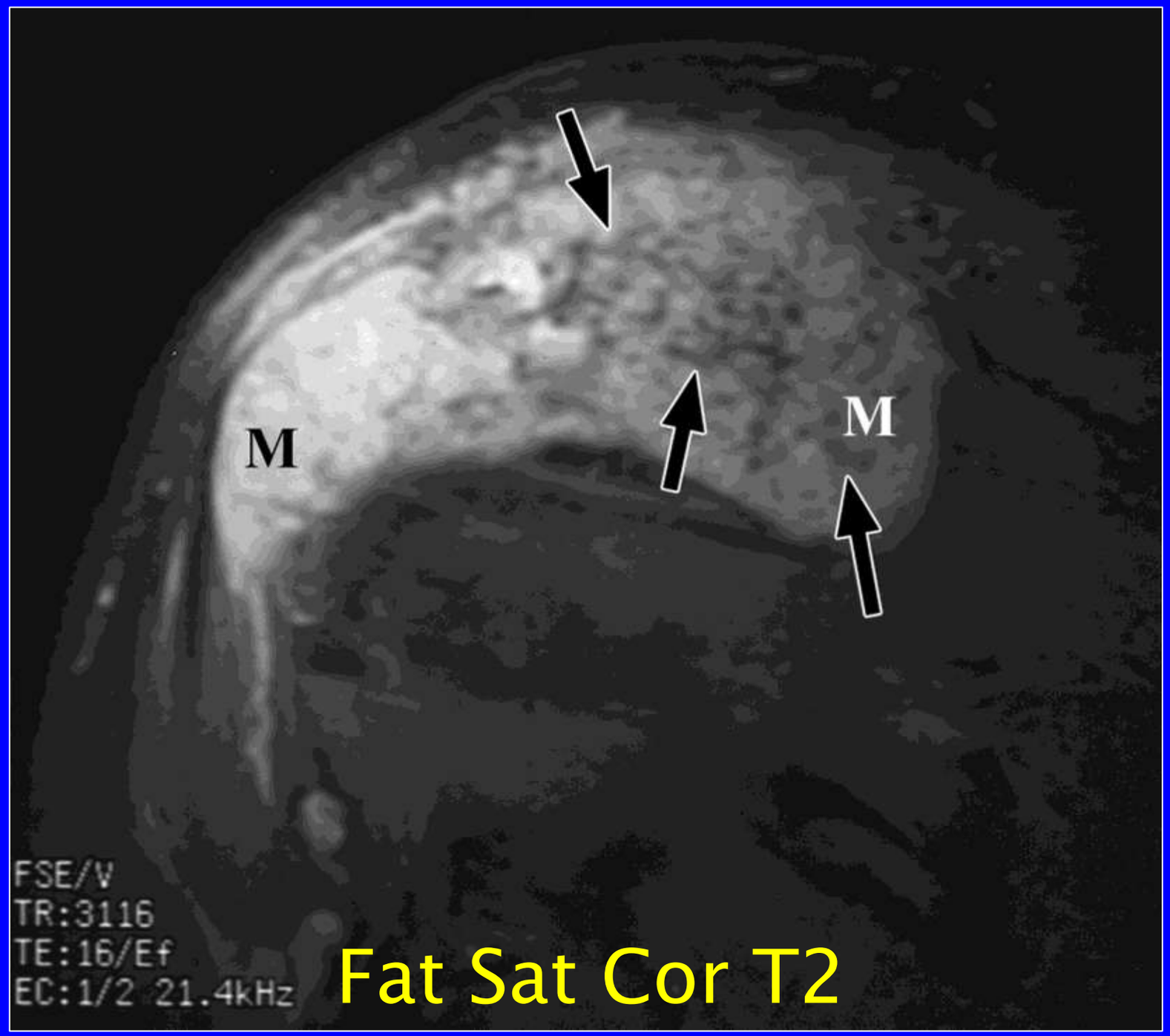

Murphey M D et al. Radiographics 2003;23:1245-1278

RadioGraphics

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Mesenchymal Chondrosarcoma

I. High grade cartilaginous neoplasm
II. Strong tendency to metastasize (lung, LN)
III. Accounts for 2-13% of chondrosarcomas
IV. M=F, 20-40 yo
V. Most commonly craniofacial (mandible, maxilla mostly)
    - Also Femur, ribs spine, humerus, tib/fib
VI. May occur secondarily within focus of fibrous dysplasia

Mesenchymal Chondrosarcoma: Tx, Prognosis

I. Tx via Wide local excision

- XRT, Chemotherapy if incomplete resection

II. Local recurrence, metastases (lung, LN, bone) common

III. Osseous lesions <30% 10 yr survival

53 yo F nocturnal shoulder pain x 6 months

Degreef I et al. An unusual cause of shoulder pain: Osteoid osteoma of the acromion—A case reportJ Shoulder Elbow Surg 2005;14:643-644.

Osteoid Osteoma

Axial CT

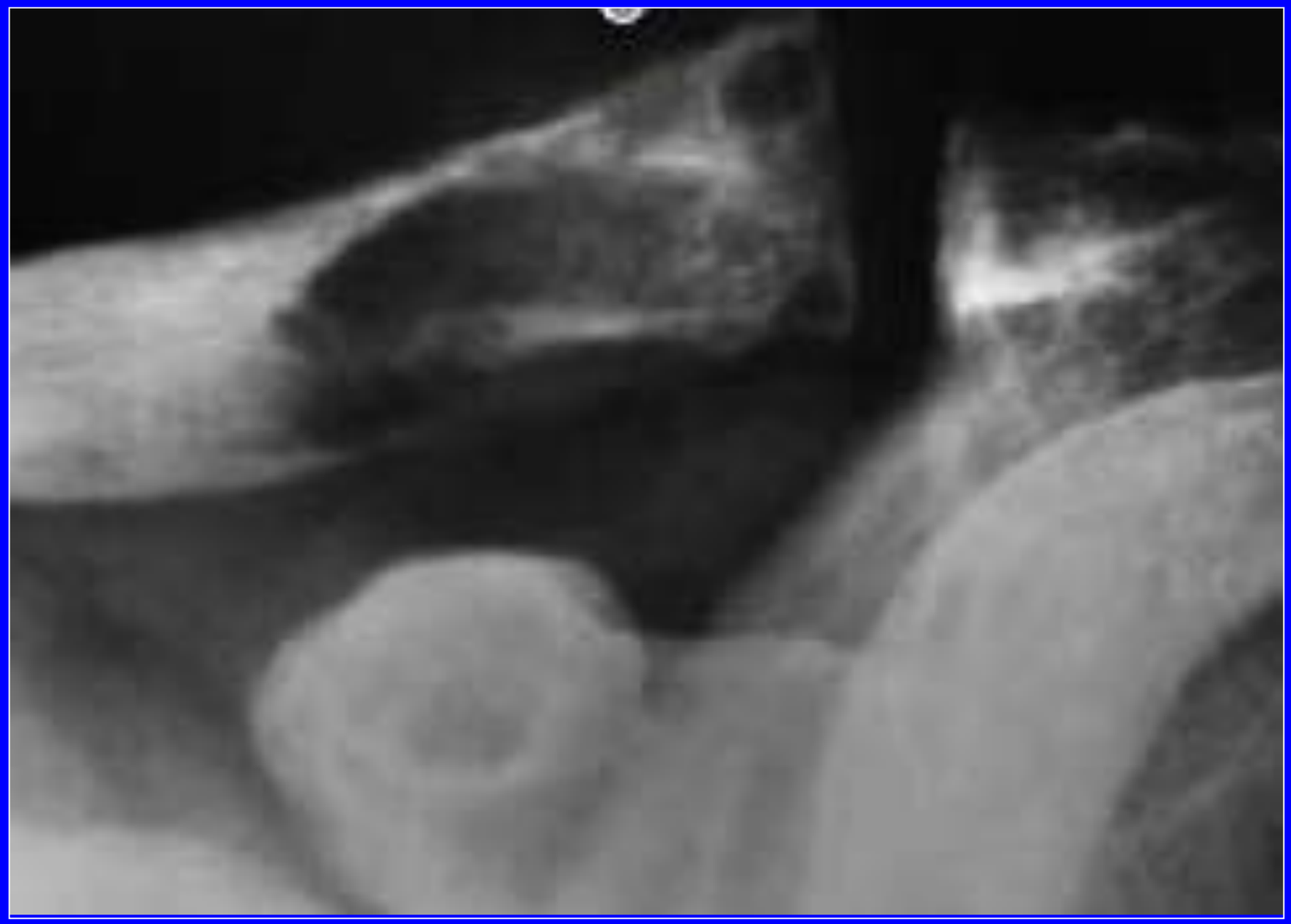
Tc99m MDP

Degreef I et al. An unusual cause of shoulder pain: Osteoid osteoma of the acromion—A case reportJ Shoulder Elbow Surg 2005;14:643-644.

Osteoid Osteoma

I. Intra or juxtaarticular osteoid osteoma is rare: 7 cases
   - 3 in the proximal humerus
   - 2 in the coracoid process
   - 1 in the distal clavicle
   - 1 in anteromedial acromion

Shoulder pain



RCC metastases

Freyschmidt J et al. Clavicle and Sternoclavicular joints. Koehler/Zimmer's Borderlands of Normal and Early Pathological Findings in Skeletal Radiography. 5th edition 2002 p 317. Thieme Publishing

AC joint metastases

I. Clavicle rare site for metastases
   - Clavicle contains scant red marrow
   - Limited vascular supply

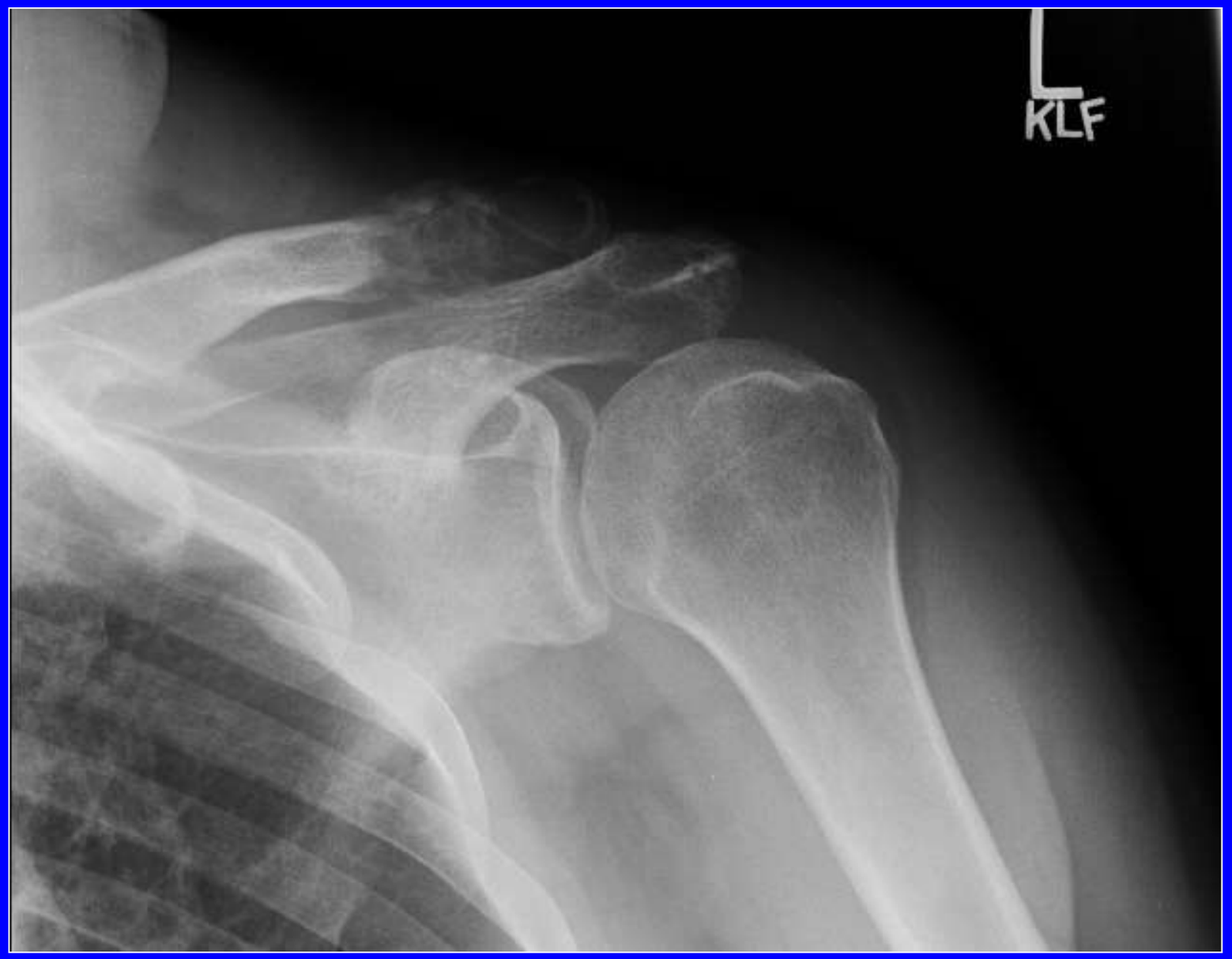
II. Most metastases are osteolytic

III. > 40 yo

Breast CA distal clavicle

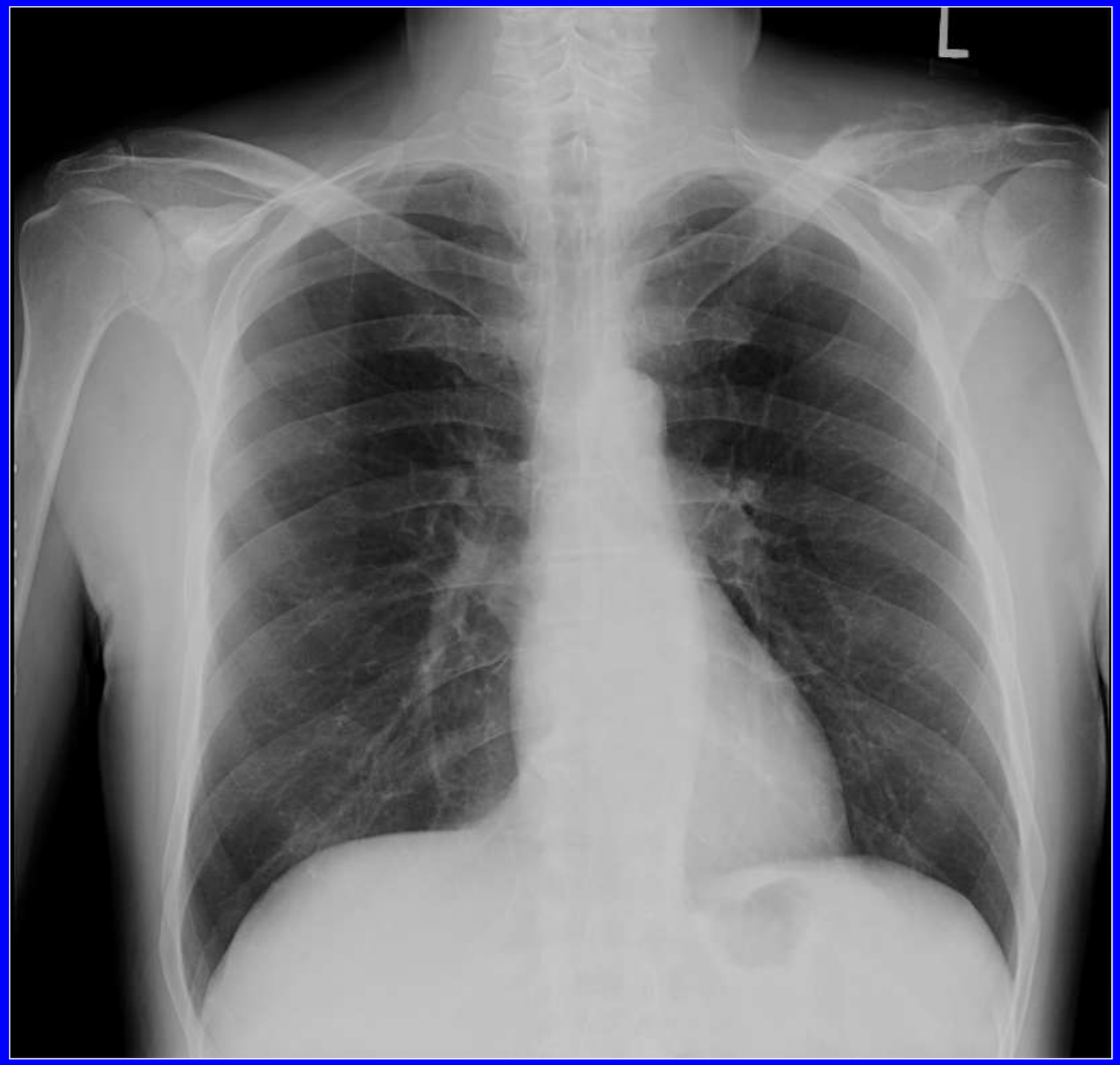
Kumar R et al. The clavicle: Normal and abnormal. *RadioGraphics*.Vol 9 (4) July,1989 pp 678-706

Multiple Myeloma



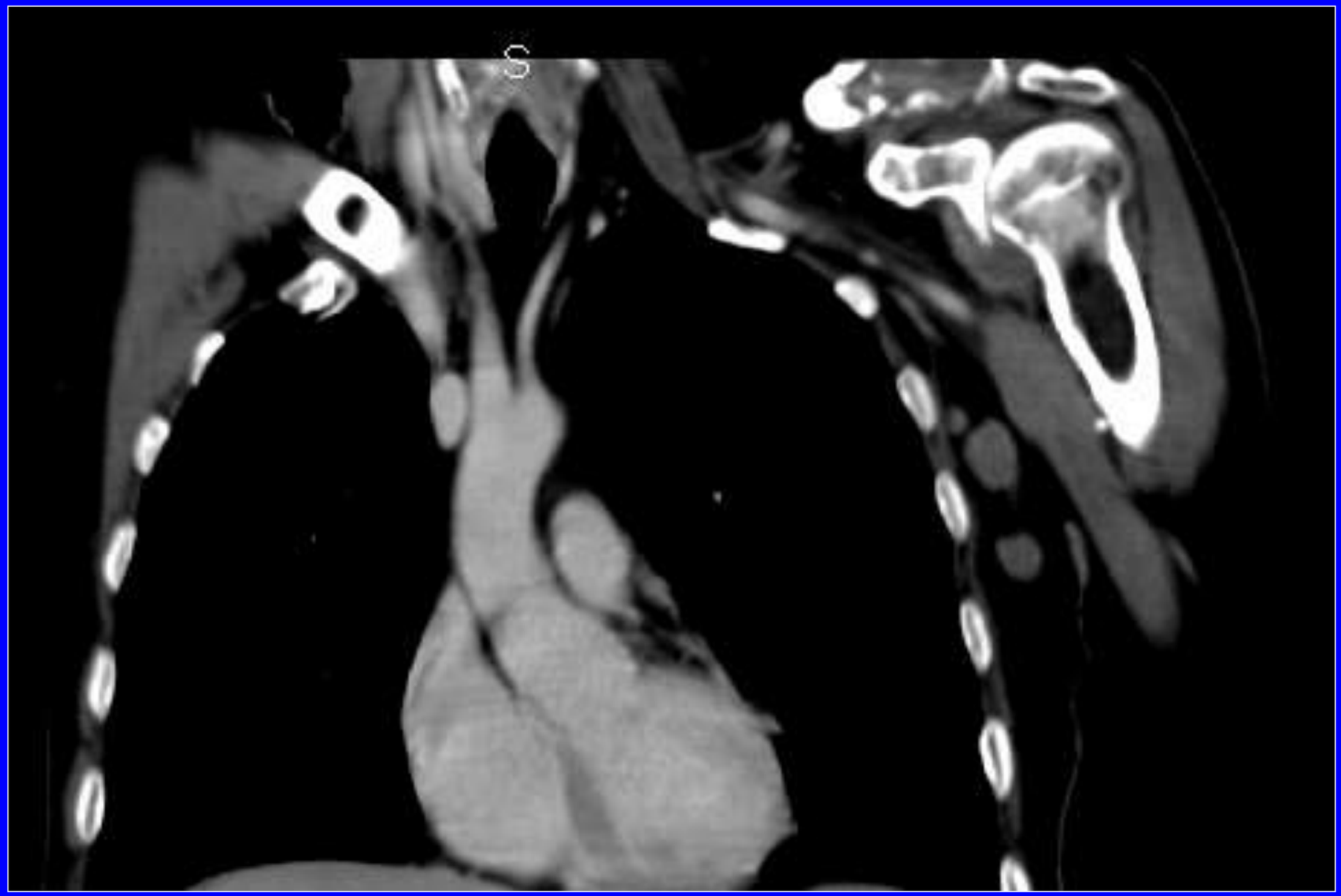
Case courtesy Shelly Marette, MD

Cough



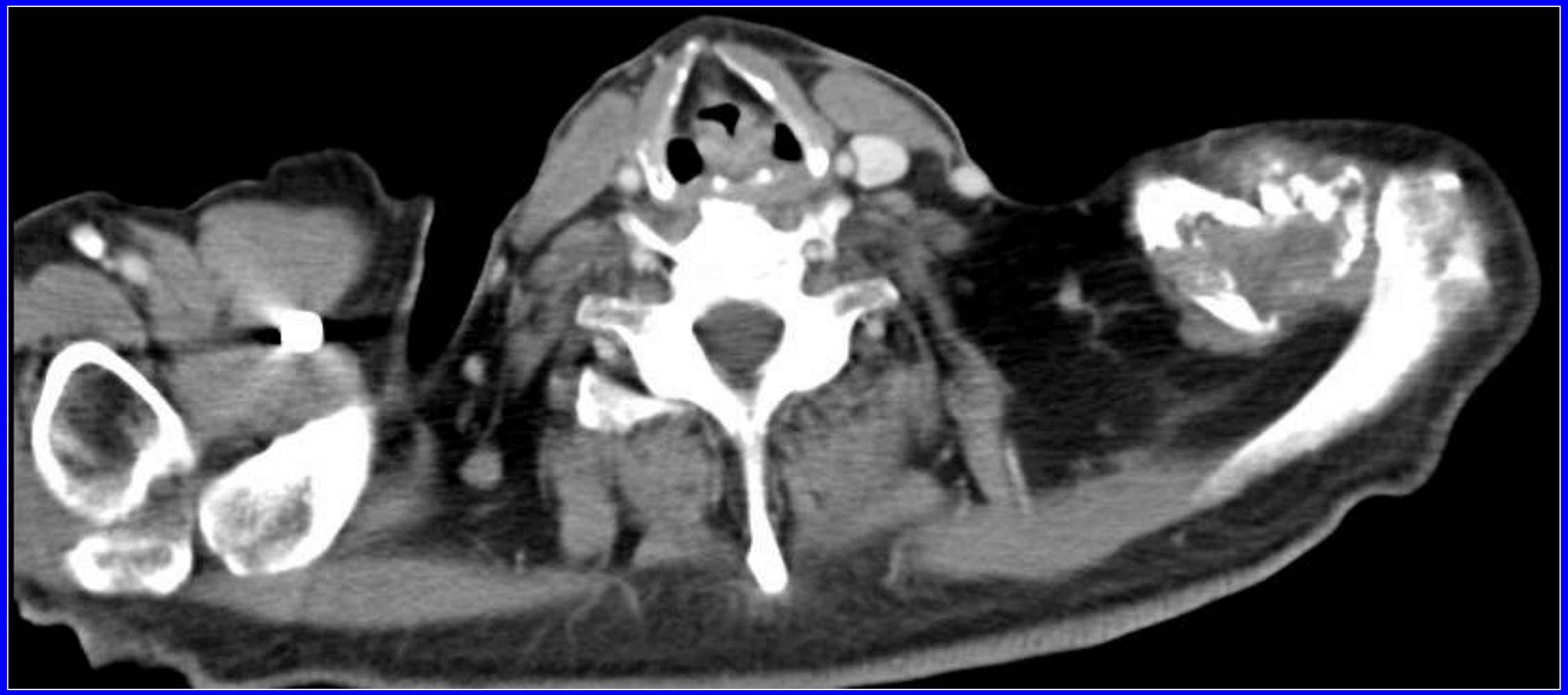
Case courtesy Shelly Marette, MD

Corner NHL



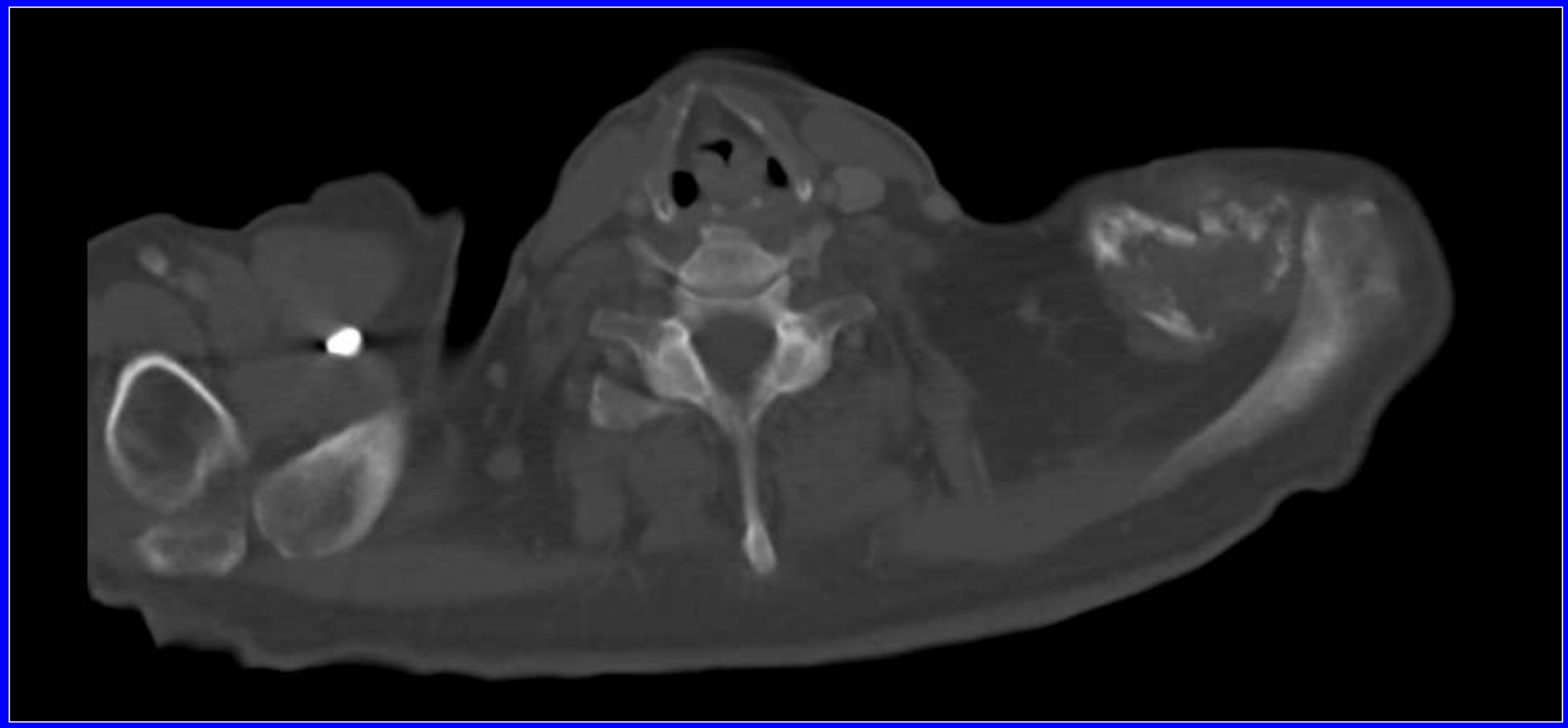
Case courtesy Shelly Marette, MD

NHL



Case courtesy Shelly Marette, MD

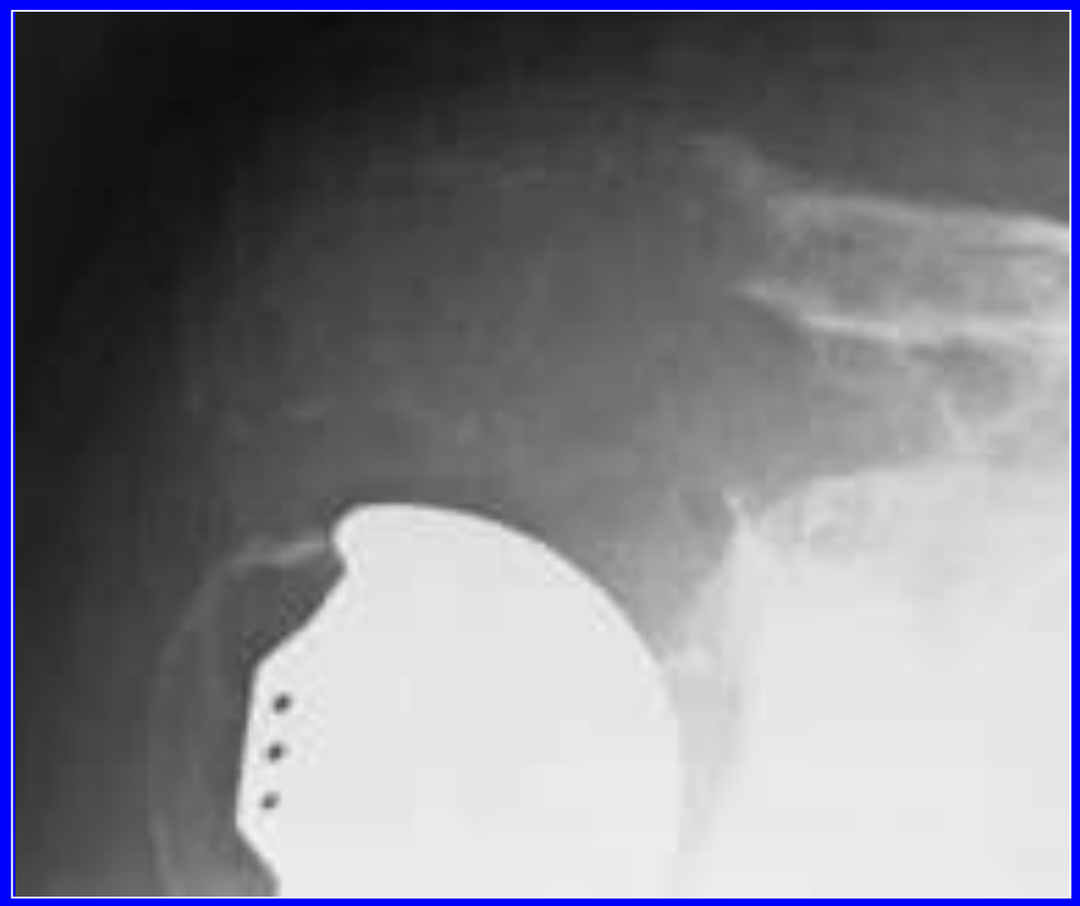
NHL



Case courtesy Shelly Marette, MD

Post op TSA

6 wk



20 wk

Woodhouse ES et al. Metastatic carcinoma to the acromion in a patient after total shoulder arthroplasty: A case report and review of the literature. J Shoulder Elbow Surg 2002;11:645-7

Undifferentiated Adenocarcinoma of Acromion unknown primary s/p TSA

I. Expansile lytic acromial mass

II. 6 month diagnostic delay

III. “no hardware complication”

Summary

- ✓ AC joint pathology common, often overlooked cause of shoulder pain
- ✓ Understanding normal (capsular) anatomy is critical
- ✓ Leave biomechanics for the engineers
- ✓ Modified Rockwood Classification useful classification scheme with surgical implications
- ✓ Extrinsic subacromial impingement a clinical Dx

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Thanks for your attention

Special Thanks

Tudor Hughes
Mini Pathria
Karen Chen
Christine Chung
Brady Huang

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