Scapular Fractures

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Objectives

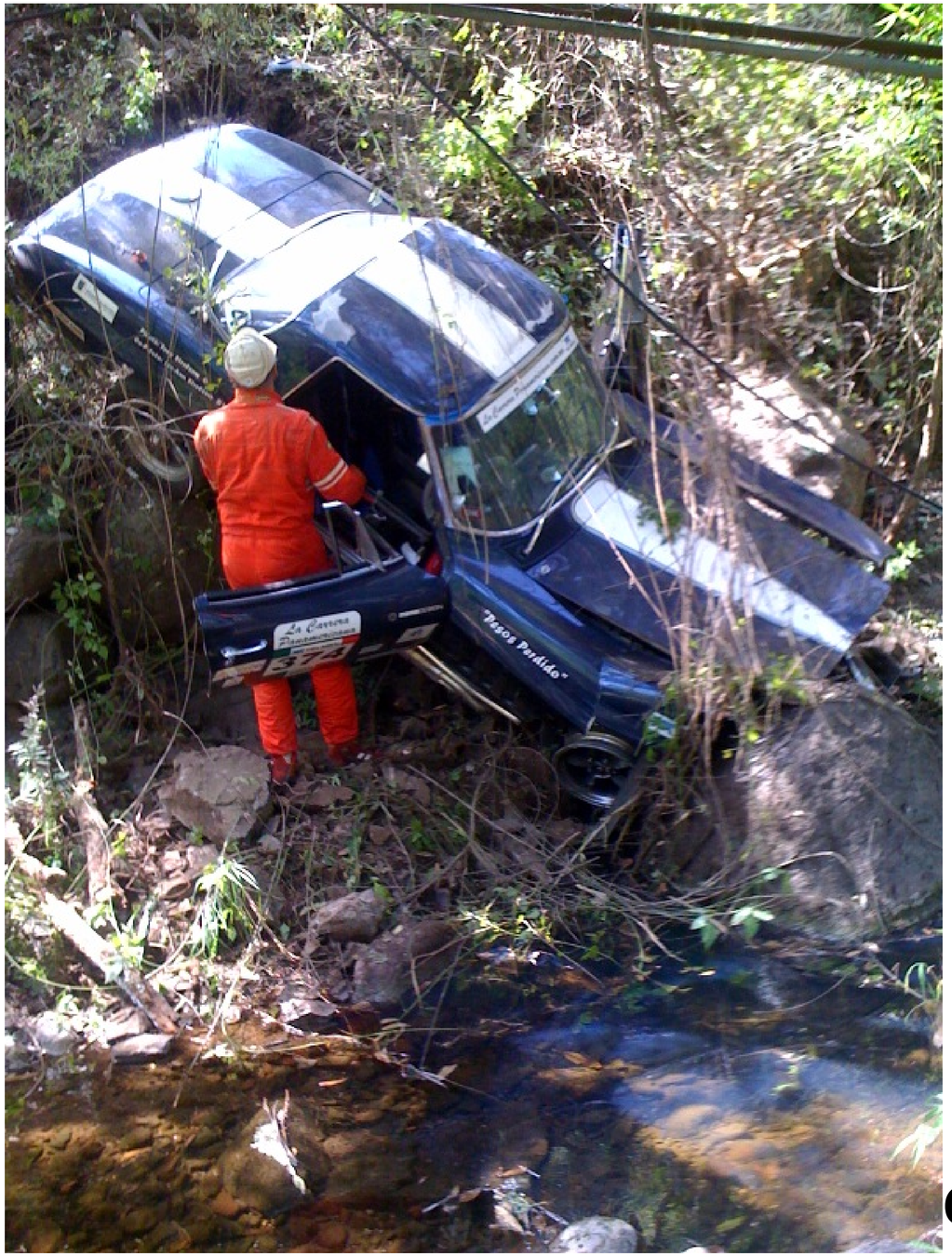
- Appreciate the anatomy of the scapula
- Understand radiographic evaluation and diagnosis of scapular fractures
- Develop a framework for treatment options and indications
- Appreciate scope of injury, and outcomes following scapular fractures

Epidemiology

- Uncommon ~1% of all fractures and 3% of peri-shoulder injuries
    - 50% Scapular Body & Spine
    - 25% Glenoid Neck
    - 10% Glenoid Cavity
    - 7% Acromial
    - 7% Coracoid
- Likely uncommon due to:
    - Scapular mobility
    - Significant protection from thoracic cavity and musculature

Injury Mechanism

- High energy Trauma
  - Direct blows
  - Impact to shoulder



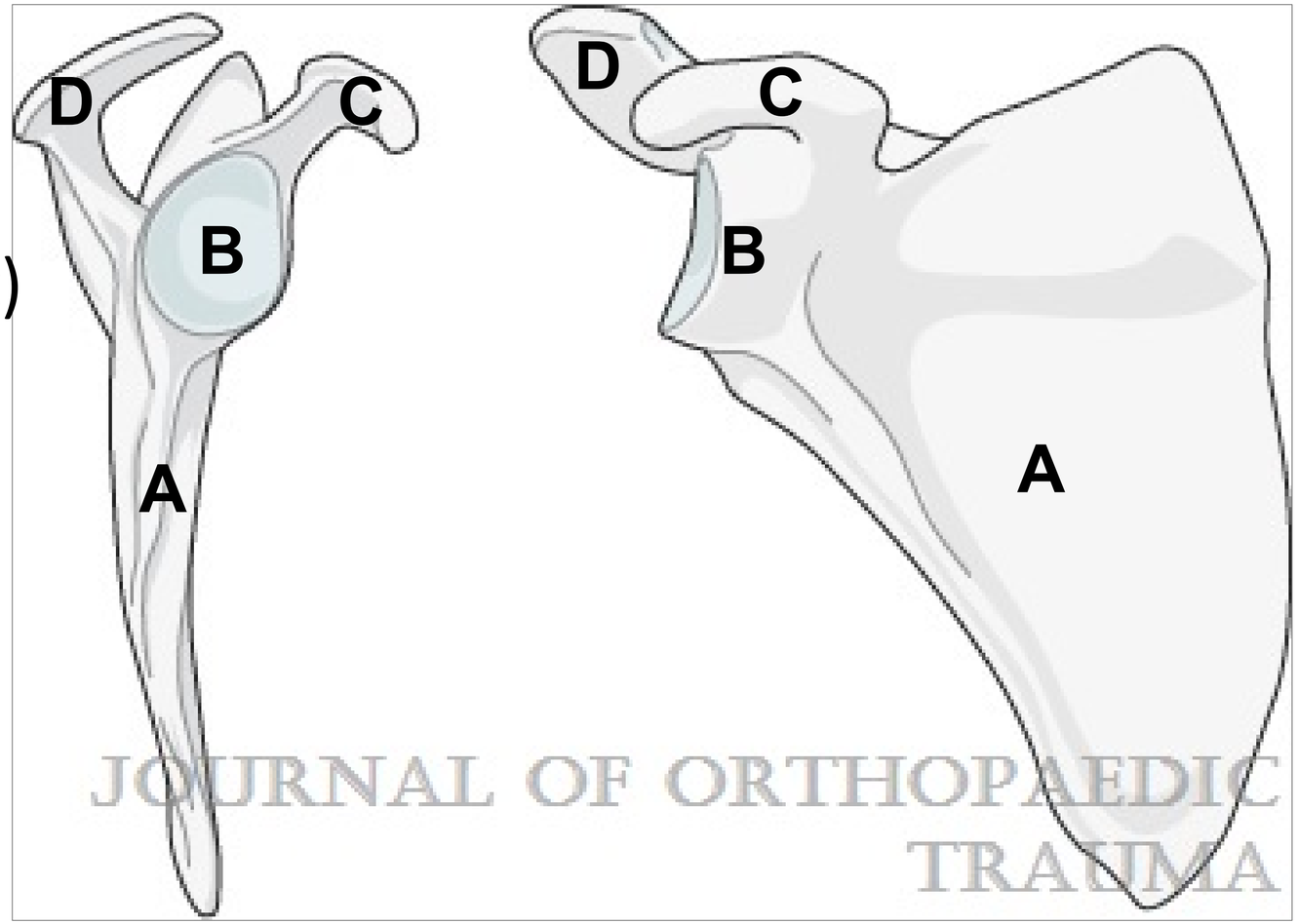
Injury Mechanism

- Direct Force
  - Most commonly
- Indirect Force
  - Fall with humeral head impaction into the glenoid

- 80-95% of scapular fractures associated with multiple or life-threatening injuries

Anatomy

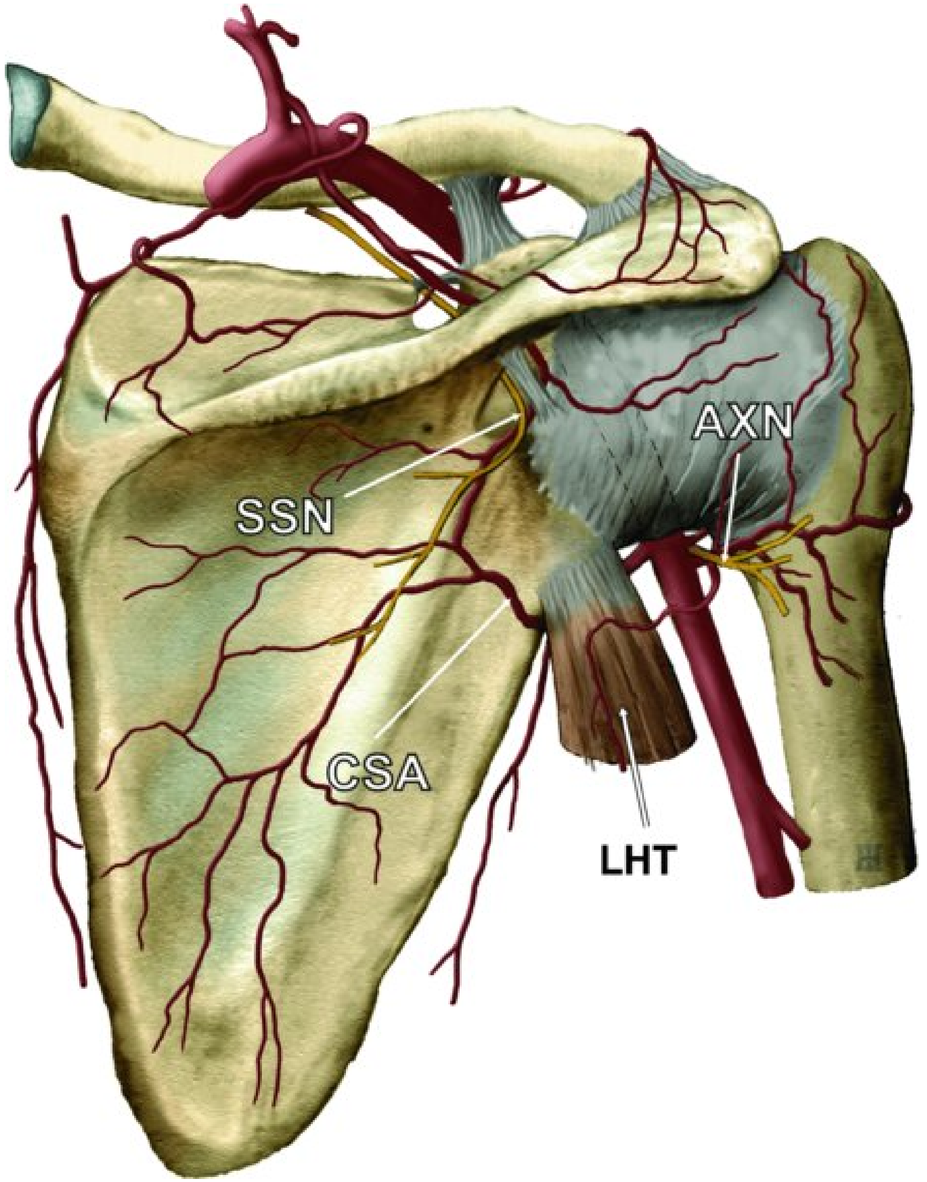
- A - Body
- B - Glenoid Fossa (Articular Vault)
- Processes:
  - C - Coracoid Process
  - D - Acromial Process



Scapula Journal of Orthopaedic Trauma32:, January 2018. S101-S104

Anatomy

- Suprascapular nerve (SSN) is main surface Neurovascular structures
- Related neurovascular anatomy:
  - Axillary Nerve (AXN)
  - Circumflex Suprascapular Artery (CSA)



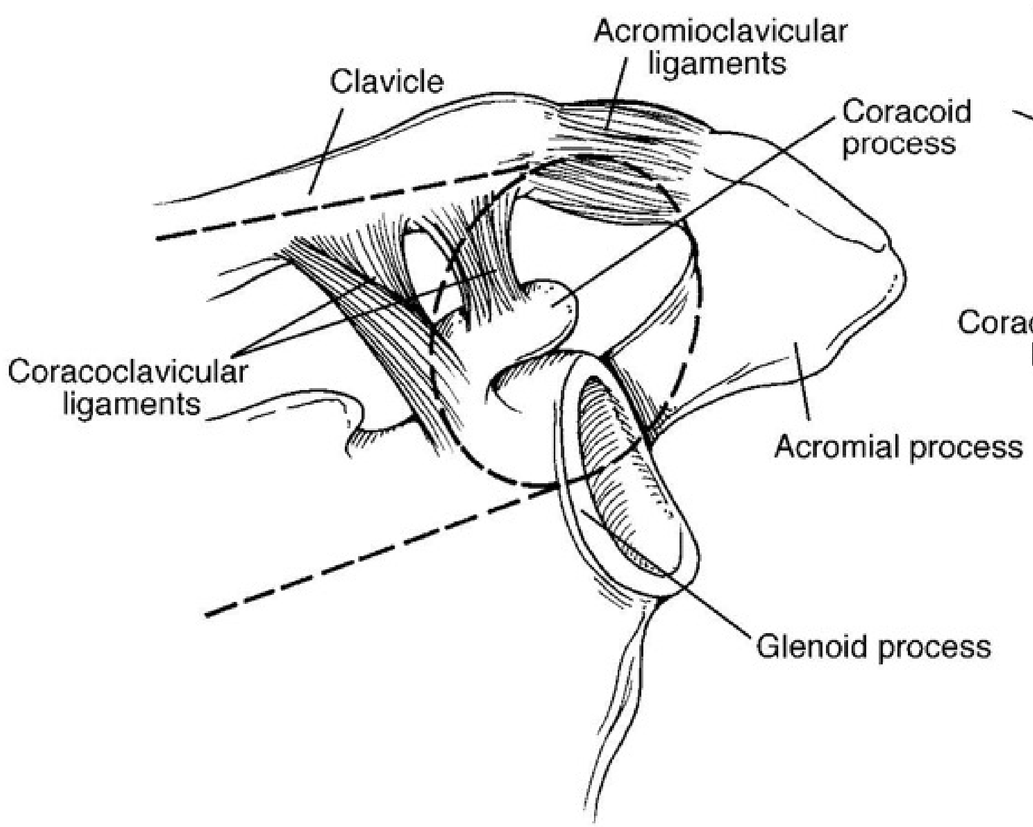
Tornetta, Ricci. Rockwood and Green's Fractures in Adults, 9e, Wolters Kluwer Health Inc, 2020

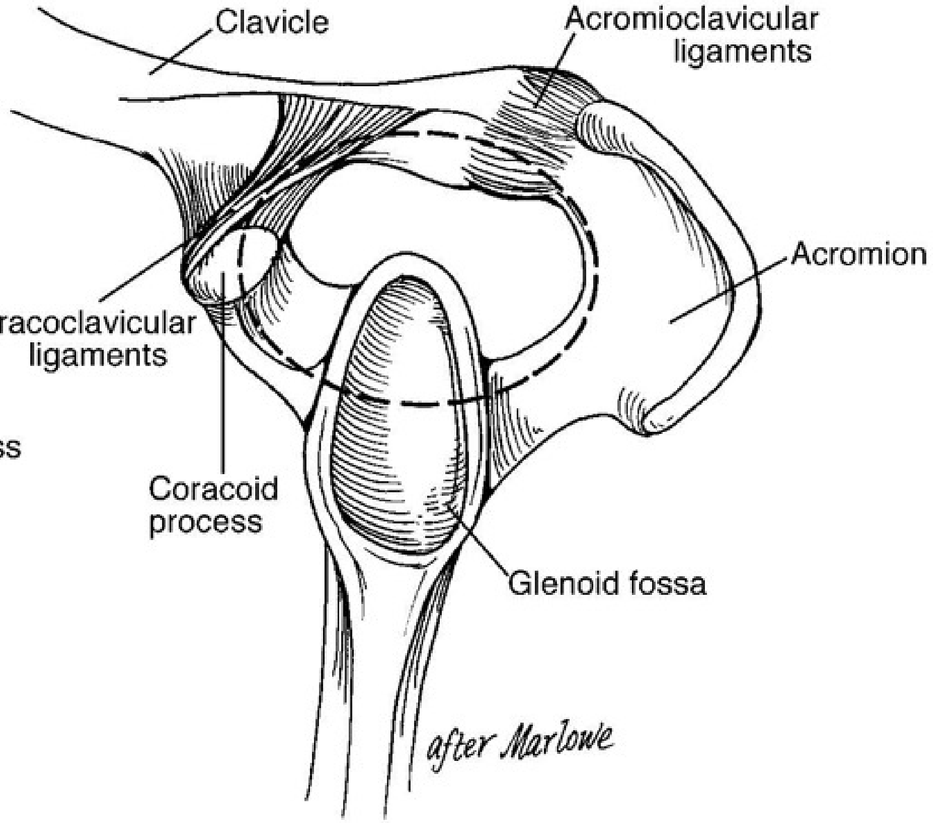
Superior Shoulder Suspensory Complex (SSSC)

- Defined by Goss - JOT 1993
  - Critical in maintenance of the relationship of the upper extremity and axial skeleton throughout he scapula
  - **Complex bone-soft tissue ring:**
    - Coracoid Process
    - Coracoclavicular ligaments
    - Distal Clavicle
    - AC joint
    - Acromial Process
  - SSSC “supports” the Clavicle and Scapular body/spine in space

Superior Shoulder Suspensory Complex (SSSC)

- Defined by Goss - JOT 1993

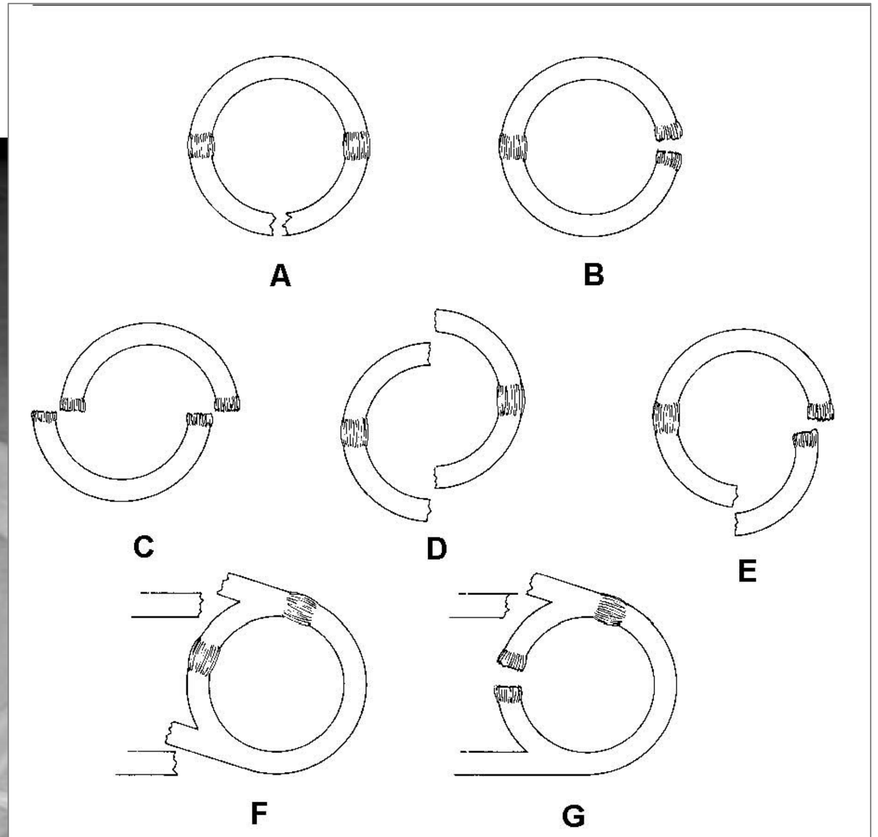




Goss, T. (1995). **Scapular Fractures and Dislocations: Diagnosis and Treatment** Journal of the American Academy of Orthopaedic Surgeons 3(1), 22-33. https://dx.doi.org/10.5435/00124635-199501000-00004

Superior Shoulder Suspensory Complex (SSSC)

- A ‘double disruption’ of the SSSC leads to instability and extremity dysfunction



JAAOS – JOURNAL OF THE AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS

Goss, T. (1993). Double Disruptions of the Superior Shoulder Suspensory Complex Journal of Orthopaedic Trauma 7(2), 99-106. https://dx.doi.org/10.1097/00005131-199304000-00001

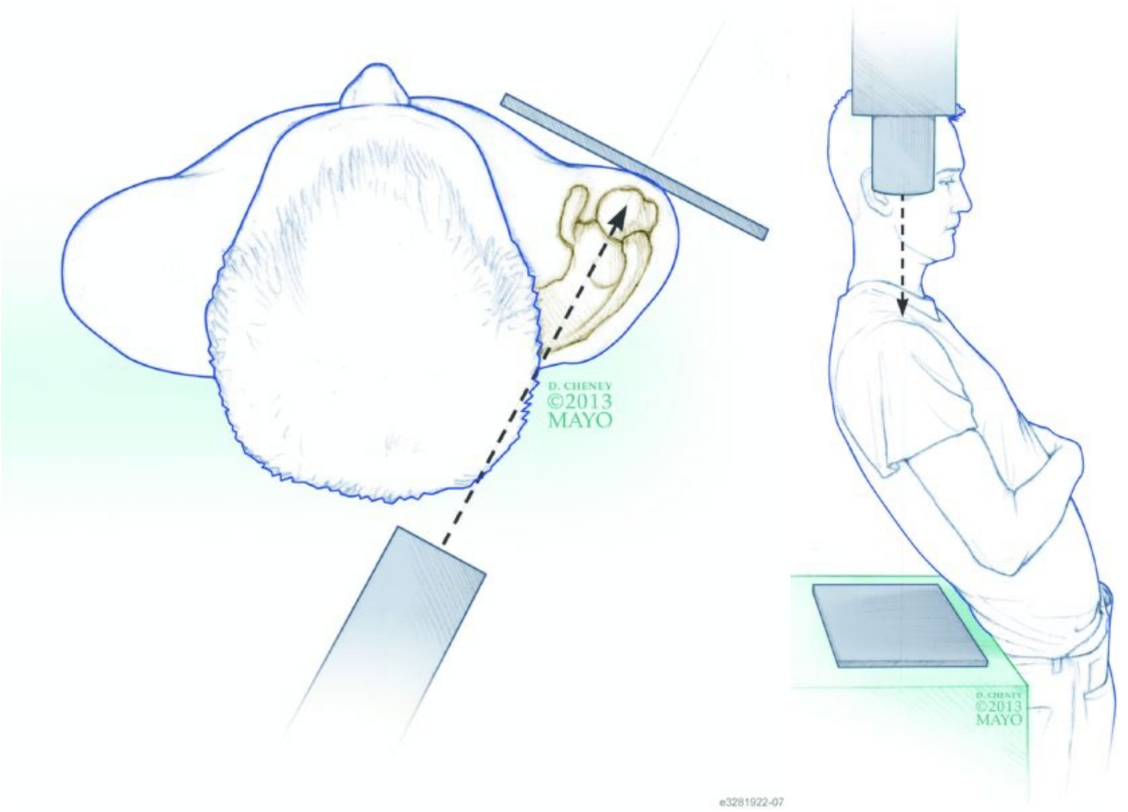
Evaluation

- Physical examination
    - Skin Abrasions, Bruising, Swelling
    - Painful diffusely, difficulty with motion
    - Careful NV examination required
- Radiographic evaluation
    - Mainstay of treatment
    - May first be appreciated on Trauma Series chest Xray

Imaging Evaluation

- Xray
  - Trauma Series —> True Scapular AP, Glenohumeral axillary and Scapular - Y view
  - Complex 3D anatomy presents difficulty
- Computer Tomography (CT)
  - 3D reconstructions with humeral subtraction can be very helpful

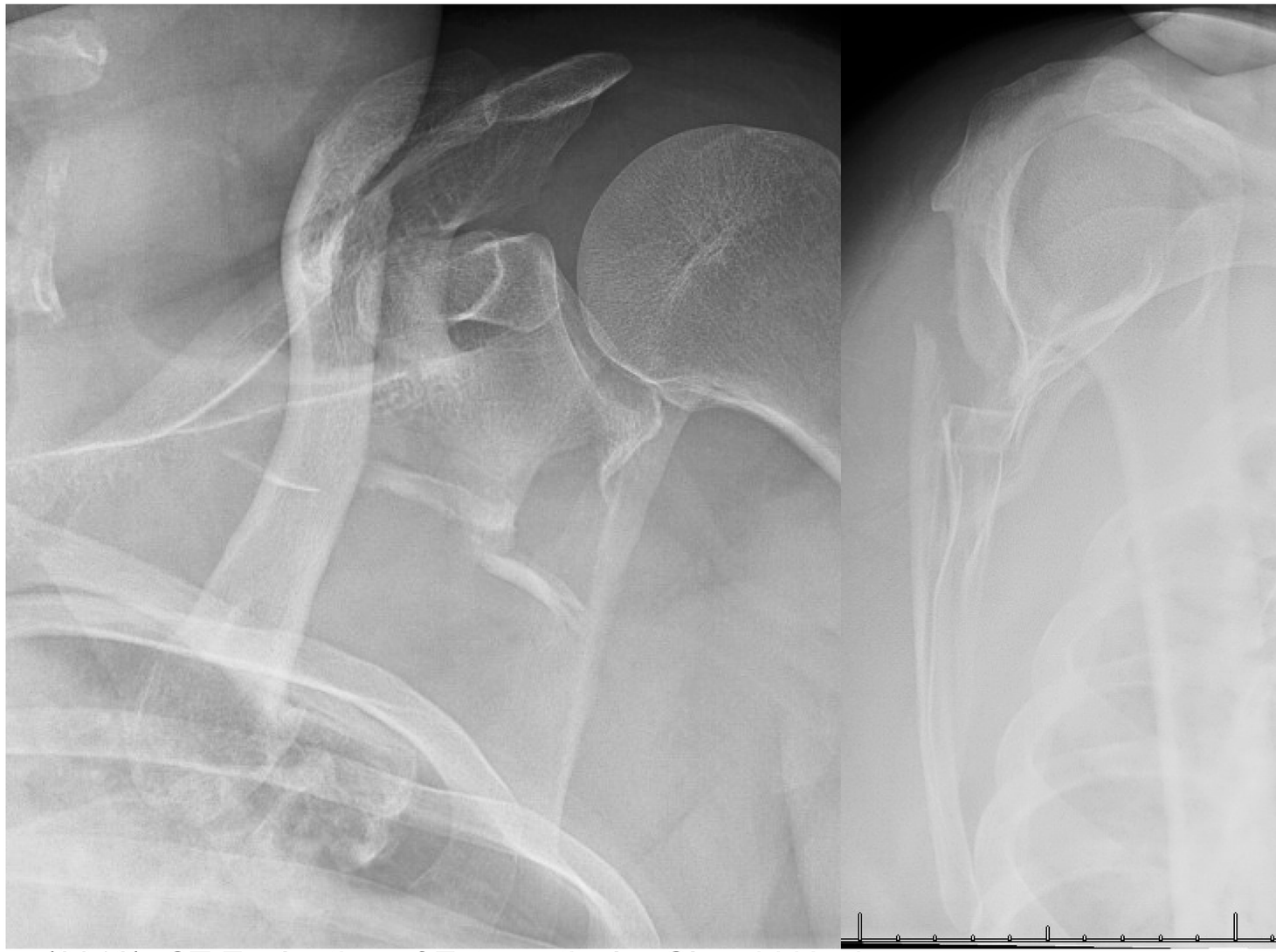
Imaging Evaluation



Imaging Evaluation

- Lateralized Scapular Body
    - Rarely medial glenoid
- Visible fracture lines

- 3D appreciation can be difficult

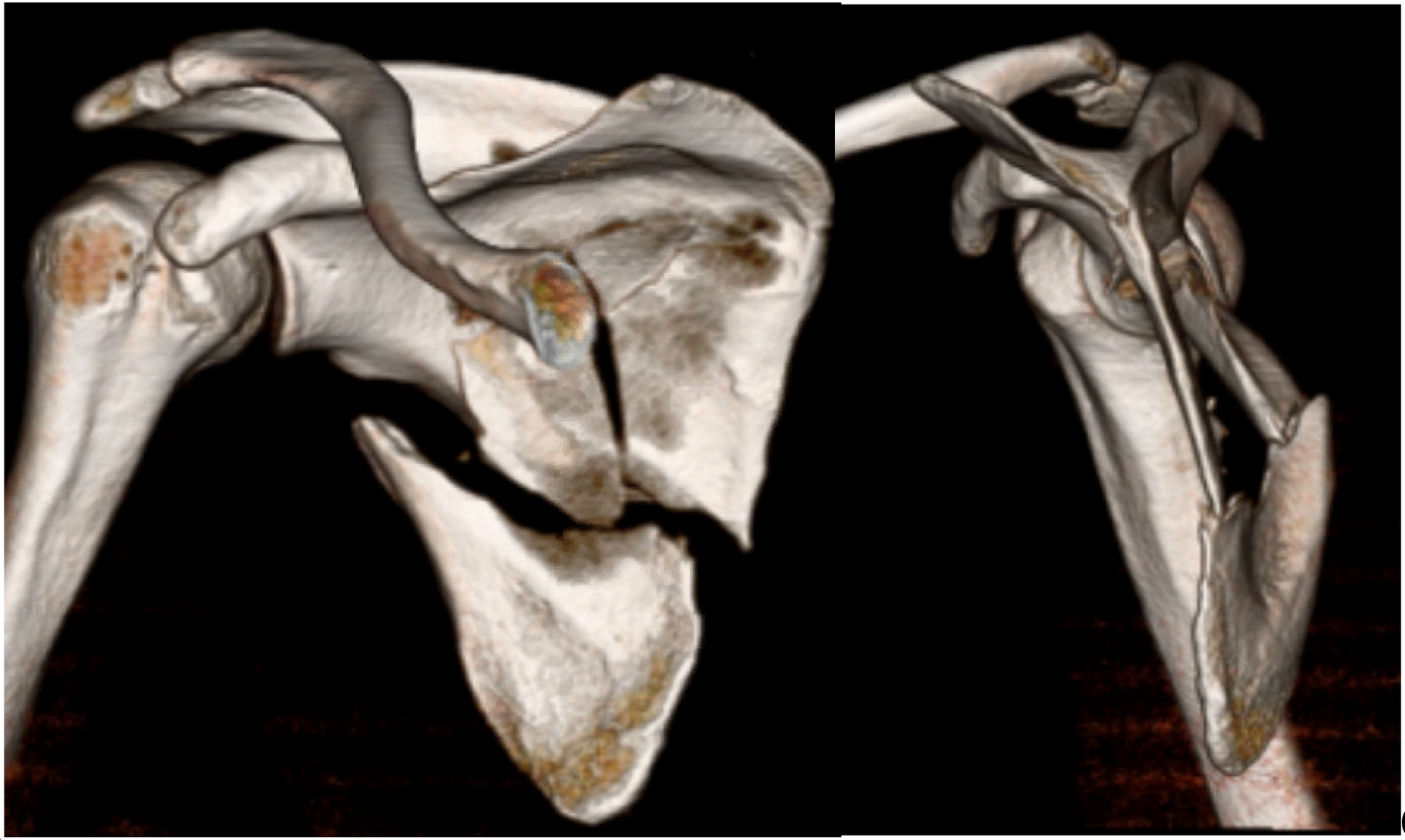


Patterson, (2012). CT Evaluation of Extra-articular Glenoid Neck Fractures Journal of Orthopaedic Trauma

Imaging Evaluation

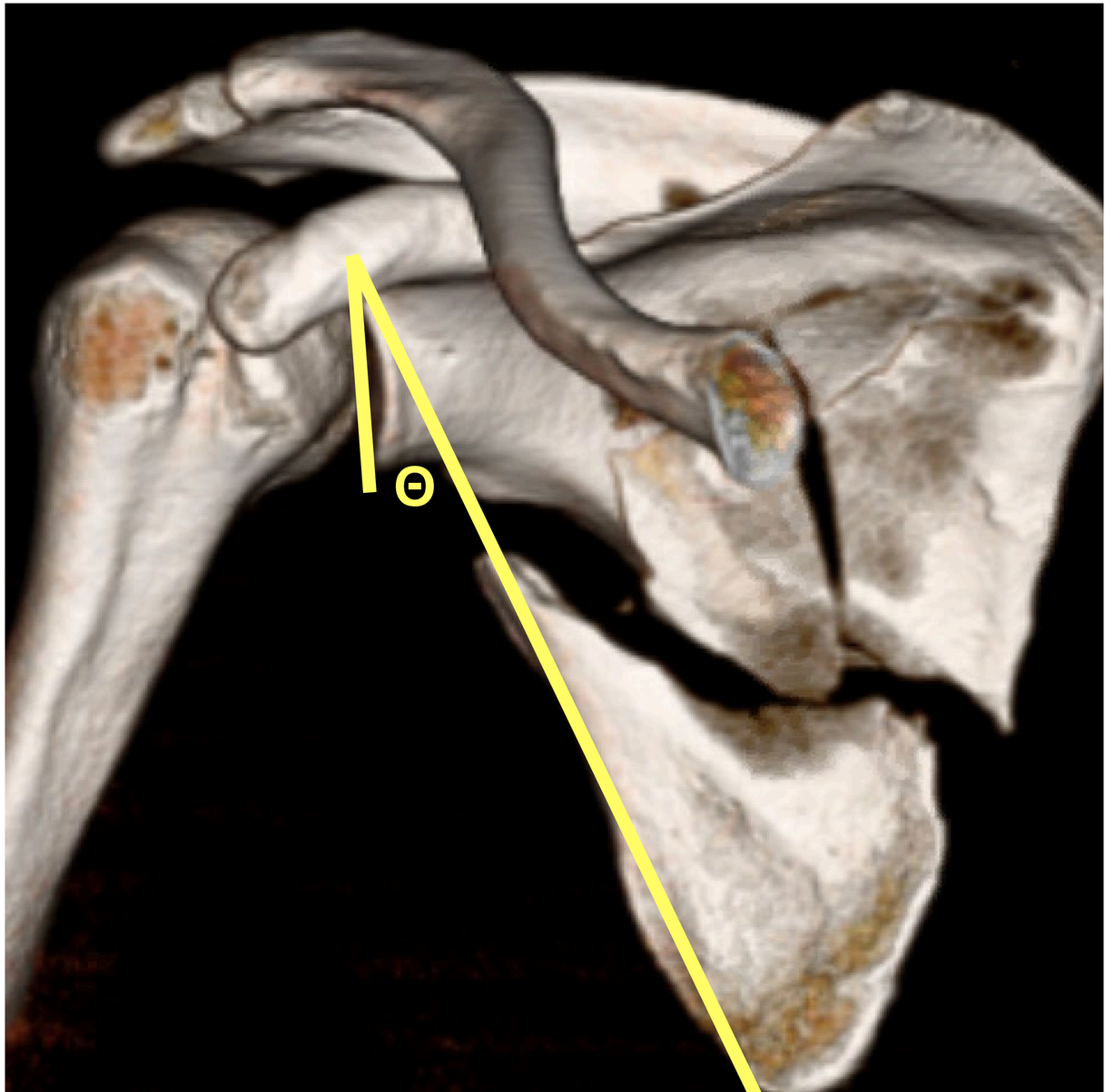
- Computer Tomography (CT)
  - 3D reconstructions with Humeral subtraction can be very helpful to understand anatomy & relationships

Imaging Evaluation



Imaging Measurements

- Glenopolar Angle (Θ)
  - Angle generated by the intersection of 2 lines:
    - 1) Inferior glenoid fossa to the superior lip of the glenoid
    - 2) Superior apex of the glenoid fossa to the inferior angle of the scapula

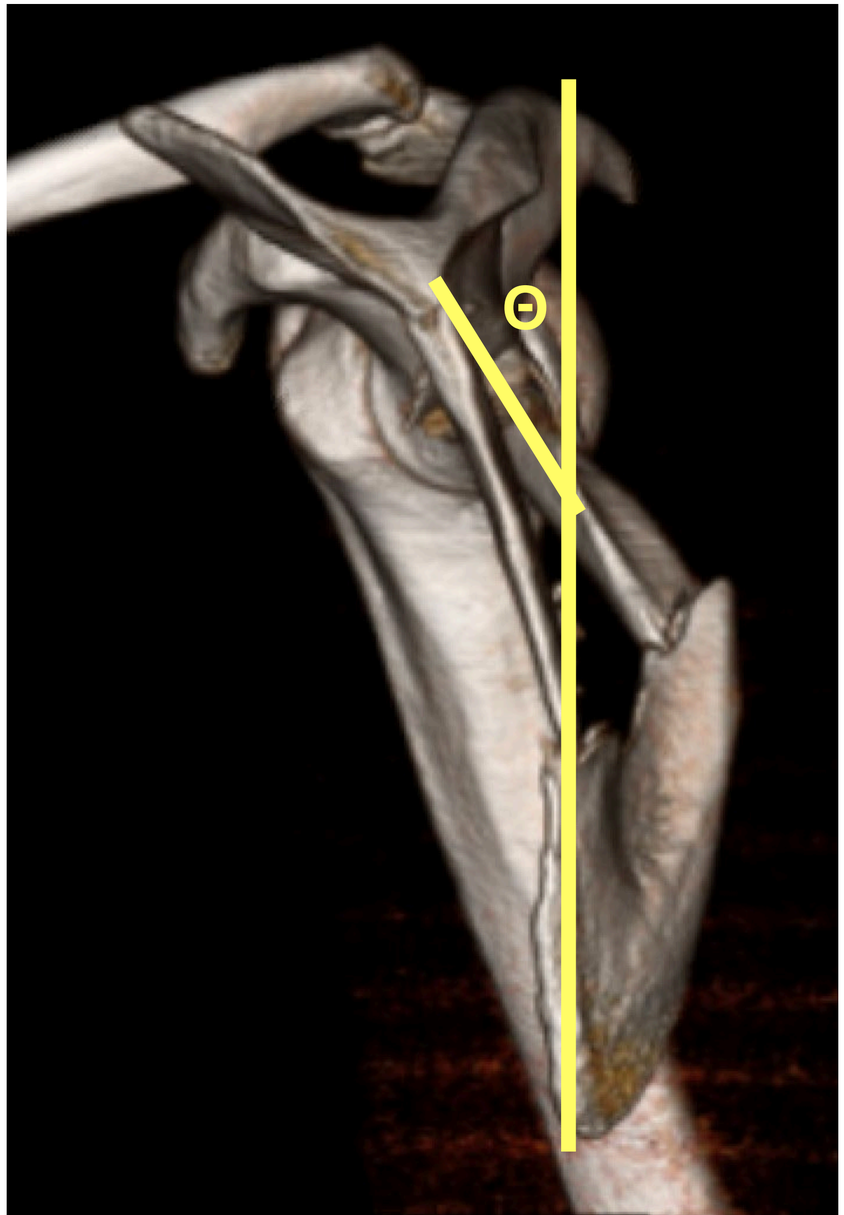


Imaging Measurements

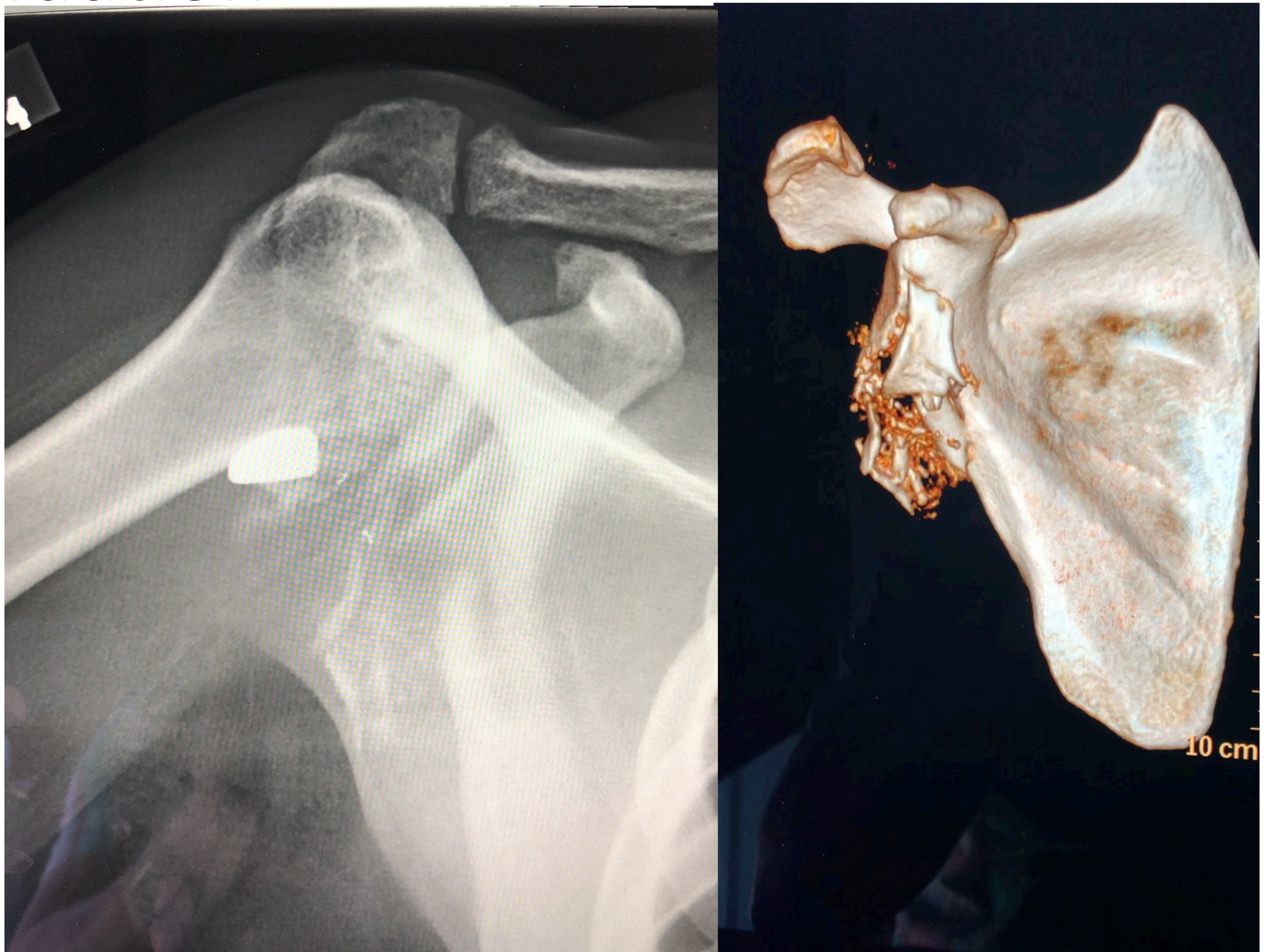
- Medial / Lateral Displacement
  - Displaced between
    - Most lateral point of distal Fragment
    - Most lateral point of proximal fragment

Imaging Measurements

- Angulation
  - Angle generated by the intersection of 2 lines on Scapular Y view or CT reformat:
    - Line along proximal fragment
    - Line along distal fragment



CT Evaluation

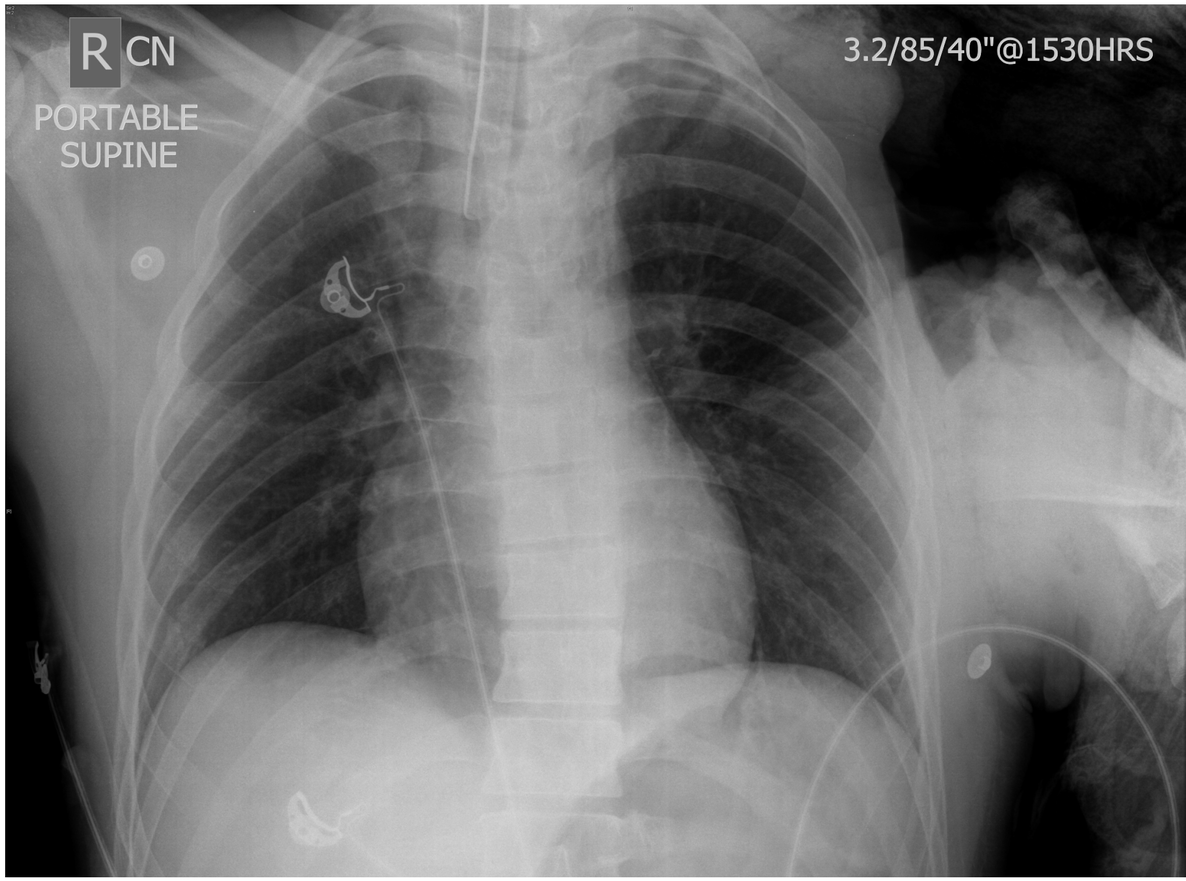


Scapulothoracic Dissociation
(Lateral Dislocation of the Scapula)

- Rare disruption of the Scapulothoracic articulation
- Severe energy dissipation - commonly traction
  - Scapula essentially ‘torn away’ from the thoracic wall
- Associated with disruption of at least 1 of the three ‘joints’
  - Glenohumeral, Acromioclavicular, Sternoclavicular
- Associated with injury to the NV structures:
  - Subclavian/Axillary artery, Brachial plexus

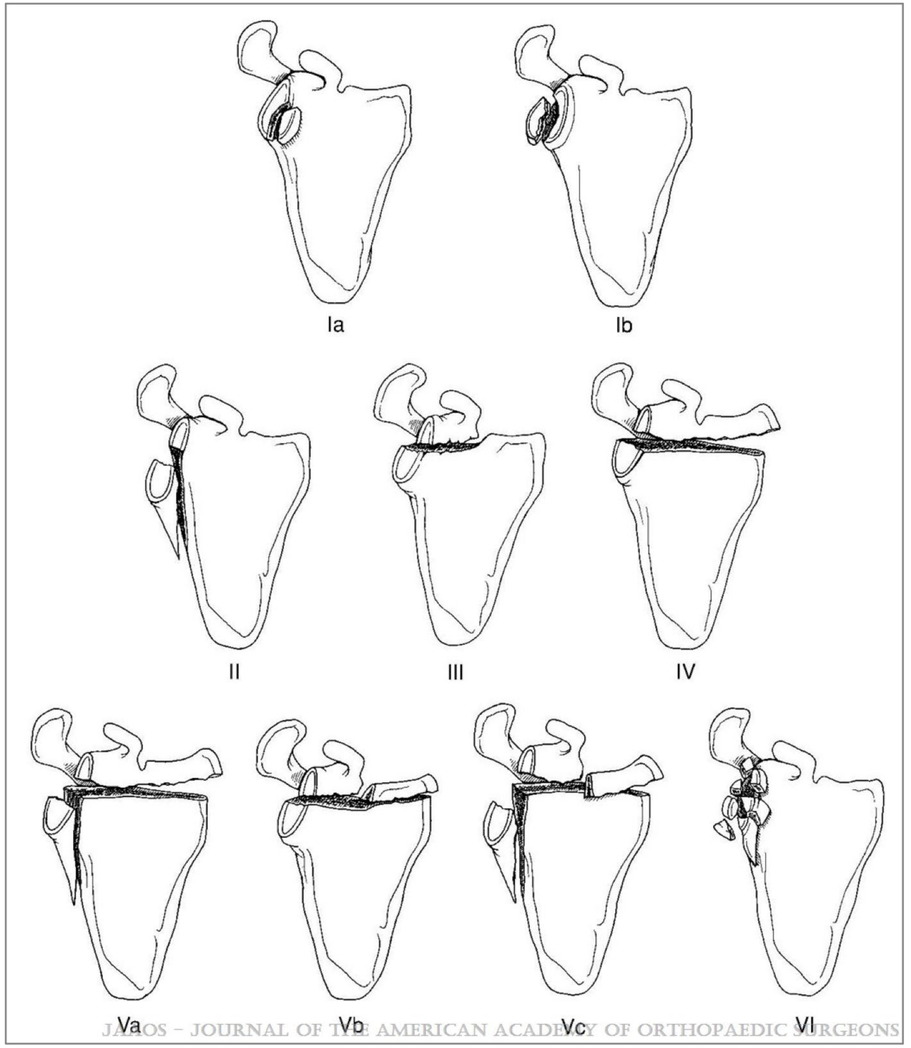
Evaluation

- **Physical examination**
  - Vascular and/or neurologic deficit
  - High energy mechanism and significant soft tissue trauma to the shoulder
- **Radiographic evaluation**
  - Lateral displacement of scapula
    - >1cm from contralateral
    - Increased Scapular index (1.43)
    - Widely distraction clavicle fracture or SC joint



Glenoid Classification (Idaberg)

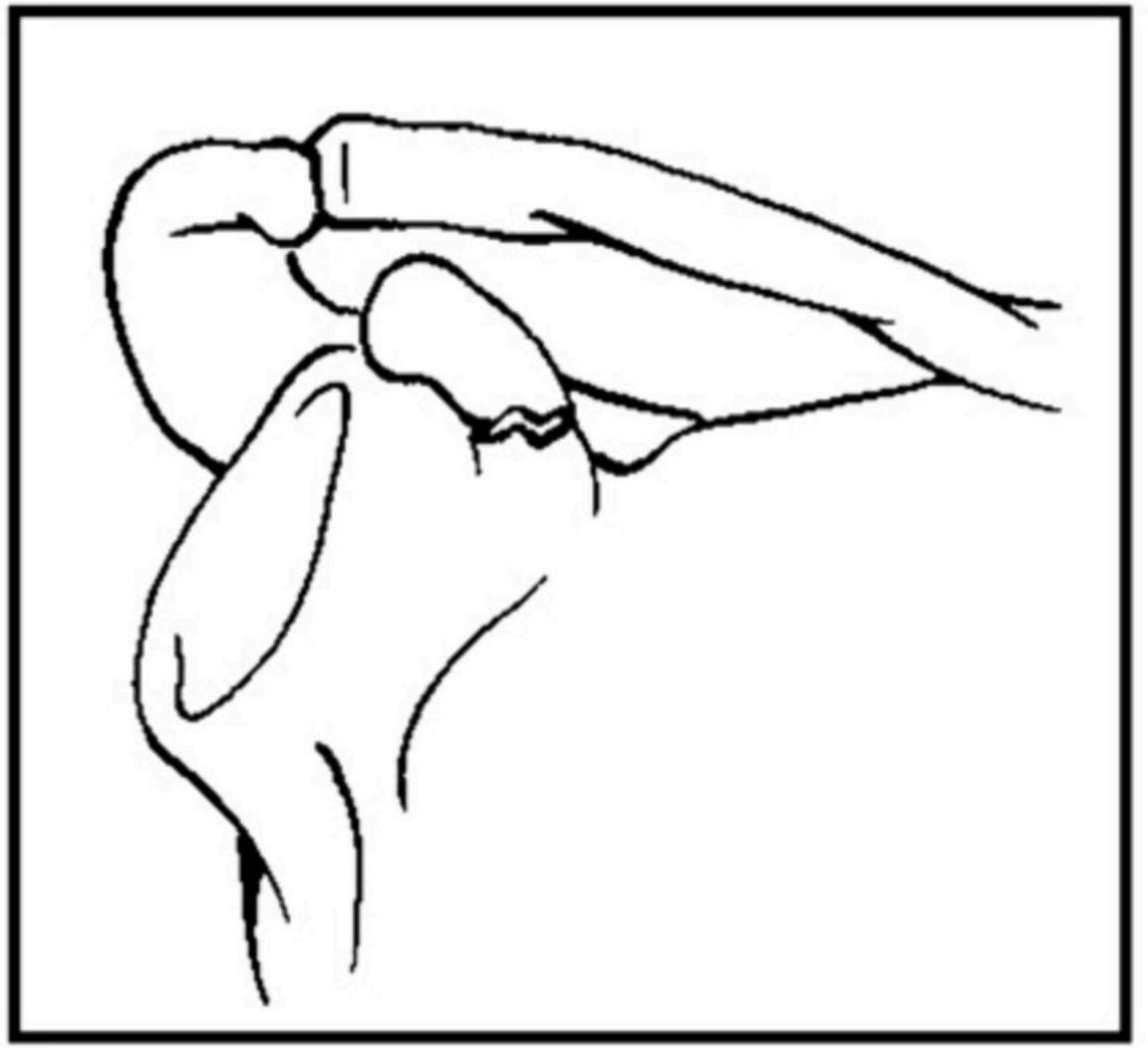
- Type I
  - a - Anterior rim
  - b - Posterior rim
- Type II - Through glenoid exiting inferior
- Type III -Through glenoid exiting medial to coracoid
- Type IV -Through Glenoid exiting medial scapula
- Type V
  - a - Combined II and III
  - b - Combined IV with comminuted acromion
  - c - Combined II, and Vb
- Type VI - Comminuted Glenoid



Goss, Thomas P. Scapular Fractures and Dislocations: Diagnosis and Treatment JAAOS - Journal of the American Academy of Orthopaedic Surgeons3(1):22-33, January-February 1995

Coracoid

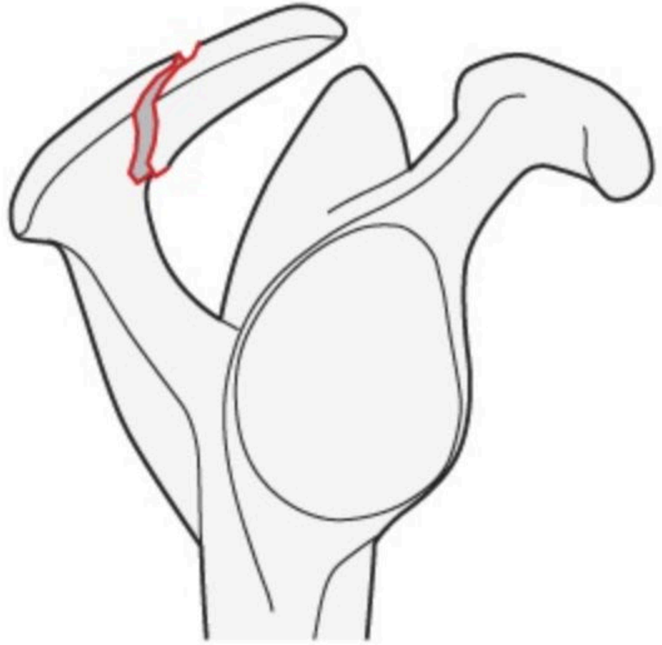
- Many on location of fracture (Eyres)
  - Type 1 - Tip
  - Type 2 - Shaft
  - Type 3 - Base

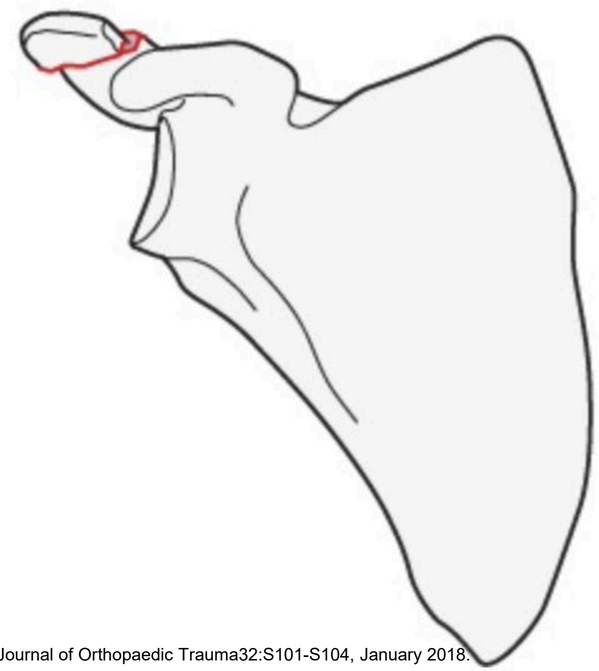


S L. Zuckerman. *Understanding the Concept of Medialization in Scapula Fractures.* J Orthop Trauma. Volume 26, Number 6, June 2012

Acromial Classification

- Ogawa & Naniwa (1997)
  - Type 1 (Lateral Acromion)
  - Type II (Medial Acromion)



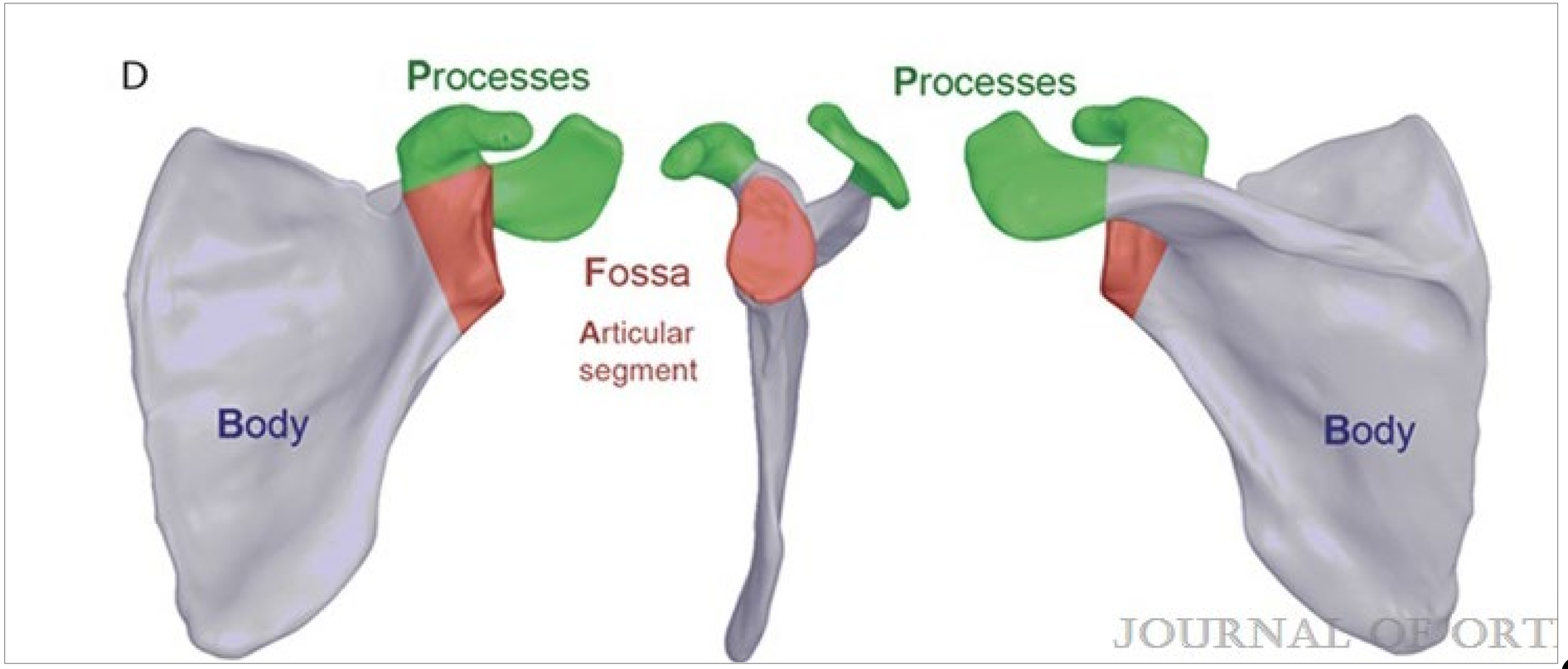


Scapula. Journal of Orthopaedic Trauma32:S101-S104, January 2018.

Ogawa, K., Naniwa, T. (1997). Fractures of the acromion and the lateral scapular spine Journal of Shoulder and Elbow Surgery 6(6), 544-548. https://dx.doi.org/10.1016/s1058-2746(97)90087-2)

Scapular Classification

- 3 Parts : Fossa, Body, Processes
- Kappa 0.66 for Xray & 0.78 for CT

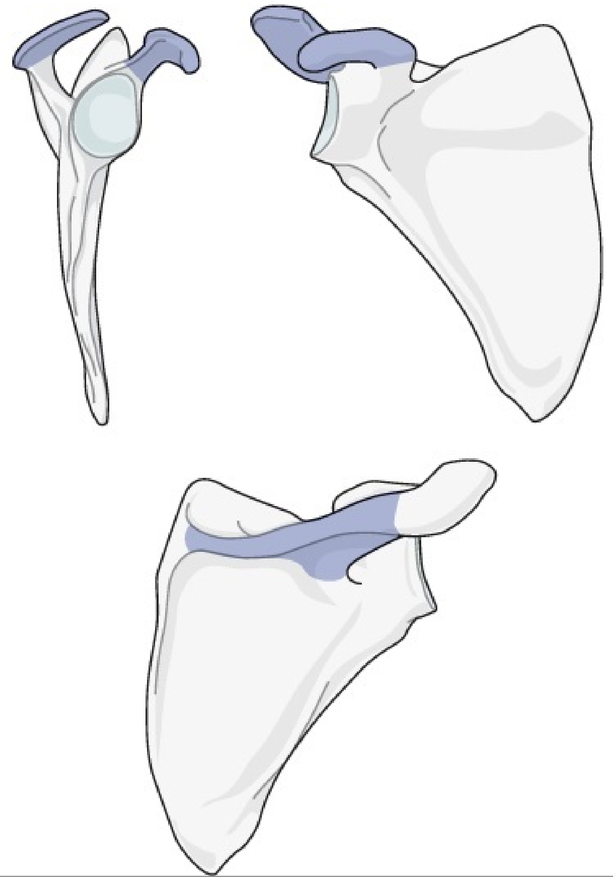


Scapula Journal of Orthopaedic Trauma32:, January 2018. S101-S104

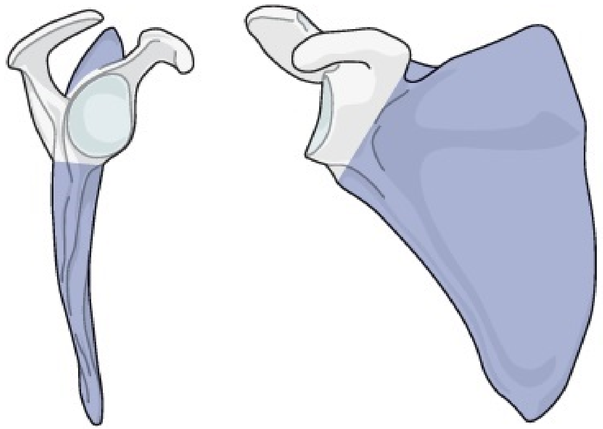
Scapular Classification

Locations:

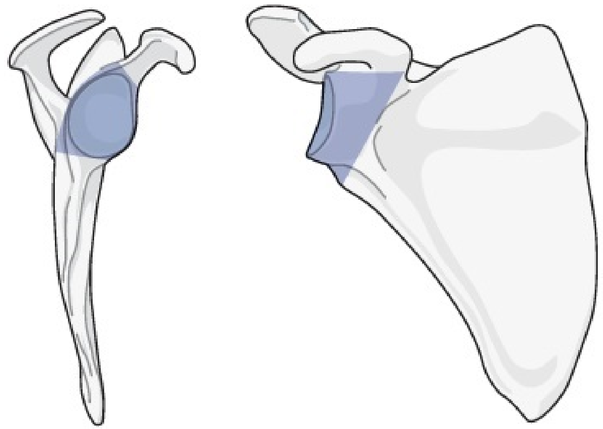
Scapula, **process**
14A



Scapula, **body**
14B*



Scapula, **glenoid fossa**
14F*



* Qualifications for process fractures:
- x Coracoid P1
- y Acromion P2
- z Both processes P3

(These qualifications may be added to any fracture coded as type B or type F)

JOURNAL OF ORTHOPAEDIC TRAUMA

Scapula Journal of Orthopaedic Trauma32:, January 2018. S101-S104

Treatment Options

- Non-operative
  - Vast majority
- Operative
  - Specific indications

Non-op Treatment

- Most patients (>80%)
- Surrounding soft tissue provides splinting and prevents additional displacement
- Symptomatic treatment
- Early AAROM
- Close radiographic followup needed
- Most healing or healed by 6-8 weeks.

Operative Treatment

- Percutaneous
- Anterior ORIF
- Posterior ORIF
- MIPO

Indications

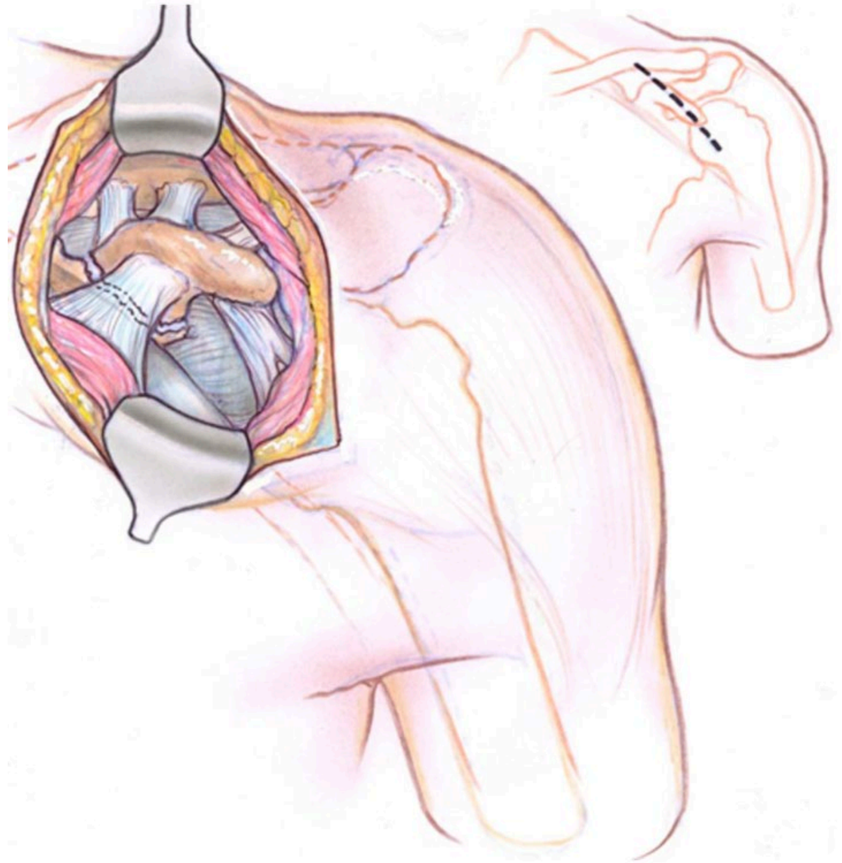
- Operative
  - Displaced injuries:
    - Displaced intra-articular gelnoid fractures involving >25% of the articular surface
    - Displaced Scapular Neck fractures
    - Scapular Process fractures:
      - Non-union or Concomitant operative scapular fracture
      - Symptomatic impingement or positioning
    - Comminuted Scapular spine fractures
    - Coracoid Fractures with > 1cm of displacement
    - Glenopolar Angle ≤ 22 degrees

Approaches

- Isolated Process
    - Coracoid - Superior Deltopectoral Approach
    - Acromial - Direct Spine Approach
- Isolated Fossa / Glenoid
    - Deltopectoral variant or Posterior Approach
- Combined or Body:
    - Judet and Variants

Coracoid Approaches

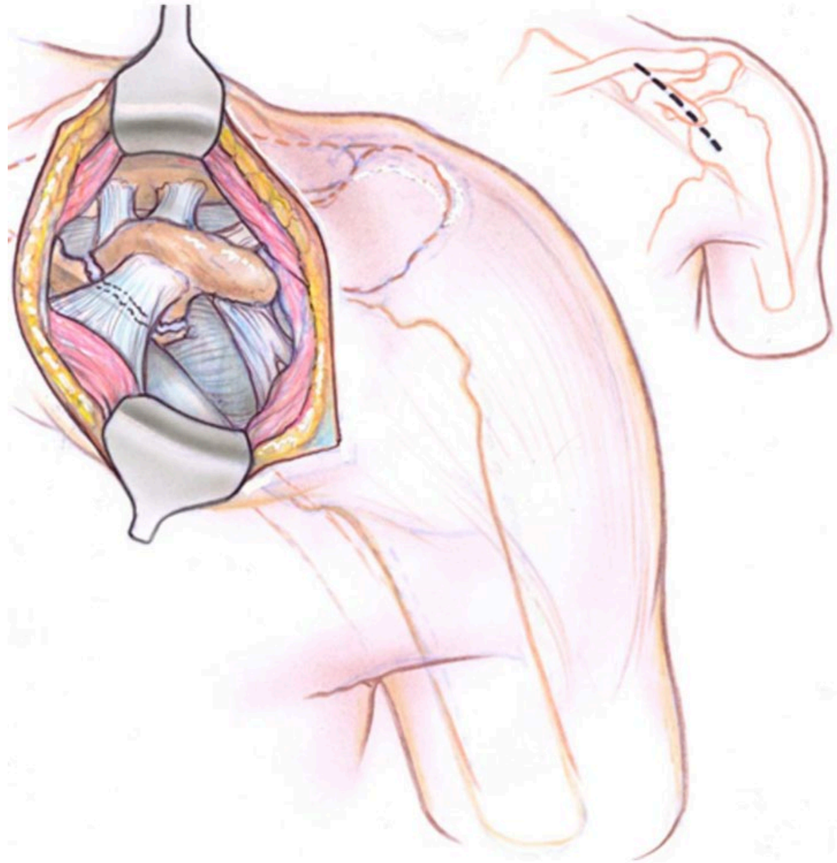
- Superior extension of the Deltopectoral approach
    - 4-5cm in length
    - Incision up to border of clavicle for full exposure and trajectory for fixation
- Isolation of Cephalic Vein and enter Mohrenheim's triangle
- Base of coracoid/glenoid involvement can be seen with Rotator Interval Split



Hill, B., Jacobson, A., Anavian, J., Cole, P. (2014). **Surgical Management of Coracoid Fractures** Journal of Orthopaedic Trauma 28(5), e114-e122. https://dx.doi.org/10.1097/01.bot.0000435632.71393.bb

Coracoid Approaches

- Operative Indications:
  - > 1cm displaced
  - Painful non-unions
  - Those associated with disruption of the SSSC



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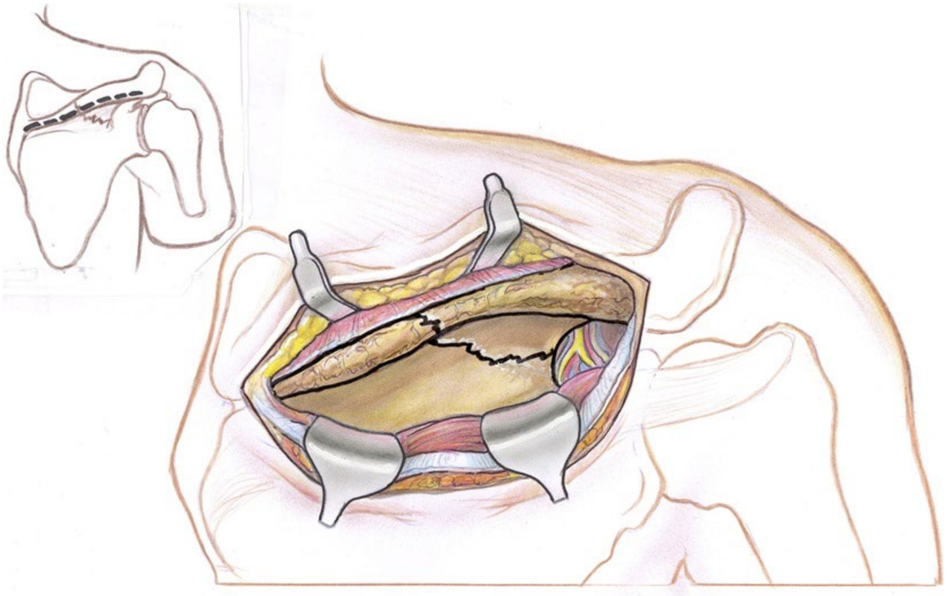
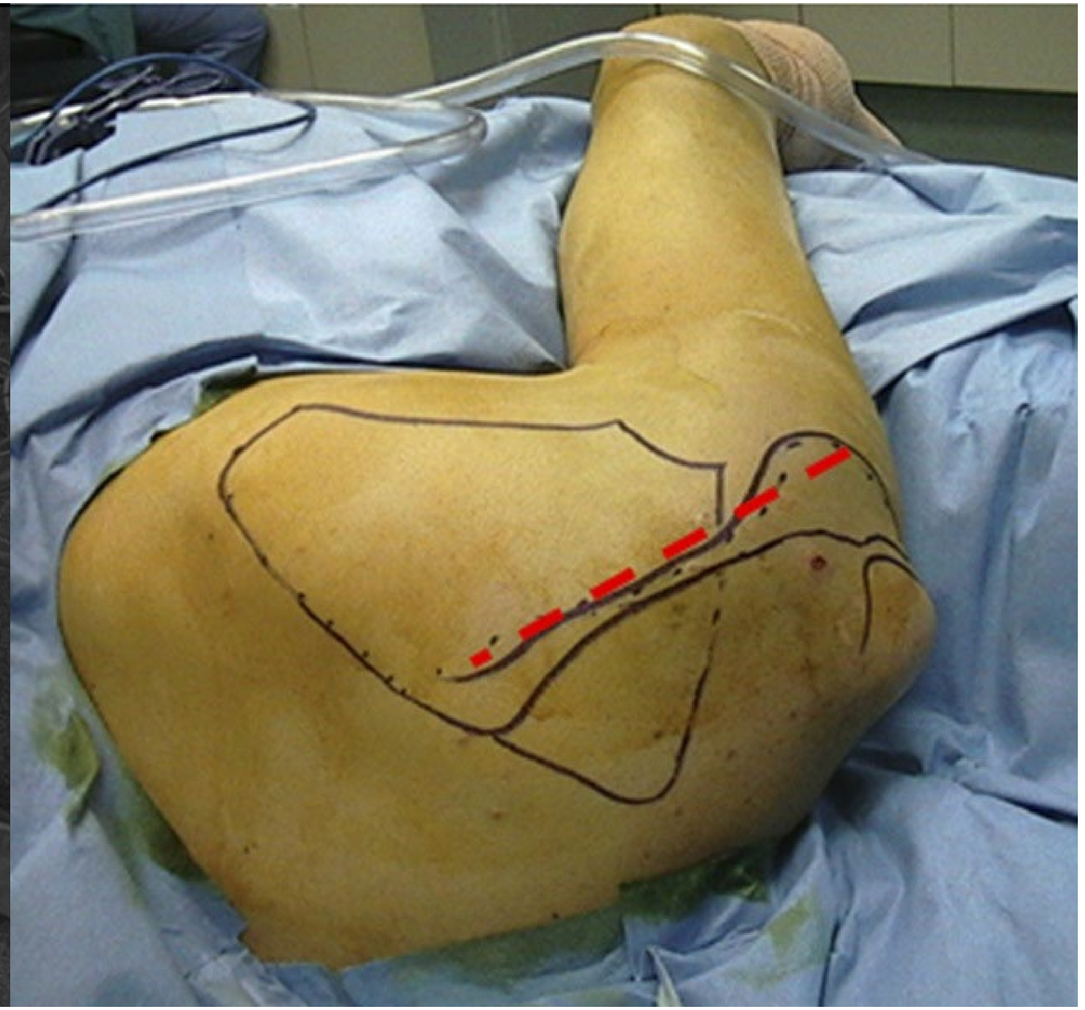
Acromial Approaches

- Incision along acromial spine angled towards anterior tip of the acromion
- Elevate & Reflect deltoid off the acromion to expose fracture as required
- Stout repair of Deltoid, Infraspinatous at end of case



Acromial Approaches

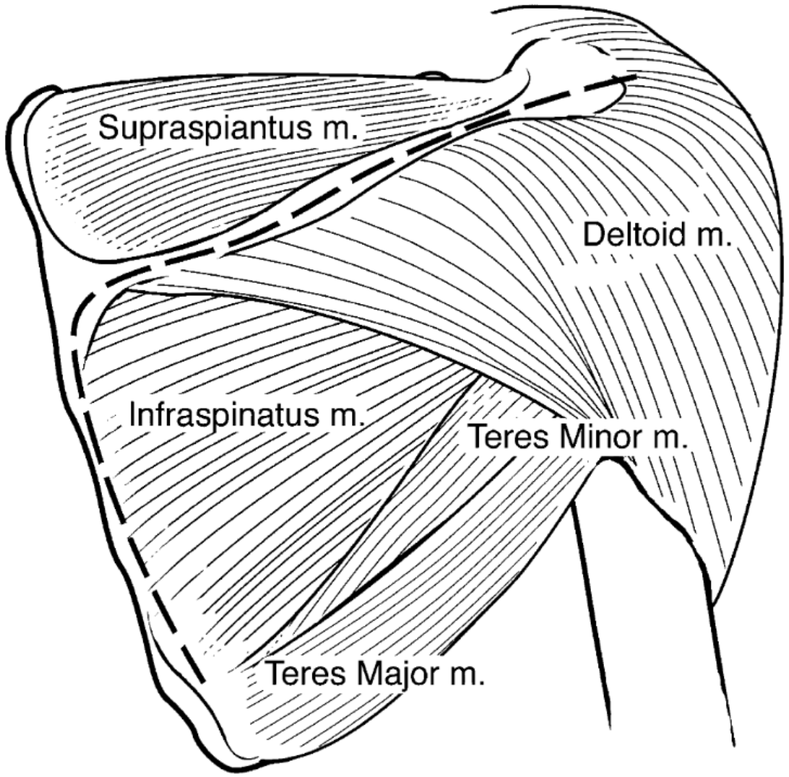
Nork SE, Barei DP, Gardner MJ, Schildhauer TA, Mayo KA, Benirschke SK. Surgical exposure and fixation of displaced type IV, V, and VI glenoid fractures.J Orthop Trauma. 2008 Aug;22(7):487-93.



Hill BW, Anavian J, Jacobson AR, Cole PA. Surgical management of isolated acromion fractures: technical tricks and clinical experience. J Orthop Trauma. 2014 May;28(5):e107-13. doi: 10.1097/BOT.0000000000000040. PMID: 24270357

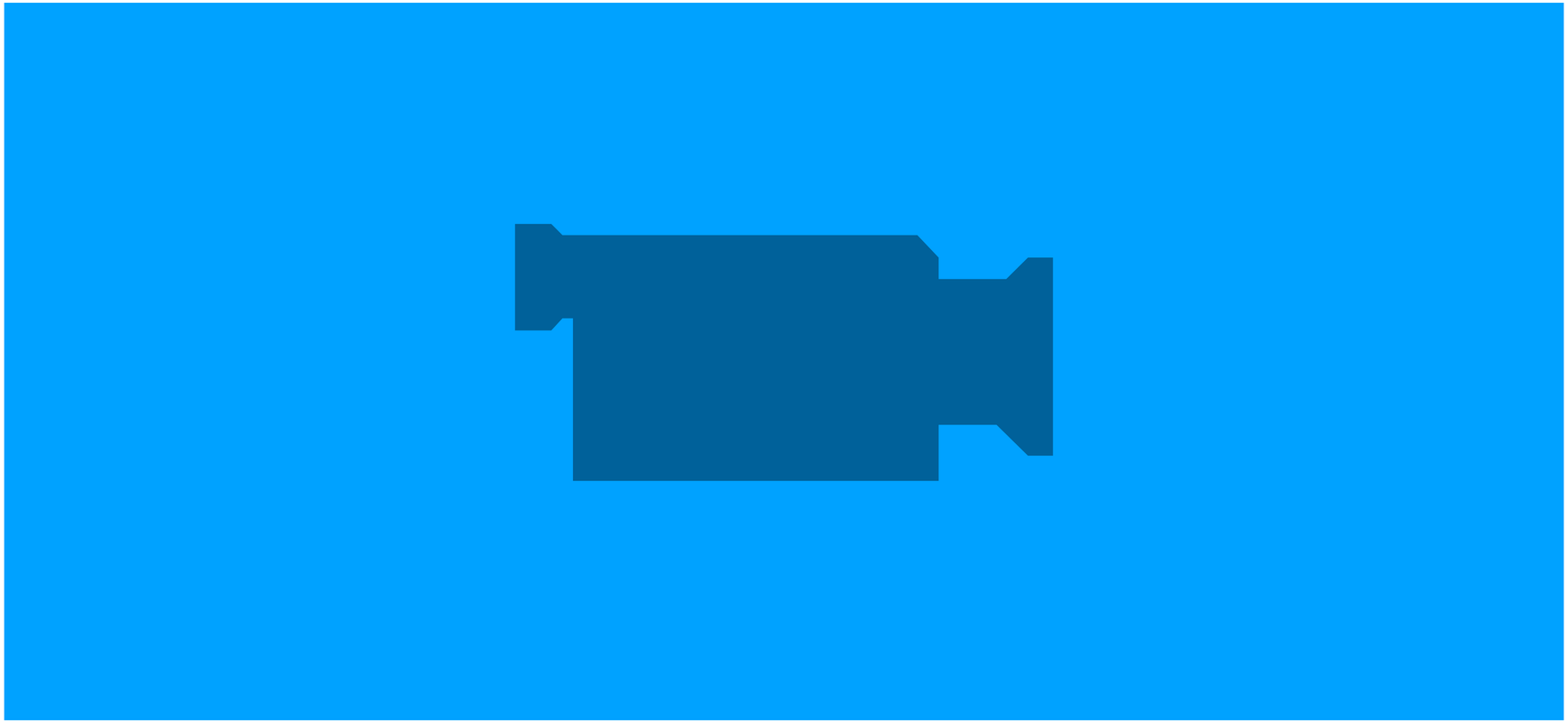
Judet Approach

- Traditional Judet Incision
- Modified Judet Incision

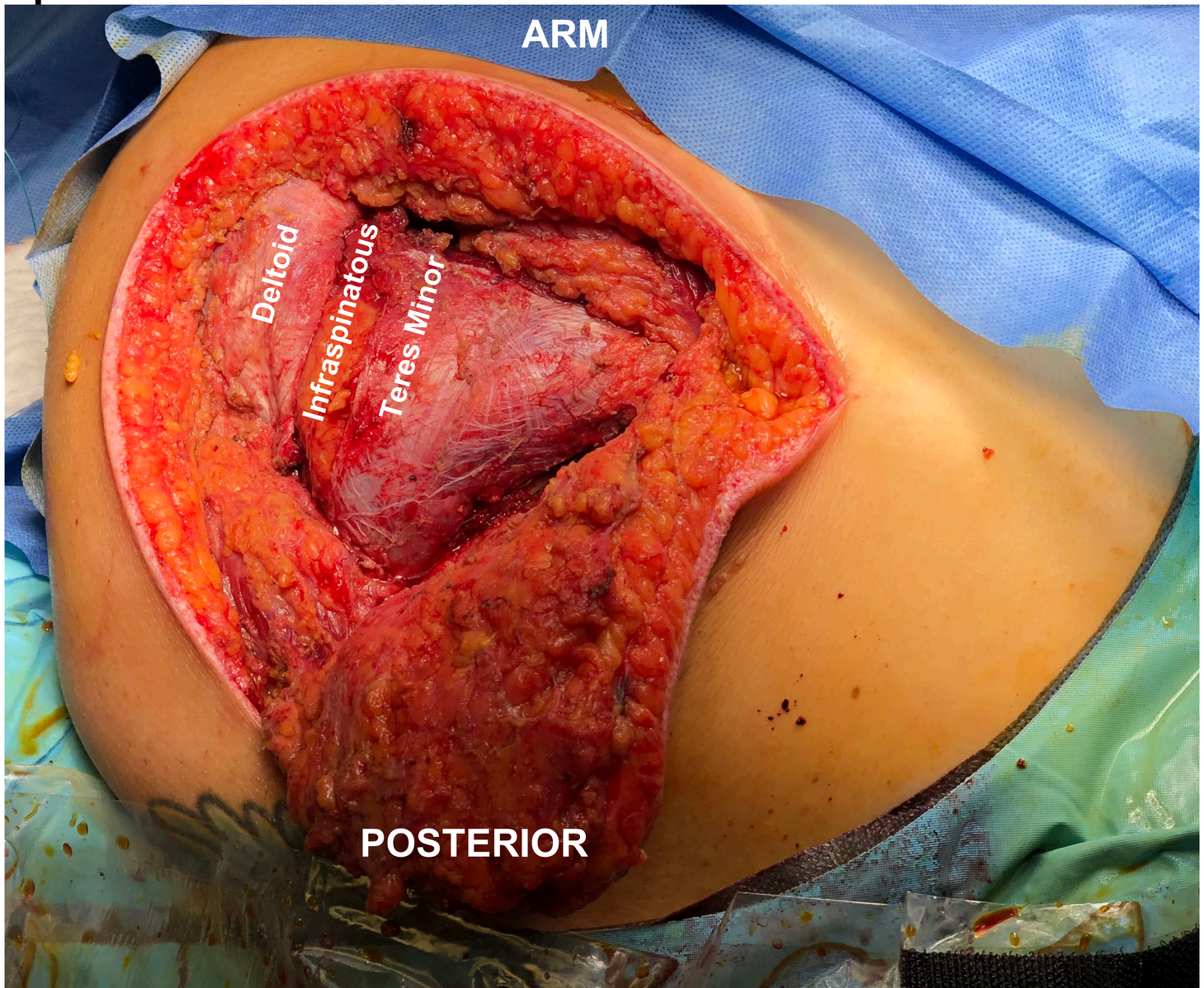


Obremskey, W., Lyman, J. (2004). **A Modified Judet Approach to the Scapula** Journal of Orthopaedic Trauma 18(10), 696-699. https://dx.doi.org/10.1097/00005131-200411000-00007

Judet Approach

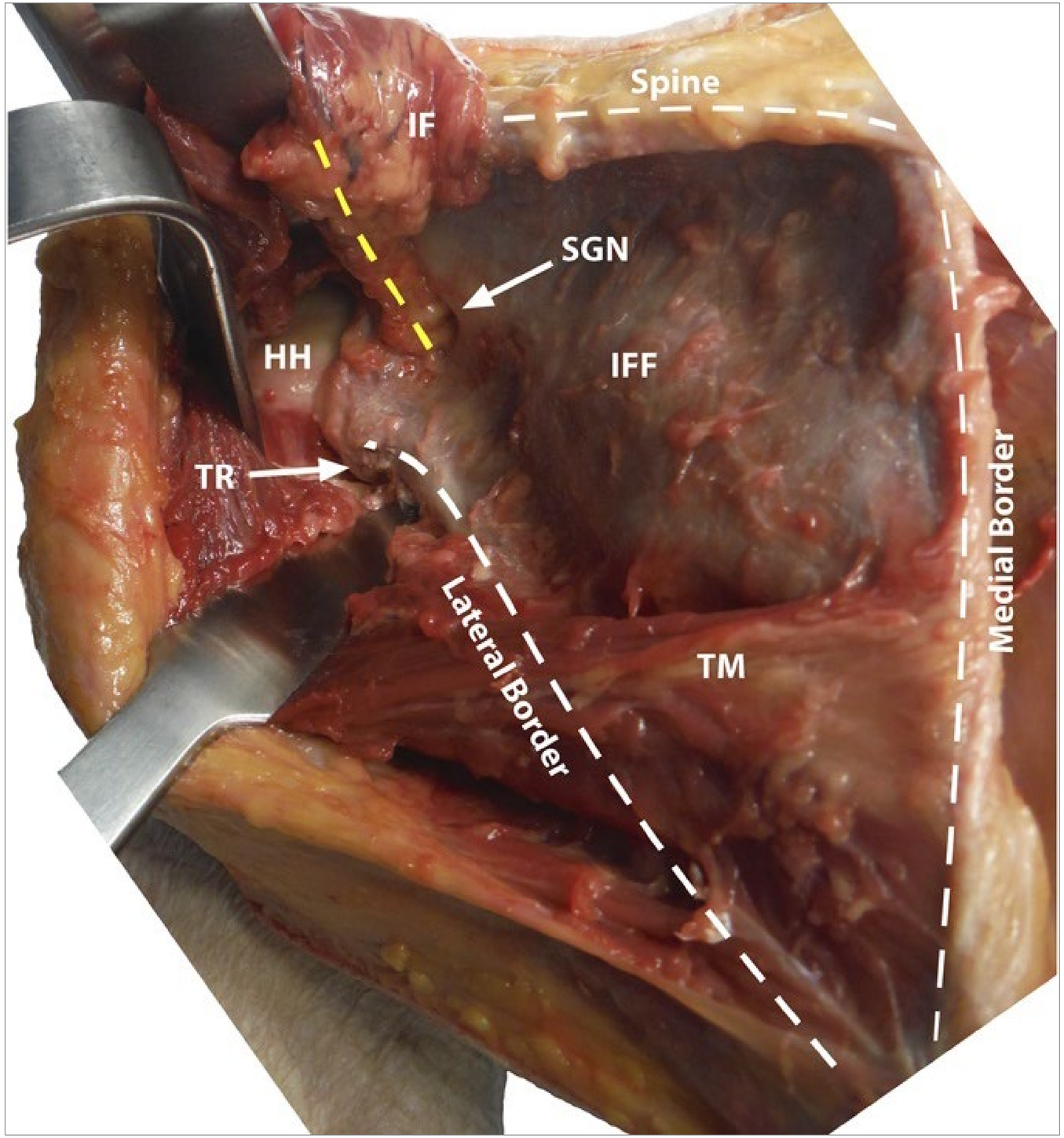


Judet Approach



HEAD

FEET

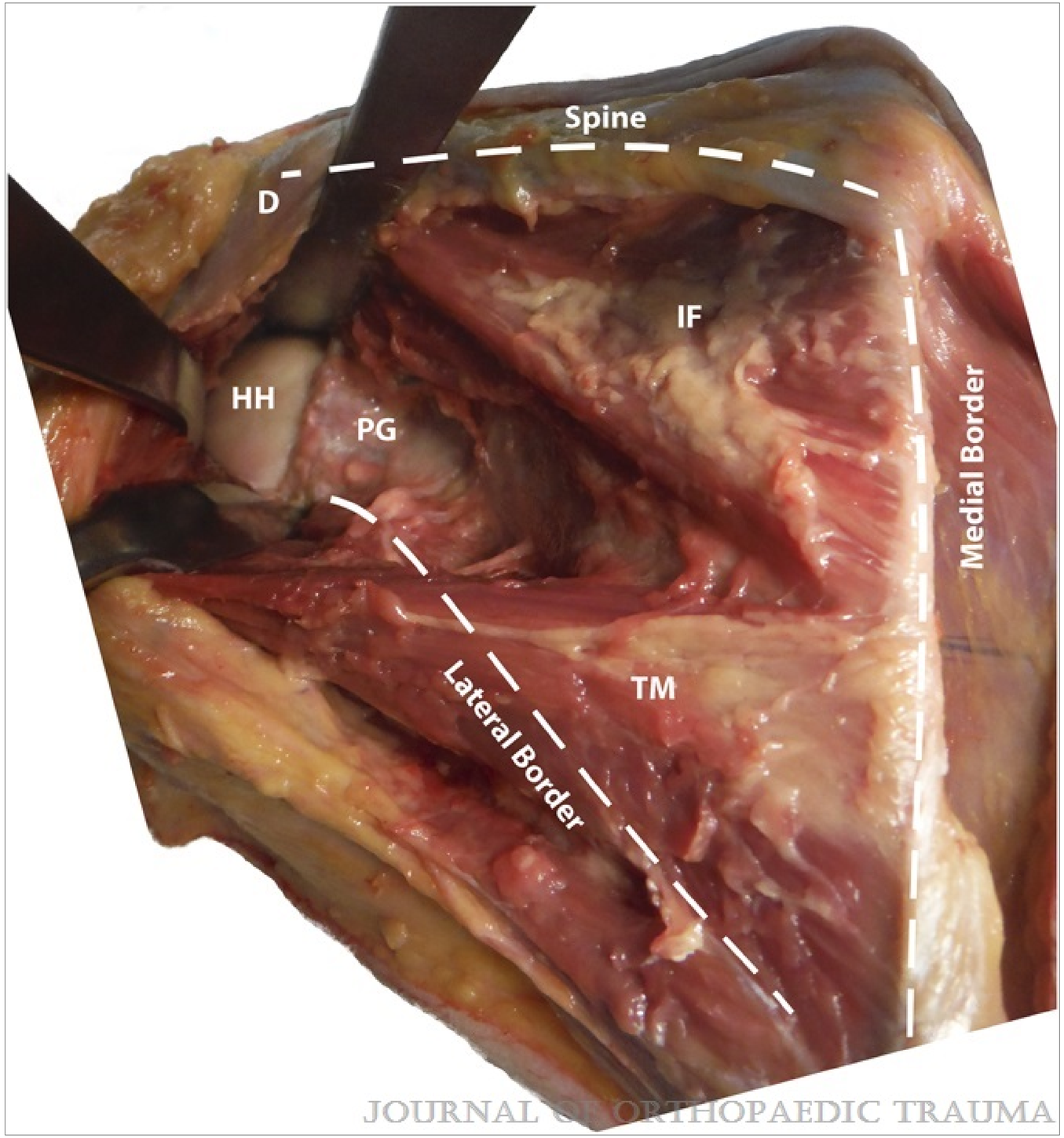


Classic Judet

- Scapular fossa musculature is **completely** lifted
- Wide exposure

- HH - Humeral Head
- IF - Infraspinatous
- TM - Teres Minor
- TR - Triceps
- SGN - Spinoglenoid fossa

Harmer LS, Phelps KD, Crickard CV, Sample KM, Andrews EB, Hamid N, Hsu JR. A Comparison of Exposure Between the Classic and Modified Judet Approaches to the Scapula. J Orthop Trauma. 2016 May;30(5):235-9.



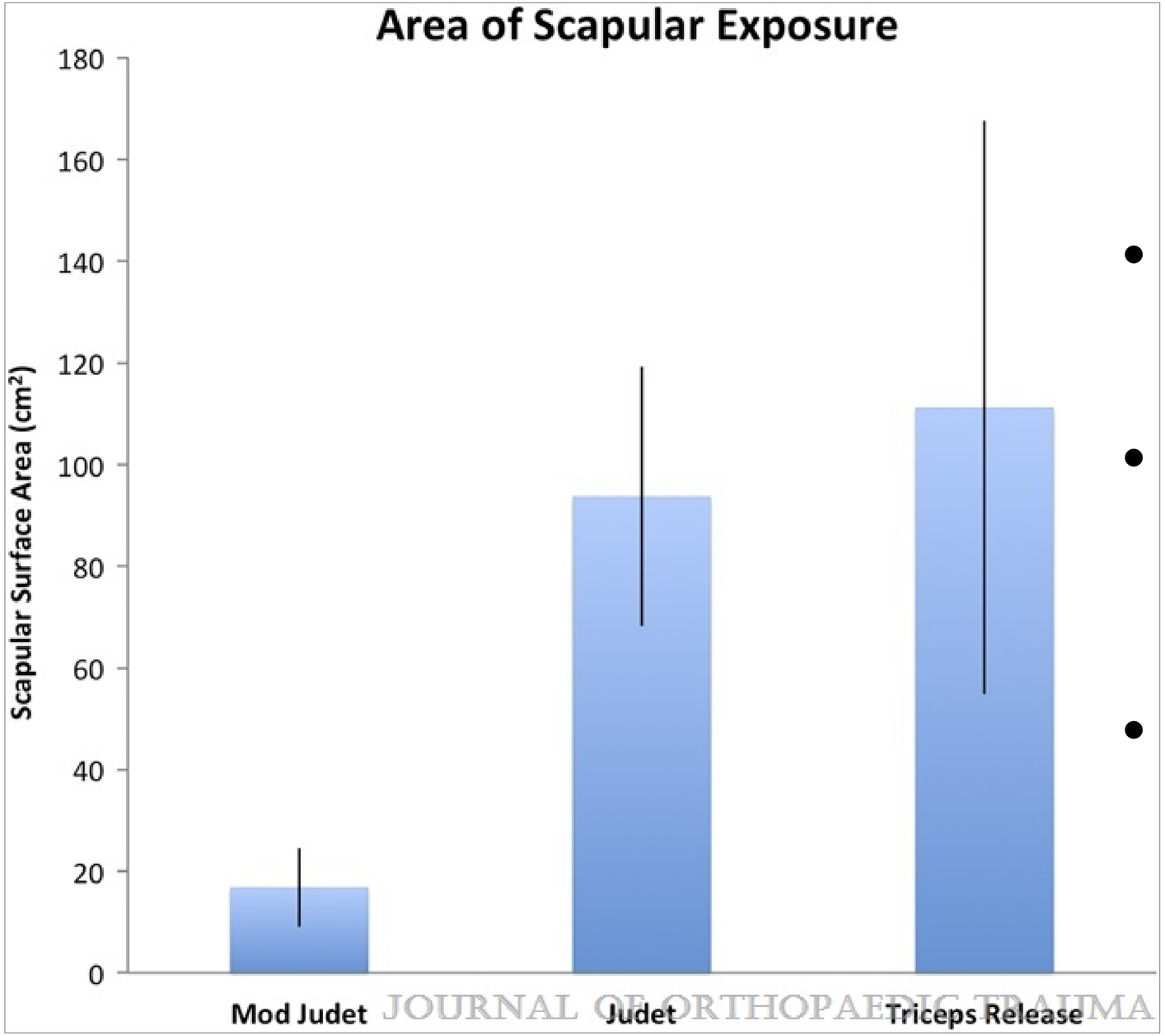
Modified Judet

- Infraspinatous **not** lifted
- Interval between IF & TM

- HH - Humeral Head
- IF - Infraspinatous
- TM - Teres Minor
- TR - Triceps
- SGN - Spinoglenoid fossa

Harmer LS, Phelps KD, Crickard CV, Sample KM, Andrews EB, Hamid N, Hsu JR. A Comparison of Exposure Between the Classic and Modified Judet Approaches to the Scapula. J Orthop Trauma. 2016 May;30(5):235-9.

Modified Judet



- Comparison of Scapular exposures
- Many fracture patterns may not require complete exposure for accurate reduction
- Modified Judet sufficient for MIPO or fractures patterns that can be indirectly reduced

Harmer LS, Phelps KD, Crickard CV, Sample KM, Andrews EB, Hamid N, Hsu JR. A Comparison of Exposure Between the Classic and Modified Judet Approaches to the Scapula. J Orthop Trauma. 2016 May;30(5):235-9.

Visibility

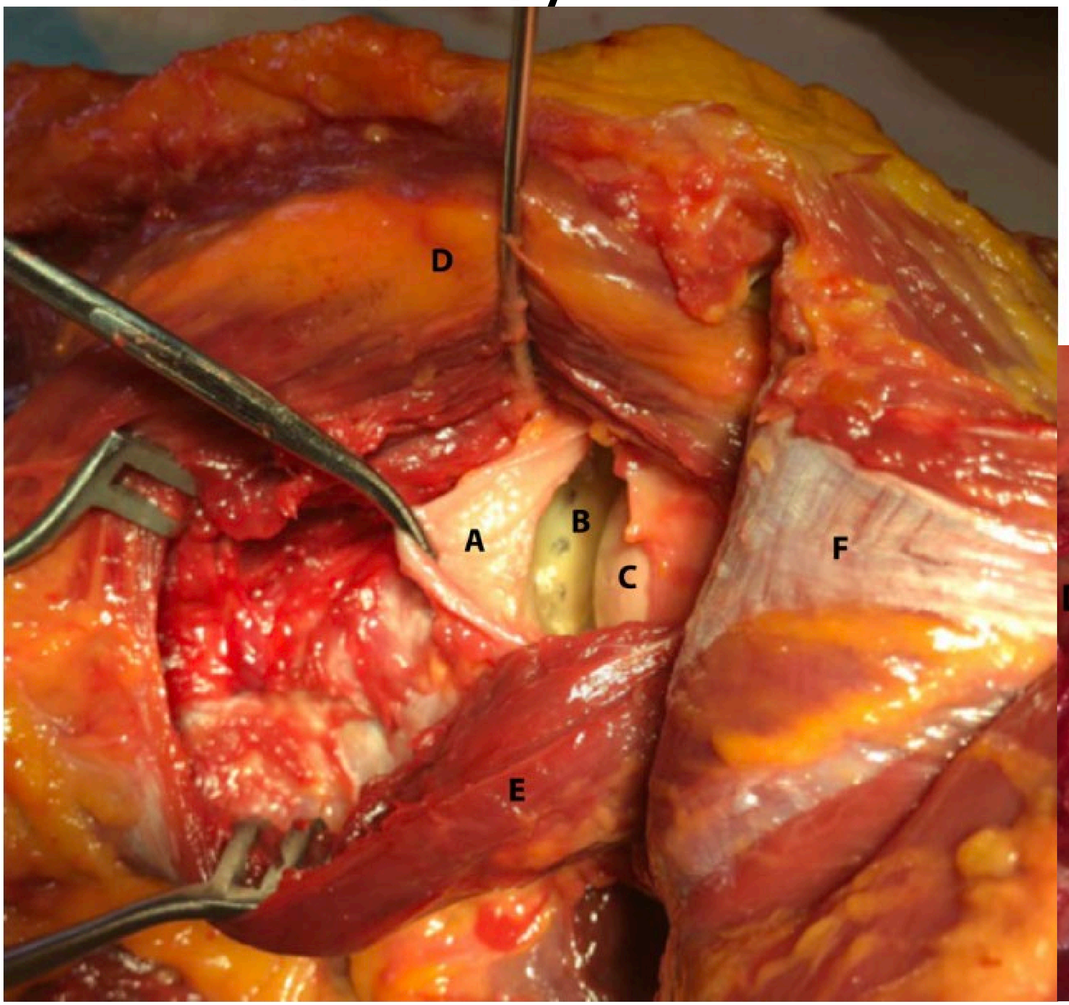
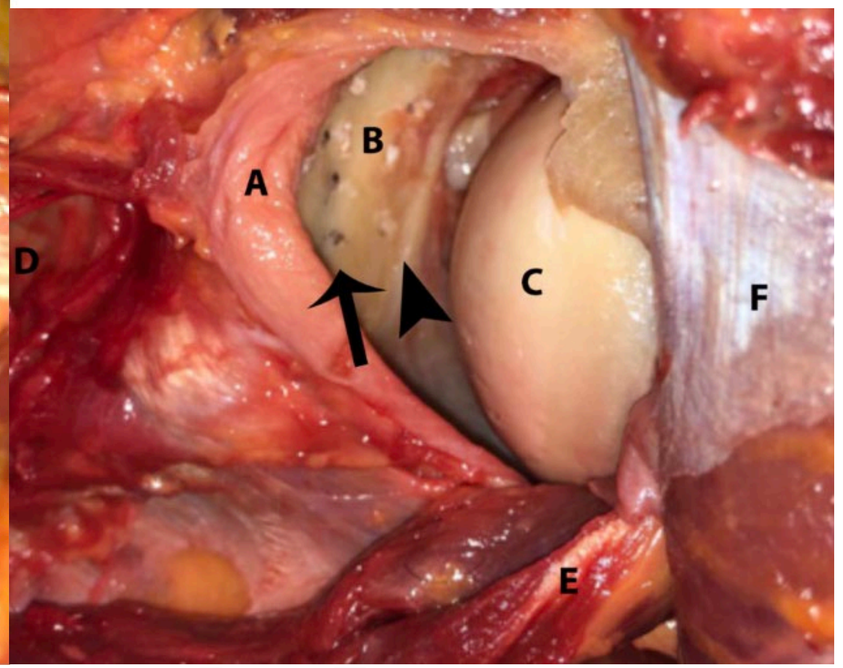


FIGURE 1. Pre-tenotomy exposure showing glenoid exposure. A, Capsule; (B) glenoid; (C) humeral head; (D) infraspinatus; (E) teres minor; (F) deltoid. **Editor's Note**: A color image accompanies the online version of this article.

- Additional exposure may be gained with Tenotomy of the Infraspinatous
- Described by Garlich et al. 2020

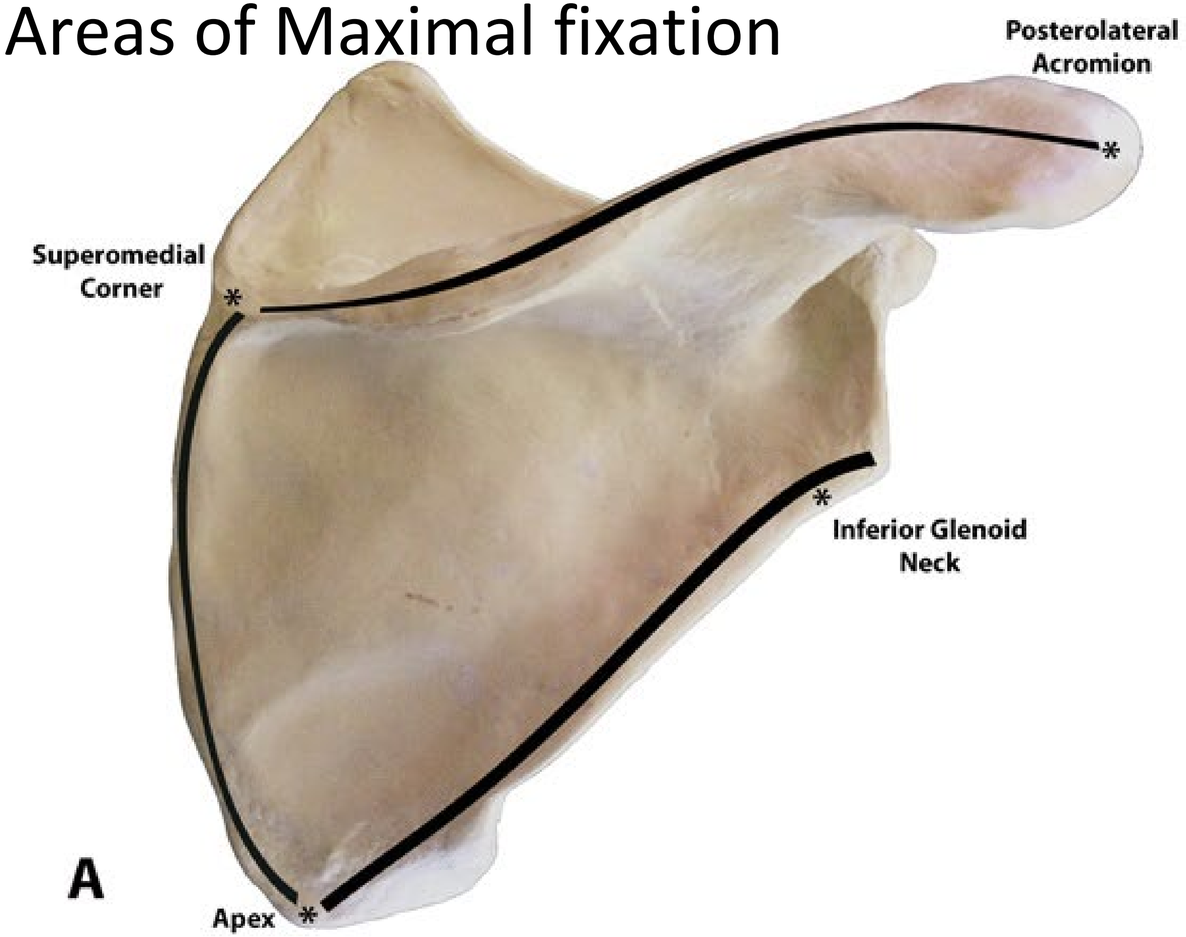


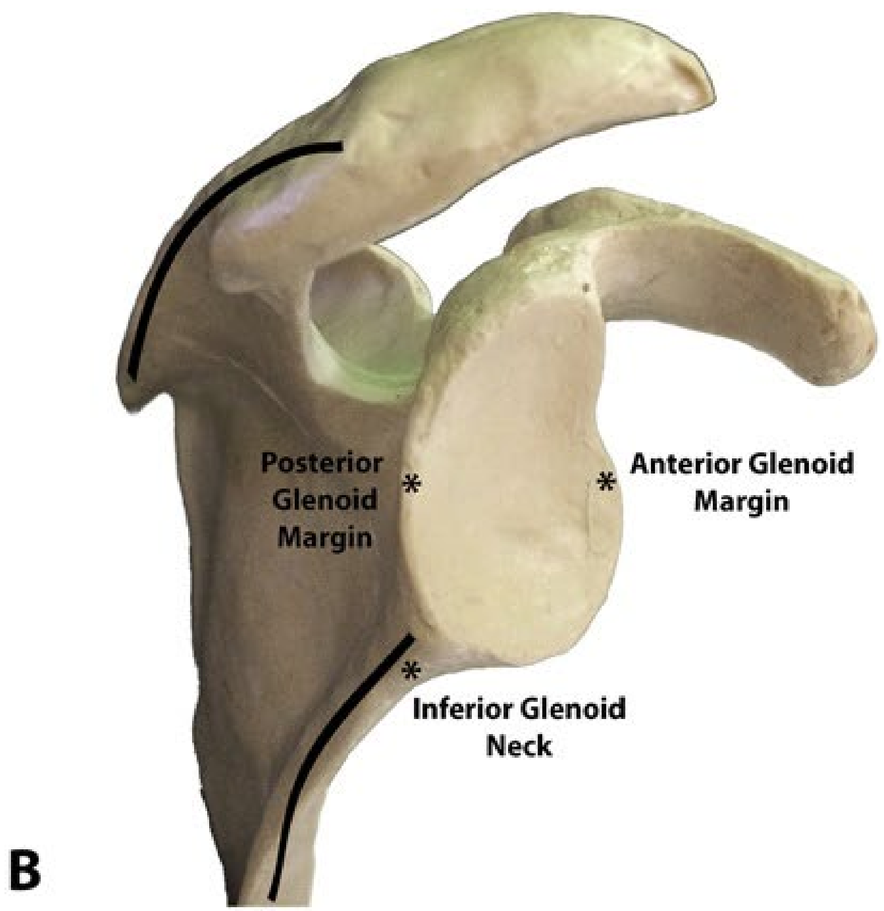
Post-Tenotomy

Garlich JM, Samuel K, Nelson TJ, Monfiston C, Kremen T, Metzger MF, Little MTM. Infraspinatus Tenotomy Improves Glenoid Visualization With the Modified Judet Approach. J Orthop Trauma. 2020 Mar;34(3):158-162

Fixation

- Areas of Maximal fixation





Harmer LS, Phelps KD, Crickard CV, Sample KM, Andrews EB, Hamid N, Hsu JR. A Comparison of Exposure Between the Classic and Modified Judet Approaches to the Scapula. J Orthop Trauma. 2016 May;30(5):235-9. doi: 10.1097/BOT.0000000000000486. PMID: 26562583.

Final product

- Incision typically heals well
- Robust blood supply

Outcomes

- Literature is limited but growing:
  - Goss 1995
  - Zlowodzki 2006
  - Lantry 2007
  - Herrera 2009
  - Tatora 2018

Outcomes

- Zlowodzki et al 2006
  - Systemic Review of 520 Fractures
    - Good / excellent results with operative treatment of Glenoid fractures (82%)
    - Most (86%) scapular body fractures non-op with Good / Excellent results
    - Most (77%) glenoid neck fractures non-op with Good / Excellent results

Outcomes

- Tatora et al. 2018:
  - Retrospective ORIF Cohort of 66 pts mean of 7 year
  - Minimal residual pain scores
  - Majority > 90% returned to work
  - Small but noted shoulder stiffness compared to uninjured side

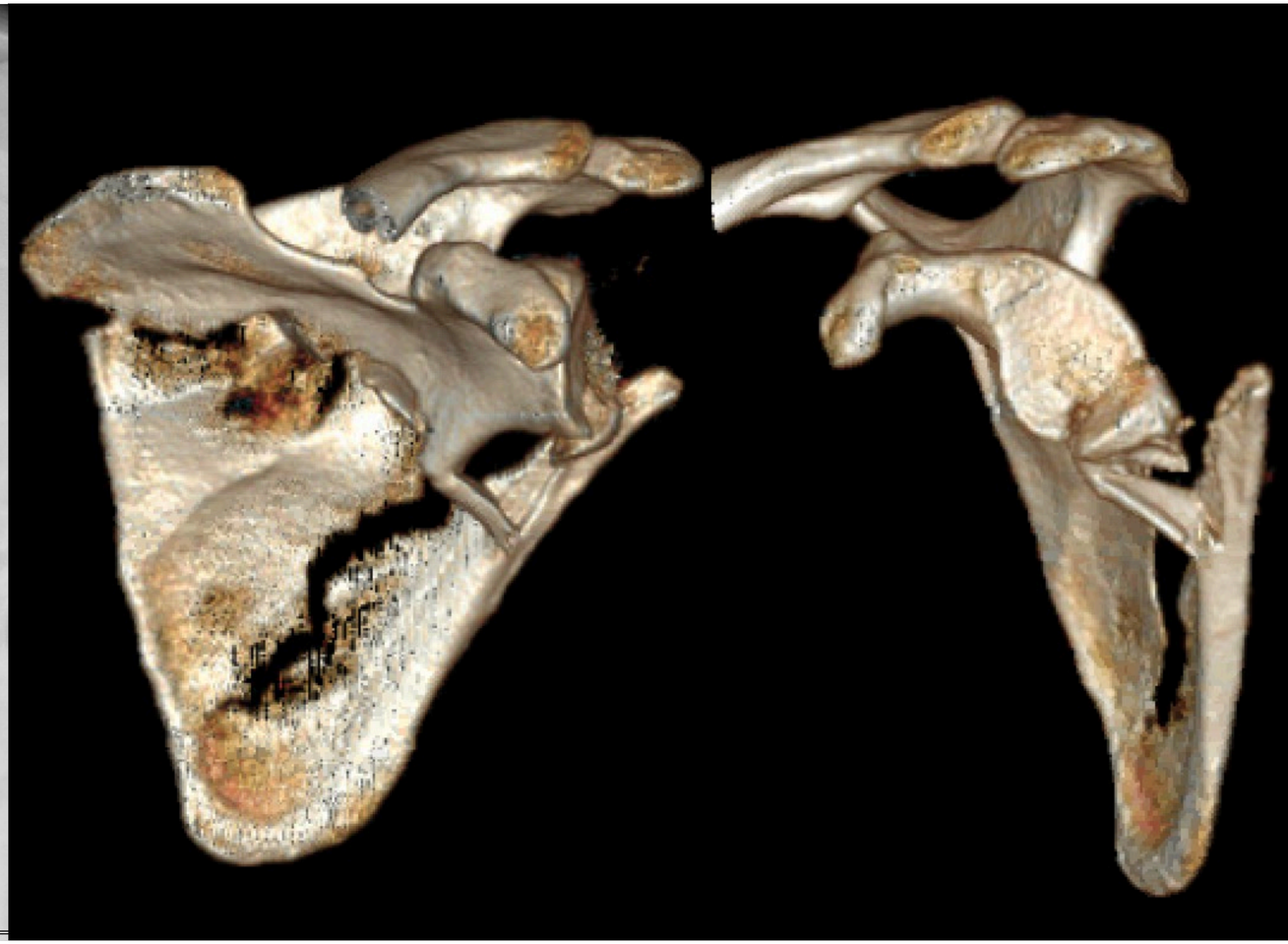
Complications

- Nerve injury (Traction on Supraspinous)
- Mechanical Failure
- Infection
- Shoulder Stiffness
- Hematoma

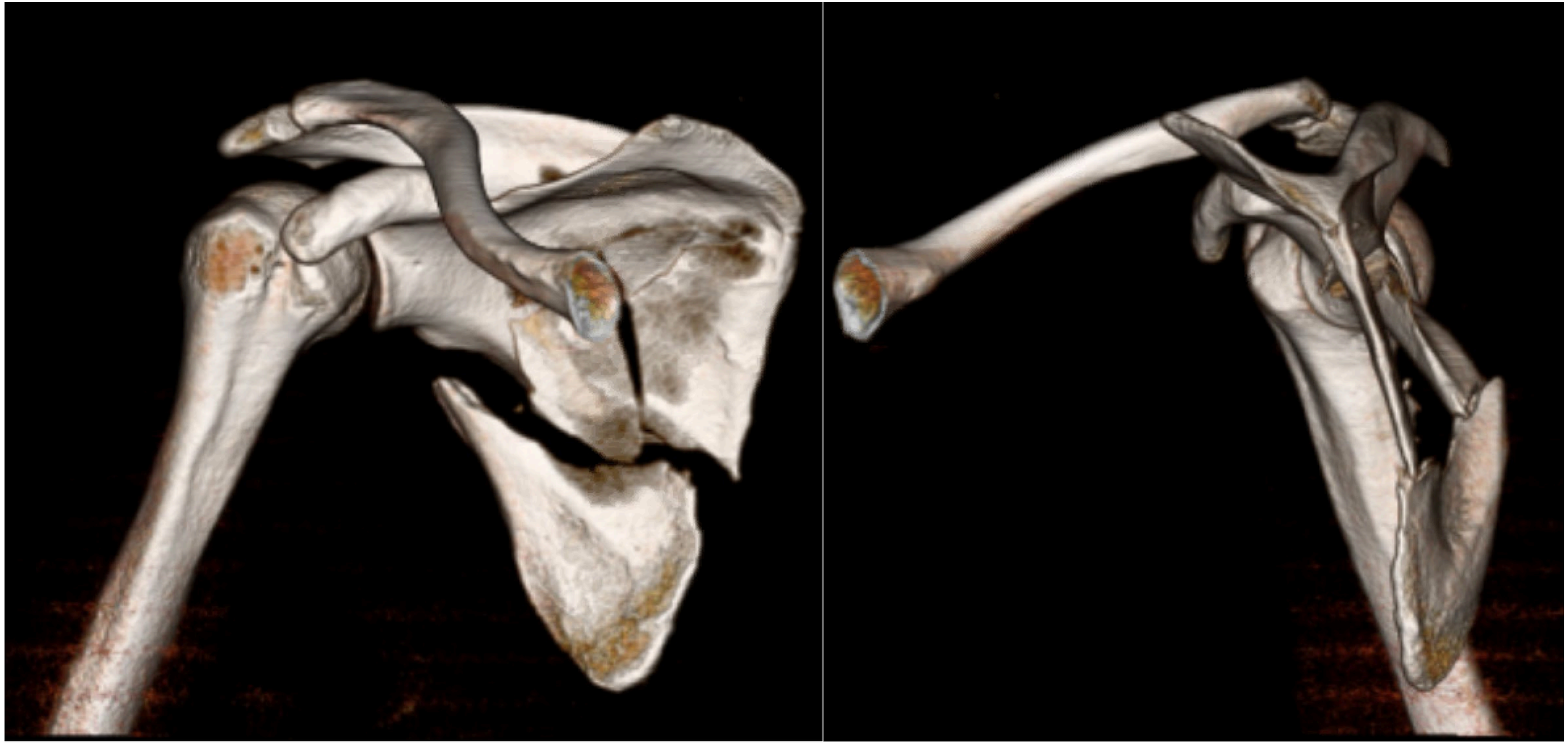
Case 1

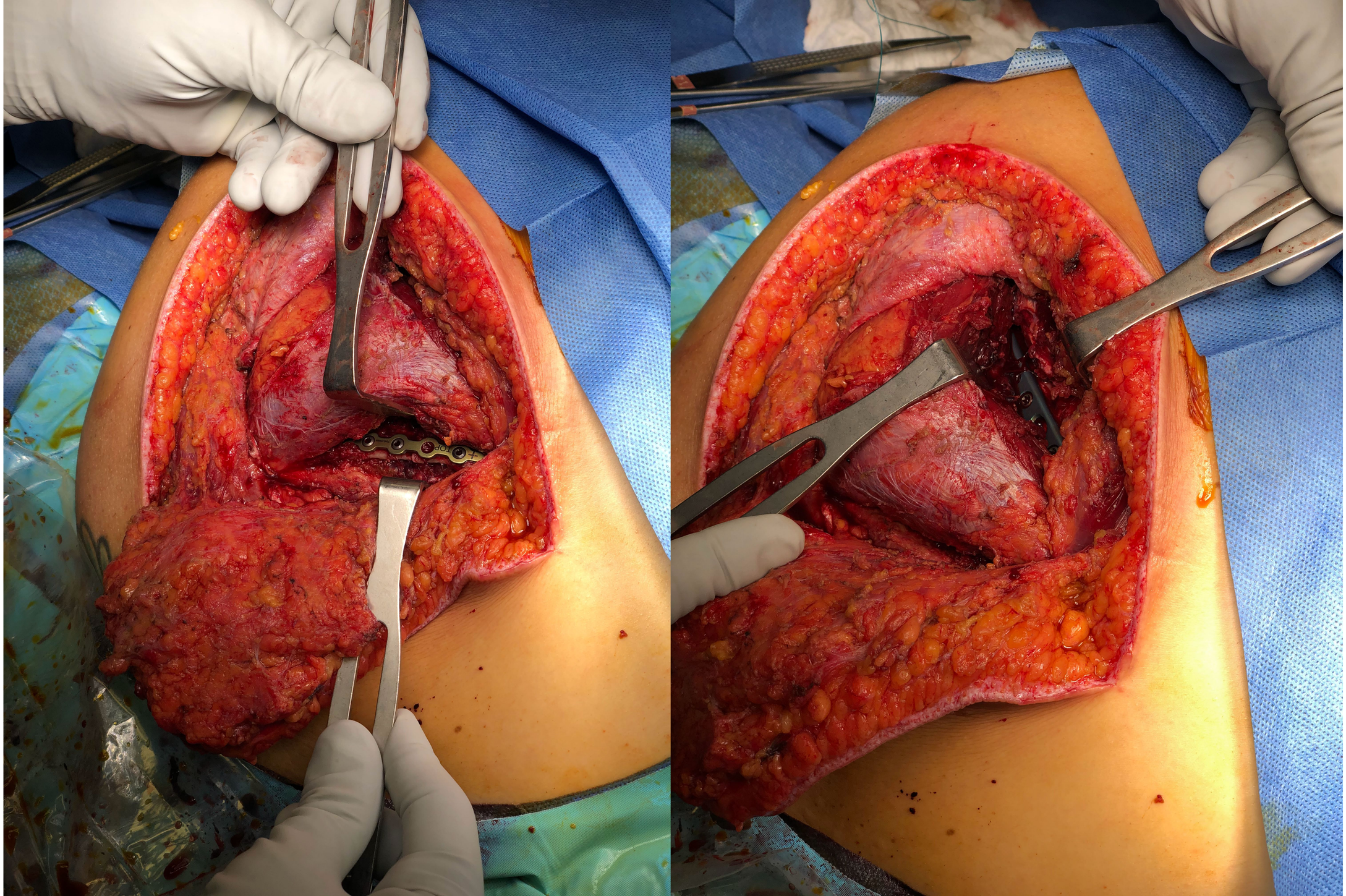
- 45 yo Male MC accident
- Bilateral Shoulder injuries
- Obese

Case



Case

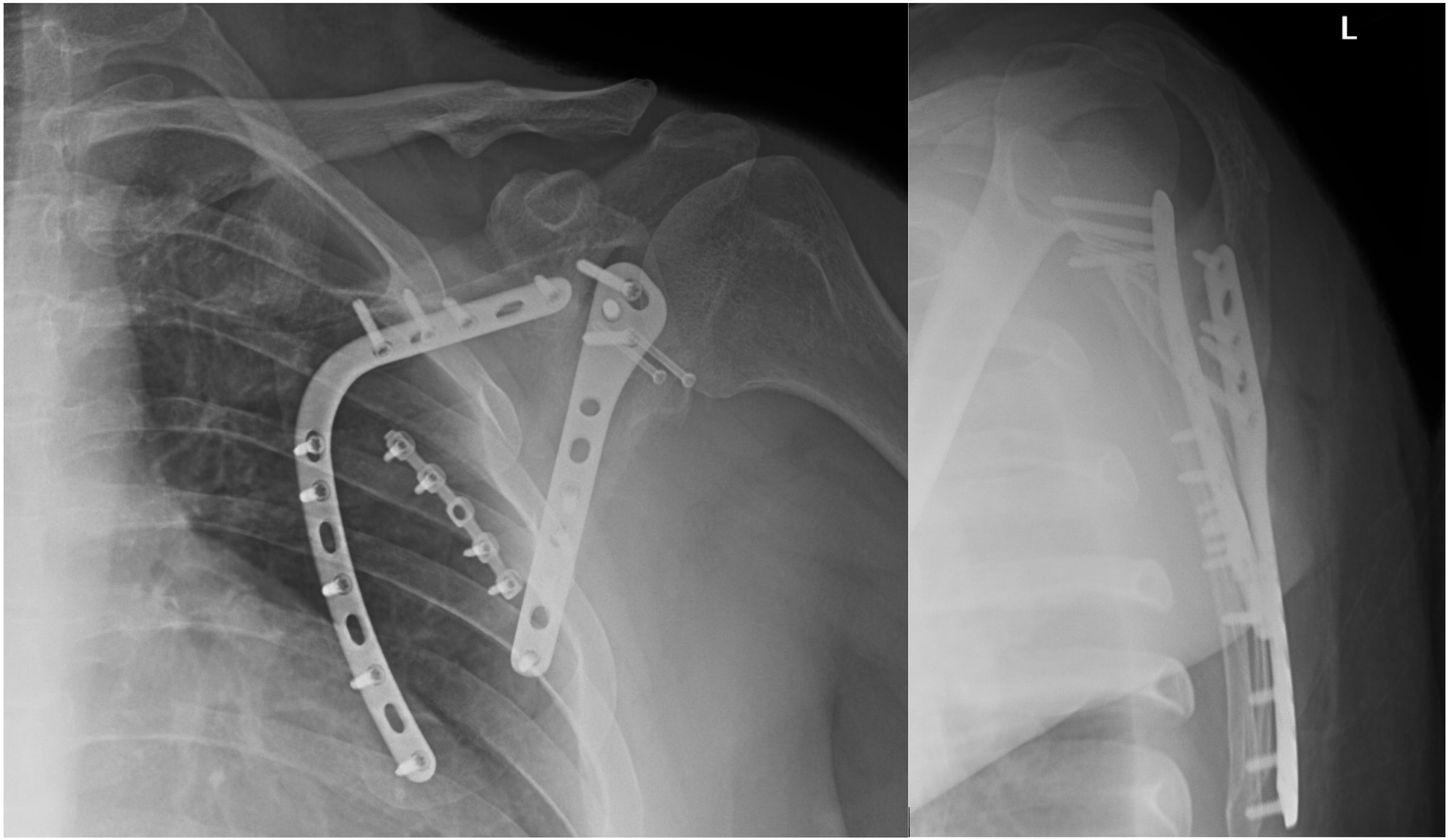




Case

- Bilateral ORIF
- Prone Positioning

Case

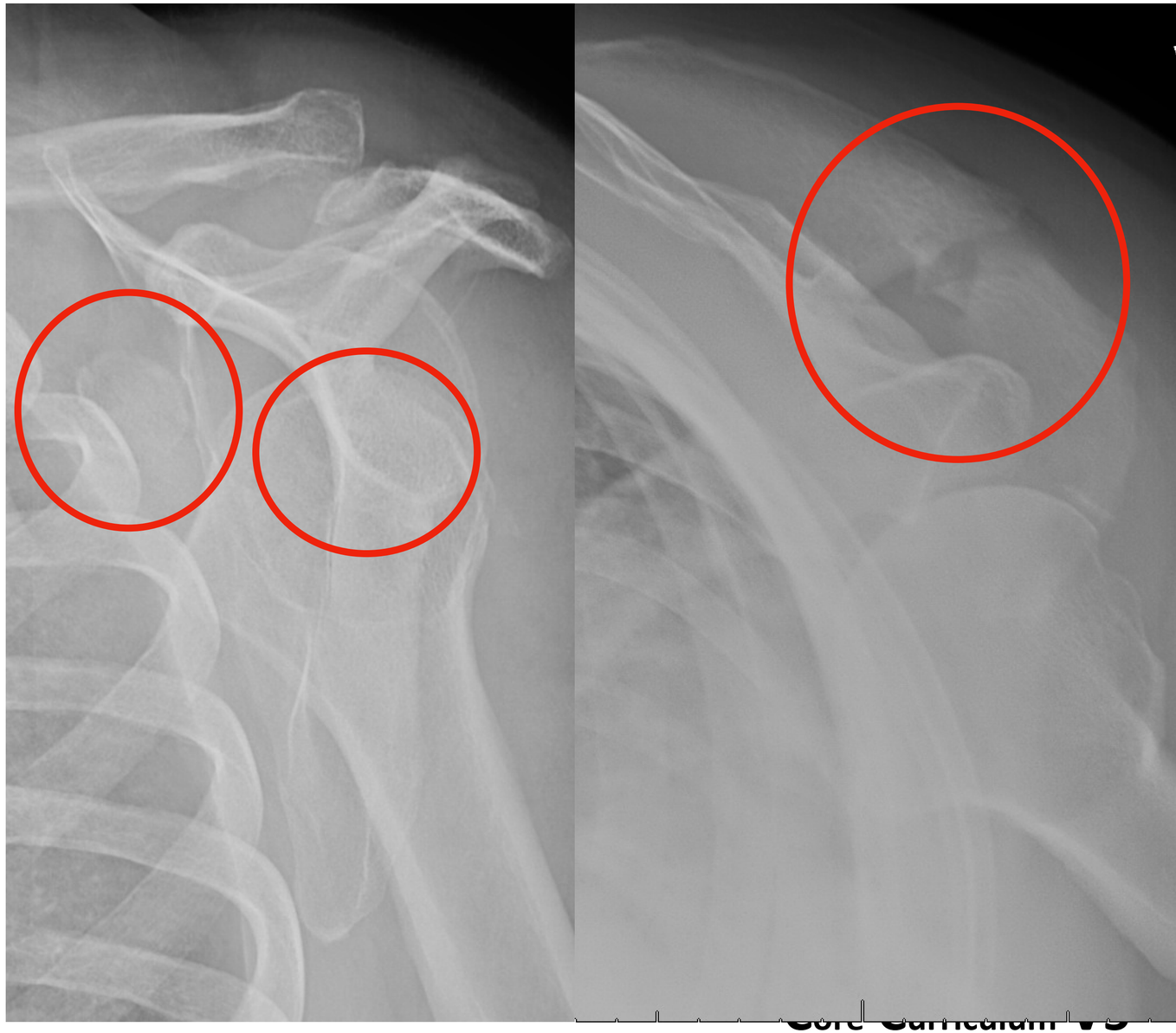


Case 2

- 65yo M
- LHD - Fall from ladder
- Reduction in ED with multiple re-dislocations
- PmHx:
  - DM
  - EtOH
- Isolated injury

Case 2

- Fractures of:
  - Acromial
  - Coracoid
  - Anterior glenoid

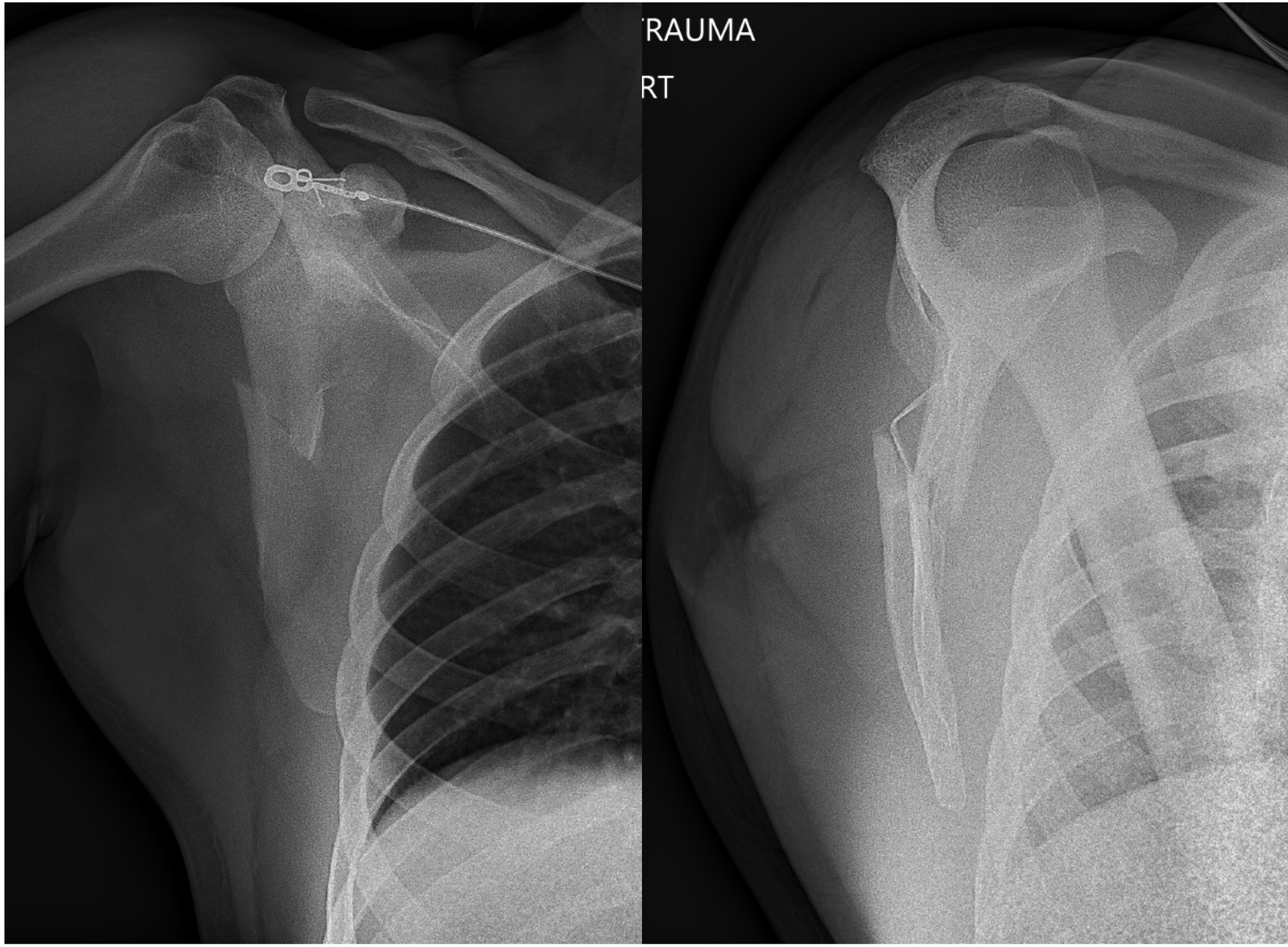


5 months post-op

- ORIF - Glenoid (Eden Hybinette), Acromion & Subscap repair using a modified Sabre incision extending deltopectoral interval over the acromion and scapular spine

Case 3

- 38 yo M RHD MC Accident
- Isolated injury
- **Elected non-operative**
  - Displacement
  - Glenopolar
  - Angulation

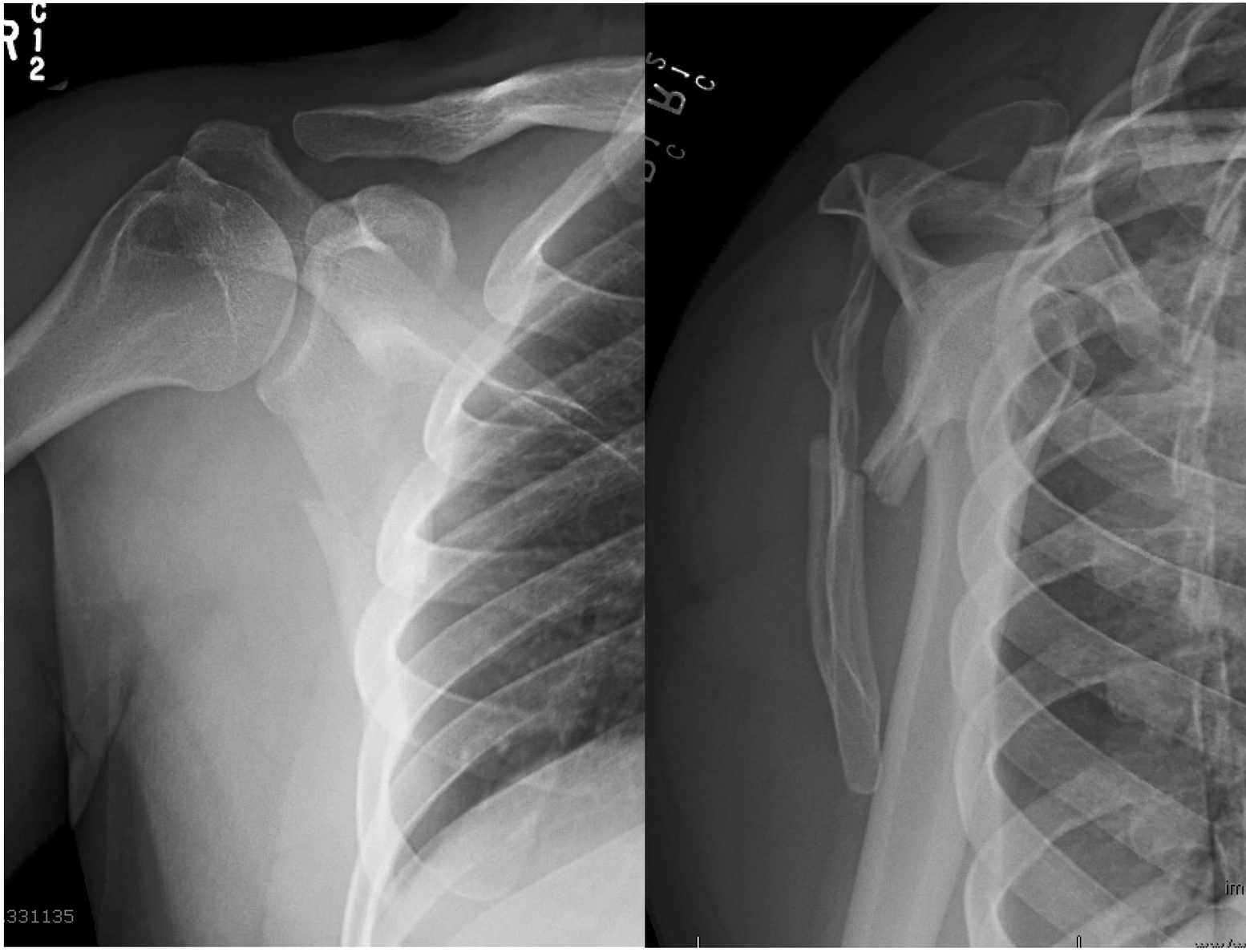


Case

- CT shows minimal Displacement but some lateralization

Case

- Returns at 4 weeks with increasing pain
- Repeat Imaging:
  - Worsening angulation
  - Minimal ongoing Lateralization



Case

Summary

- Rare, high-energy injuries
- Index of suspicion for scapulothoracic dissociation
- Largely non-operatively treated with good outcomes
- Indications continue to refine but current best include:
  - Intra-articular gap or step > 4mm & > 25% glenoid involvement
  - “Medialization” > 20mm
  - Angular Deformity > 45%
  - Glenopolar Angle ≤ 22deg
  - Double disruption SSSC with ≥ 10mm displacement

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