

GOOD EVENING...

OLDEST INJURED SCAPULA — 250 MILLION YEARS AGO OF A DINOSAUR — YANGCHUANOSAURUS HEPINGENSI



FIRST STUDY ON SCAPULA FRACTURE BY KARL AUGUST VOGT- 1799

FIRST DESCRIPTION OF “FLOATING SHOULDER”



Fig. 1 The oldest known illustration of a scapular fracture based on autopsy, published by Vogt in 1799, was associated with a fracture of the clavicle

“FLOATING SHOULDER” SSSC INJURIES & SCAPULAR FRACTURES

By
Dr. Daivik T Shetty
Senior Resident (MS.Ortho)
SIMS

- SUPERIOR SHOULDER SUSPENSORY COMPLEX INJURIES
- “FLOATING SHOULDER”
- SCAPULAR FRACTURES

FLOATING SHOULDER

What is it ?

- Still not well understood
- Unlike floating knee, elbow or hip
- Generally refers to fracture of scapula and clavicle



FLOATING SHOULDER

Who coined the term ?

- The term UNSTABLE SHOULDER given by **Ganz and Noesberger** in 1975
- *Defined it as “a fracture of the collum scapulae combined with a clavicular fracture, or acromioclavicular dislocation, and rupture of the coracoclavicular and coracoacromial ligaments.*

FLOATING SHOULDER

GANZ AND NOESBERGER

JBJS AUGUST 2001

THE FLOATING SHOULDER: A BIOMECHANICAL BASIS FOR CLASSIFICATION AND MANAGEMENT

TABLE I Fractures or Equivalent Ligamentous Injuries Necessary to Produce Floating Shoulder

Fracture	Ligamentous Injury
Coracoid base	Coracoclavicular and coracoacromial
Clavicular shaft	Coracoclavicular and acromioclavicular capsular
Scapular spine (or acromion)	Coracoacromial and acromioclavicular capsular

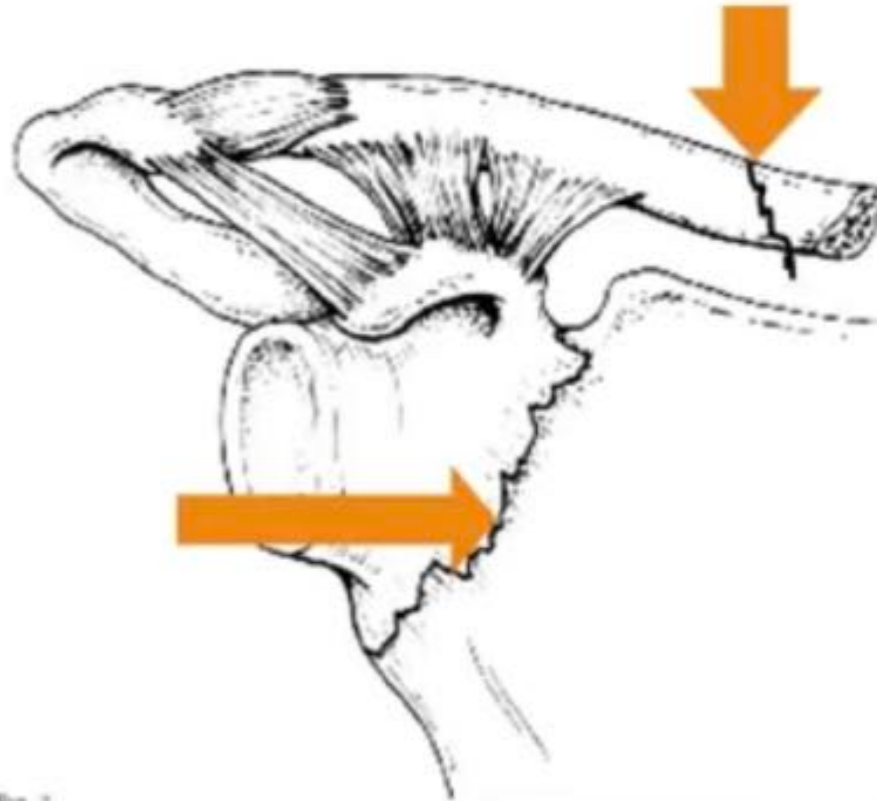
FLOATING SHOULDER

Who coined the term ?

- **Herscovici et al.** introduced the concept of the floating shoulder
- **FLOATING SHOULDER** included “ipsilateral mid-shaft clavicle fractures and scapular neck fractures.”

GOSS , JOT 1993

FLOATING SHOULDER



FLOATING SHOULDER

- Older studies considered a surgical neck fracture, associated with the rupture of the coracoclavicular ligament, to be an indispensable part of floating shoulder
- In later studies, the floating shoulder definition was reduced to an ipsilateral fracture of the scapular (glenoid) neck and the clavicle, without taking into account the importance of the coracoclavicular and coracoacromial ligaments

DEBUNKING THE THEORY

William et al

- Properly pointed out that a midshaft clavicular fracture and a fracture of the surgical neck alone cannot produce a floating shoulder:

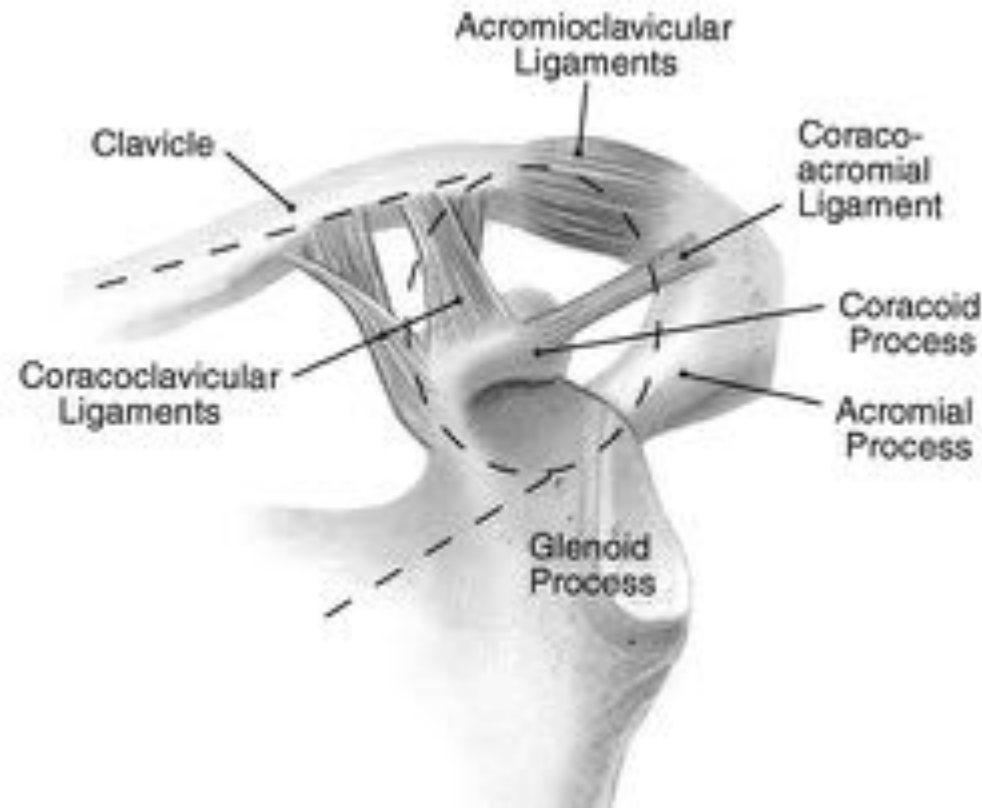
“In the presence of an ipsilateral fracture of the clavicular shaft (that is, a floating shoulder), the glenoid has lost its attachment to the axial skeleton. However, it is still attached to the acromion by the coracoacromial ligament and, through the coracoclavicular ligament and the distal clavicular fragment, by the acromioclavicular capsular ligaments.”

Thus, a floating shoulder may develop only after disruption of the coracoclavicular and coracoacromial ligaments

FLOATING SHOULDER

What changes ?

- Subsequently in 2006, **Goss** expanded on their definition by describing it as a 'double disruption' of the superior shoulder suspensory complex



Introduced the concept of SSSC to elucidate the pathoanatomy of certain shoulder injuries

MECHANISM OF INJURY

- MOST – Road traffic injuries
- High energy injuries
- Polytrauma associated with chest injuries, pneumo/haemo-thorax , rib fractures

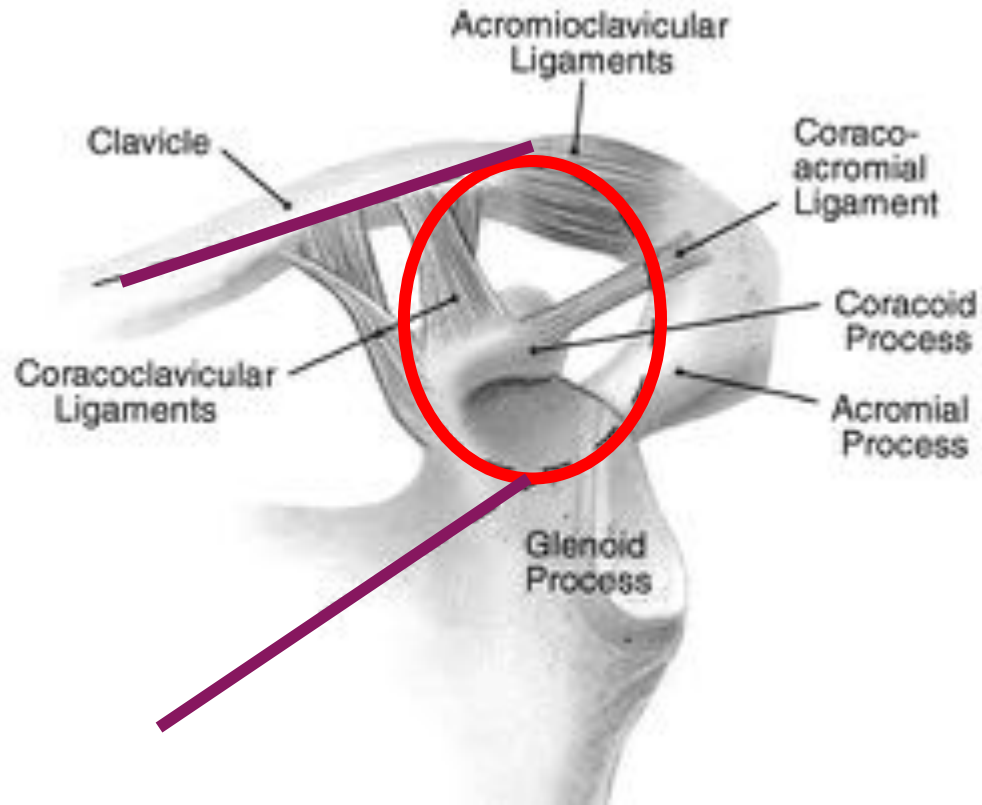
SUPERIOR SHOULDER SUSPENSORY COMPLEX

WHAT ARE THE COMPONENTS ?

- The SSSC is a OSSEO-LIGAMENTOUS RING - bone-soft tissue ring at the end of superior and inferior bone strut

- **Composed of**

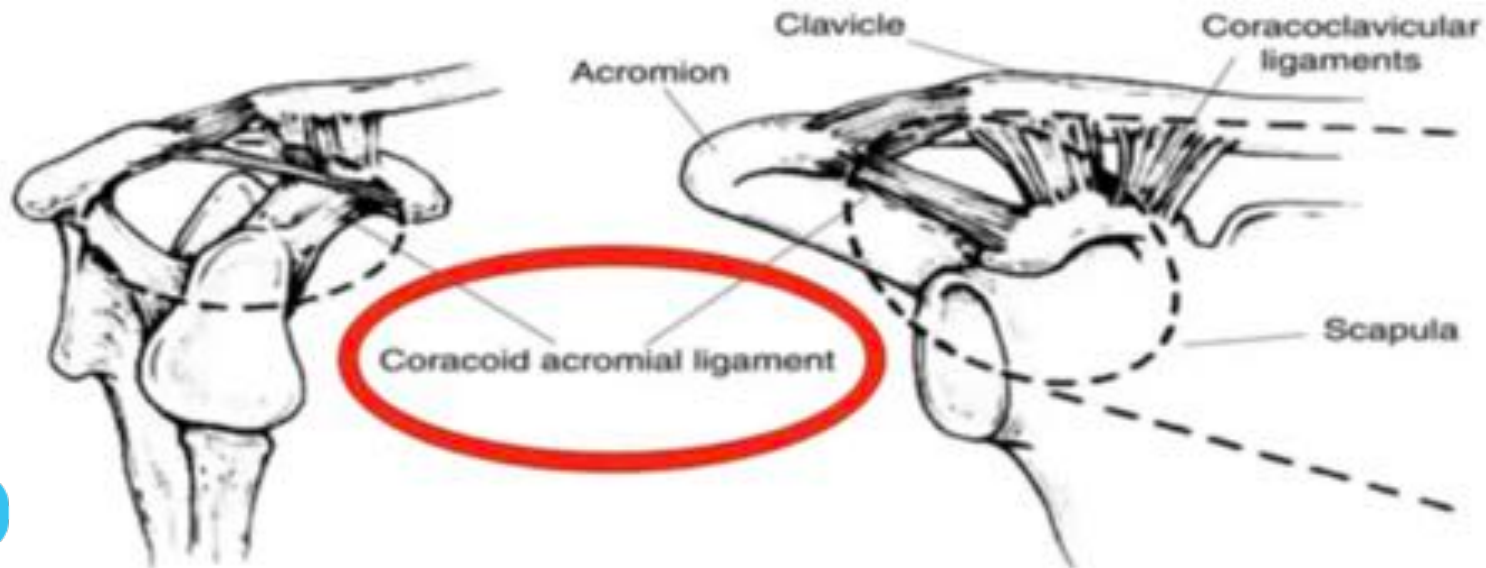
- Glenoid process
- Coracoid process
- Coracoclavicular ligament
- Distal clavicle
- AC joint



SSSC

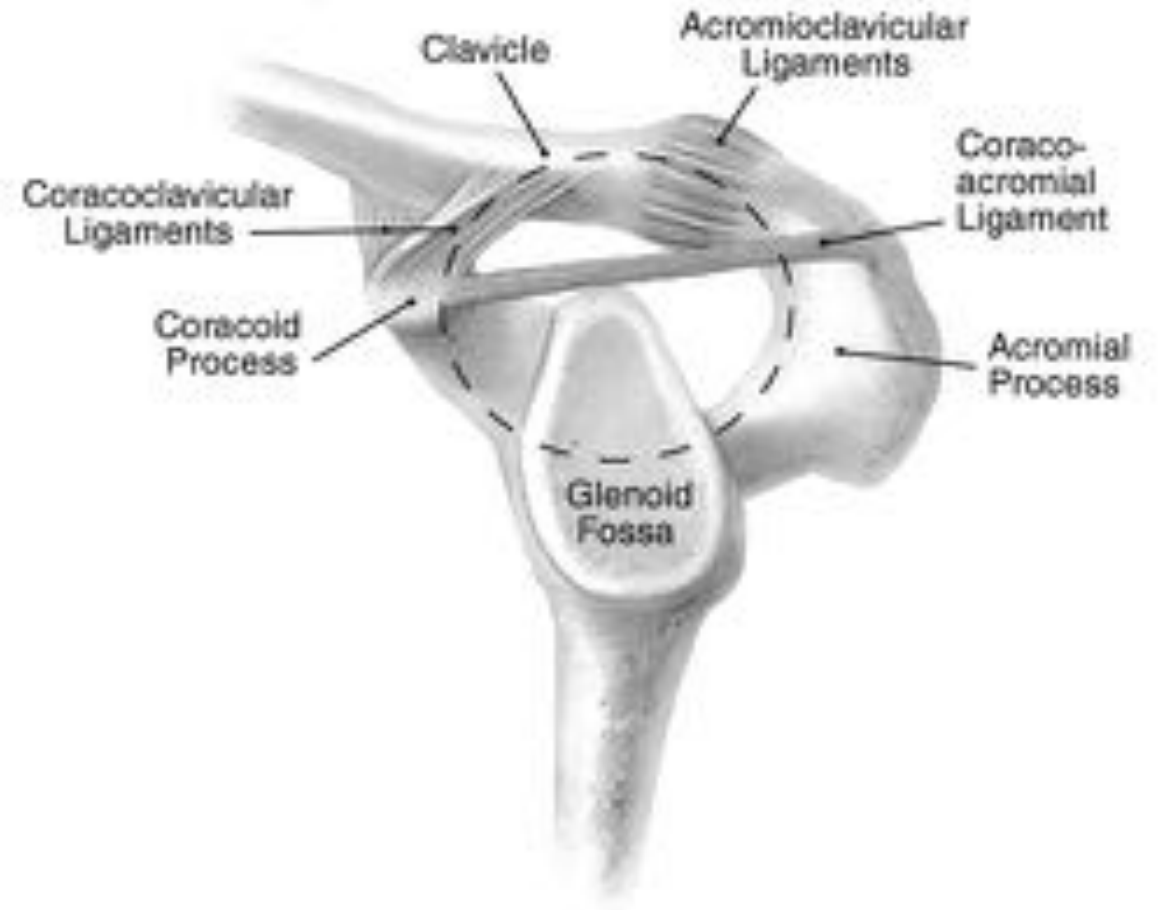
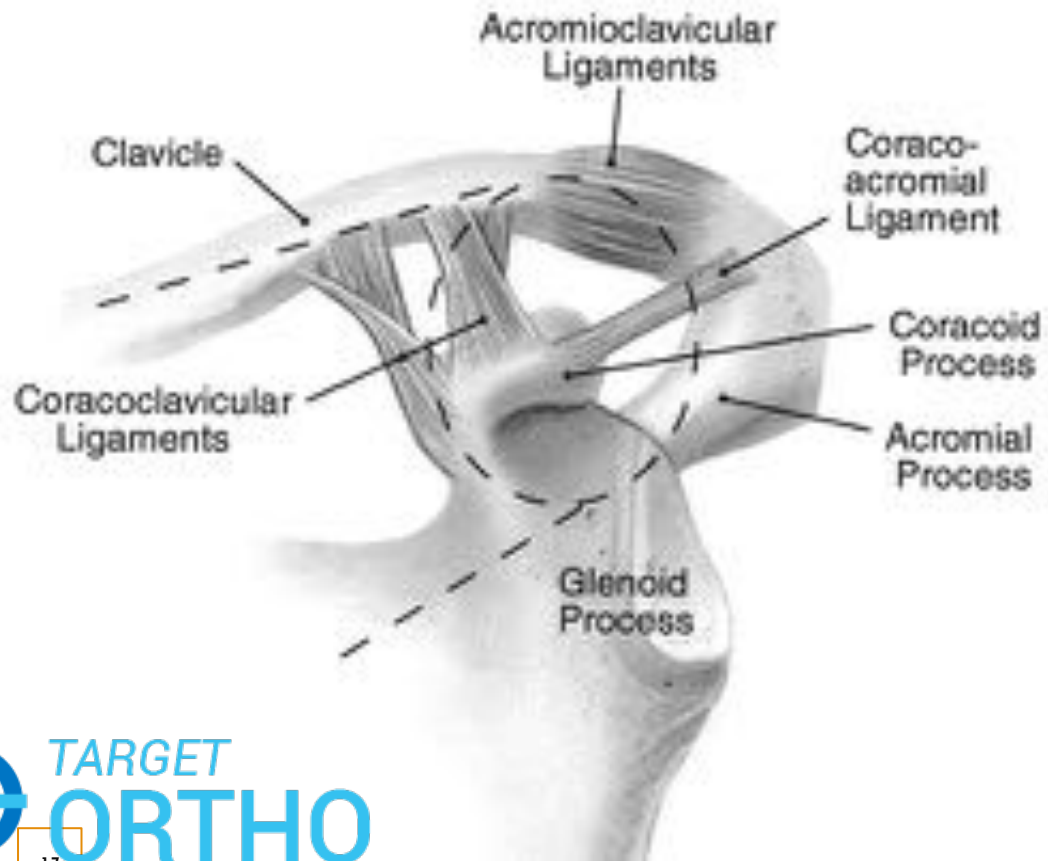
CORACOACROMIAL LIGAMENT

- The original description of SSSC did not include CA ligament
- However it is an important stabilizer of Scapular neck fractures hence should be considered as part of SSSC



SSSC

AP AND LATERAL VIEW



SSSC

Fig. 1

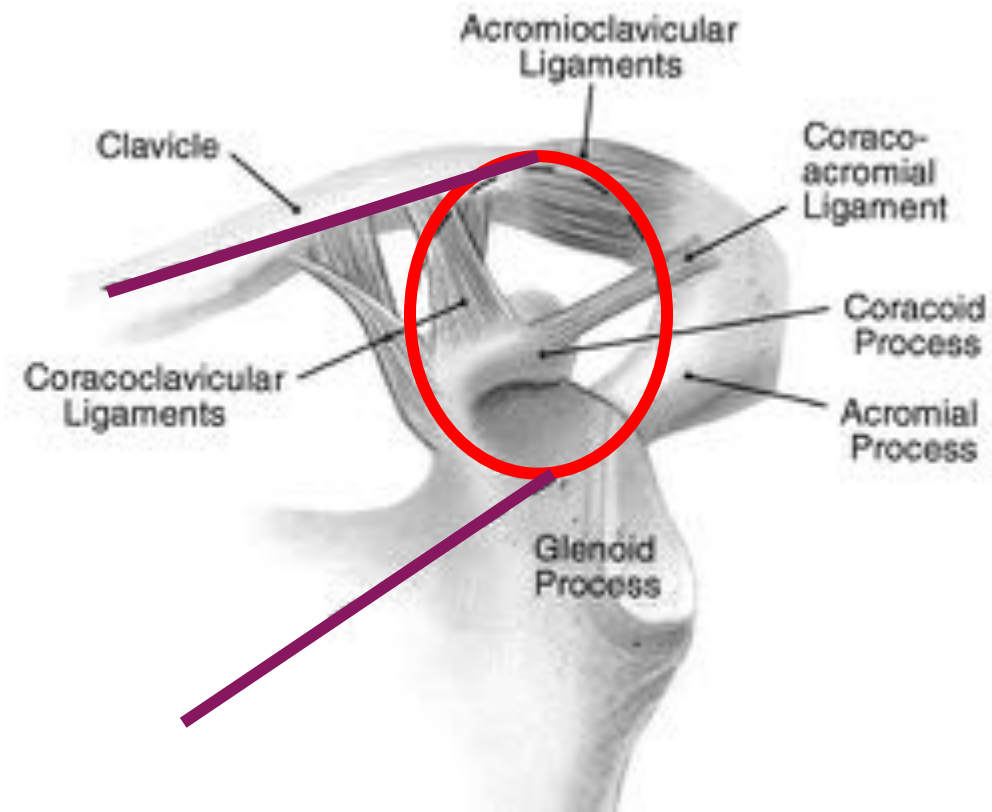
Photographs showing the anatomy of the coracoid process: superior aspect (Fig. 1-A) and anterior aspect (Fig. 1-B). AC = acromioclavicular joint, Cl = clavicle, CA = coracoclavicular ligament, CC = coracoclavicular ligament, CH = coracohumeral ligament, Co = coracoid process, HH = humeral head, Bi = conjoint tendon (short head of biceps and coracobrachialis), and Pe = pectoralis minor.



SUPERIOR SHOULDER SUSPENSORY COMPLEX

STRUTS

- The superior strut is the middle third of the clavicle
- While the inferior strut is the junction of the most lateral portion of the scapular body and the most medial portion of the glenoid neck



SUPERIOR SHOULDER SUSPENSORY COMPLEX

SUBDIVIDED INTO 3 UNITS

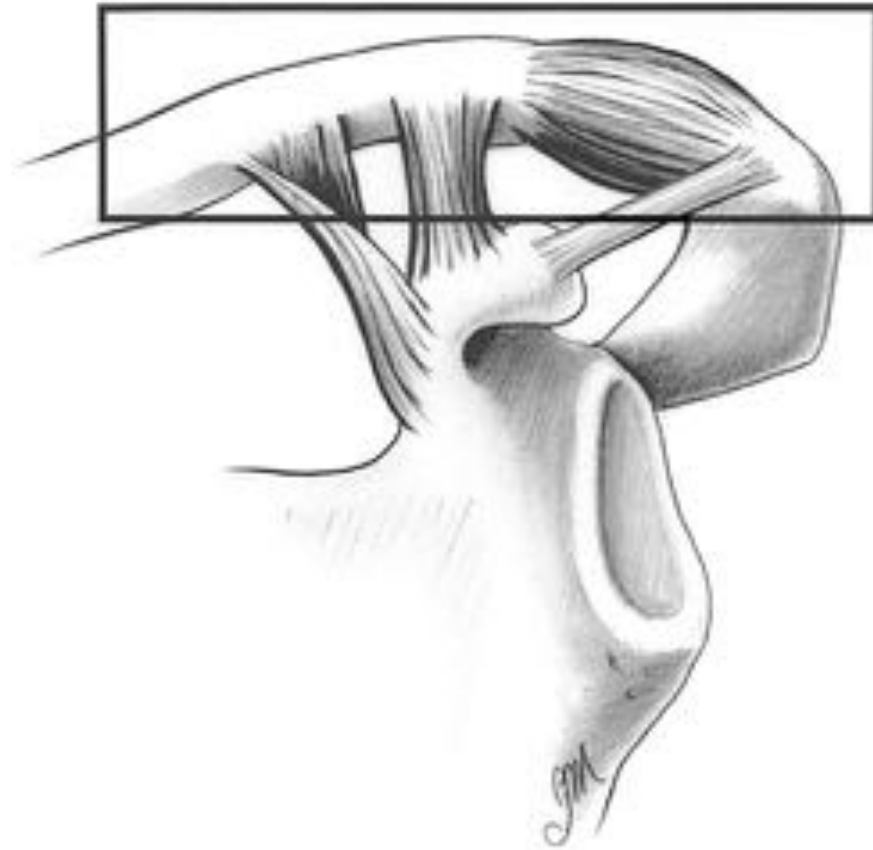
The complex can be subdivided into three units:

- **1) the clavicular-acromioclavicular joint-acromial strut**
- **2) the three-process-scapular body junction**
- **3) the clavicular-coracoclavicular ligamentous-coracoid (C-4) linkage**

Secondary support is provided by the coracoacromial ligament.

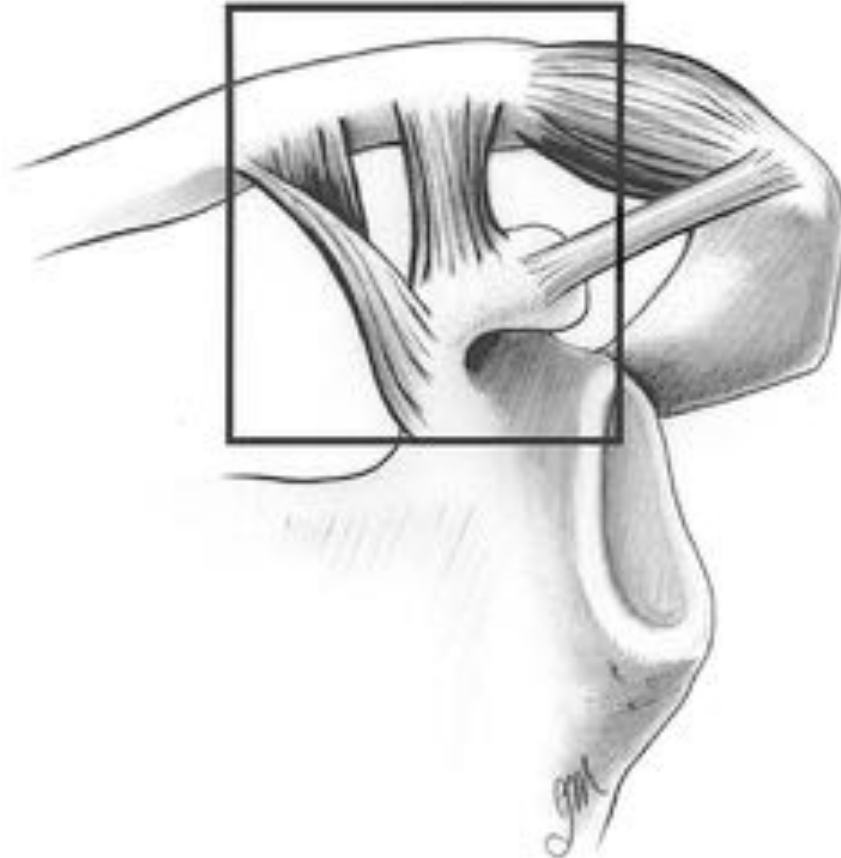
SSSC

The clavicular-acromioclavicular joint-acromial strut



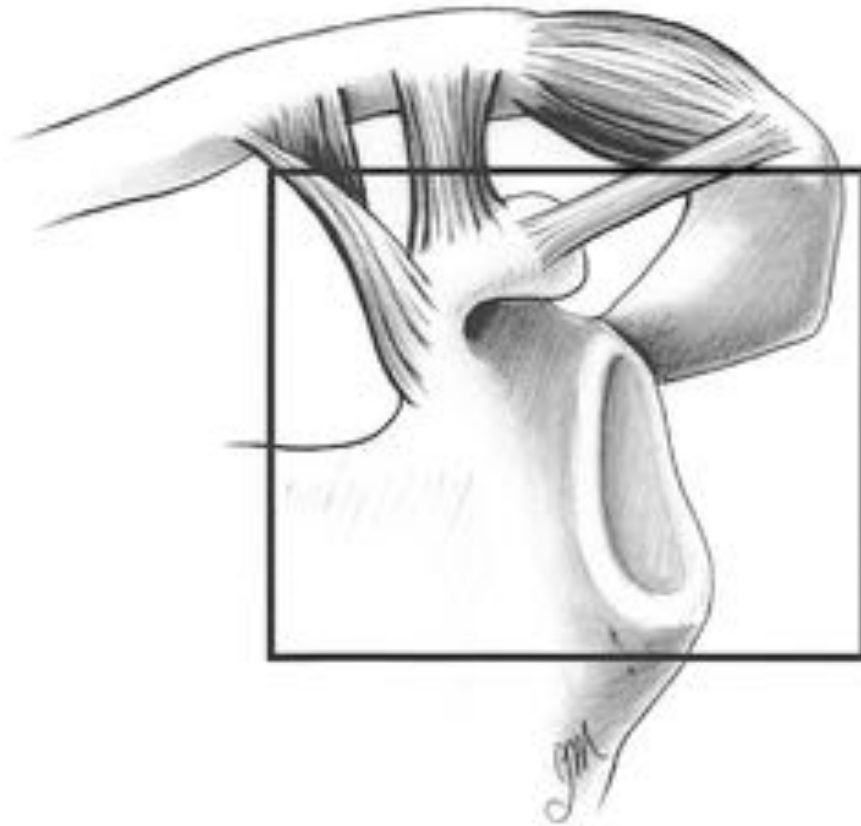
SSSC

The three-process-scapular body junction



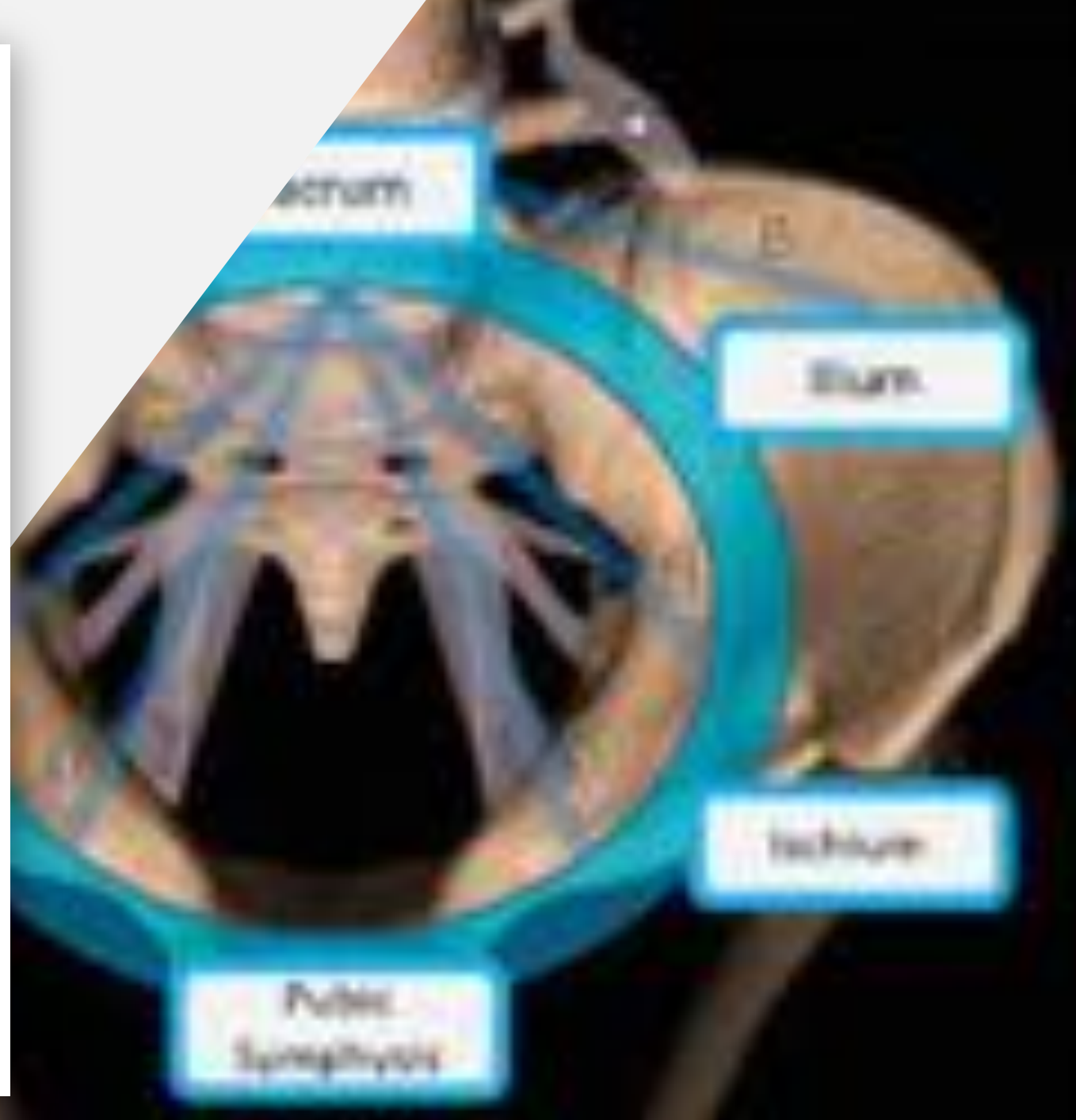
SSSC

The clavicular- coraco clavicular ligamentous-coracoid (C-4) linkage



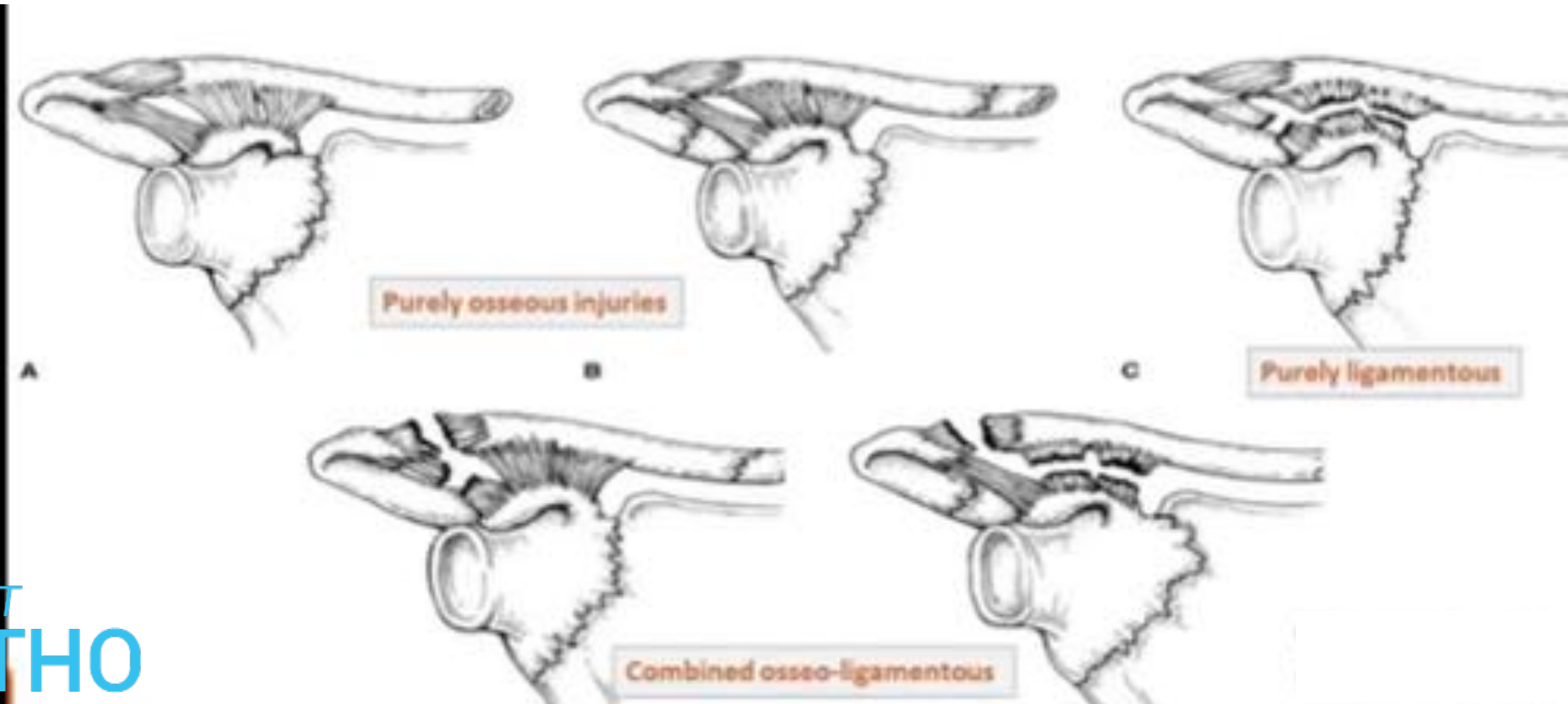
THE RING CONCEPT OF SSSC INJURIES ARE SIMILAR TO PELVIC RING INJURIES

Hence it is more reasonable to think that if the ring is broken in one area and fragments displaced, then there must be a fracture or dislocation in another portion of the ring



PATTERN OF FLOATING SHOULDER

Does not just include bony injuries !!



SSSC

USES

- The superior shoulder suspensory complex is extremely important biomechanically.
- Each of its components has its own individual functions, it serves as a point of attachment for a variety of musculotendinous and ligamentous structures
- It allows limited, but significant movement to occur through the coracoclavicular ligament and the acromioclavicular articulation, and it maintains a normal, stable relationship between the upper extremity and the axial skeleton.
- It should be appreciated that the clavicle is the only bony connection between the upper extremity and the axial skeleton. The scapula is 'hung' or suspended from the clavicle by the coracoclavicular ligaments and the acromioclavicular joint.

SUPERIOR SHOULDER SUSPENSORY COMPLEX

Double Disruption theory

When the complex is disrupted in two places (a double disruption), the integrity of the superior shoulder suspensory complex is breached and a potentially unstable anatomical situation is created.

If significant displacement occurs at either or both sites, there may be problems with healing, such as delayed union, malunion, and nonunion, as well as adverse long-term functional difficulties, such as sub acromial impingement, weakness and discomfort due to muscle fatigue, neurovascular compromise from a drooping shoulder, and degenerative joint disease, depending on the nature of the particular injury.

DOUBLE DISRUPTION THEORY

- **Disruption of the osseo fibrous ring at 2 sites,**

Or

- **At 1 site in combination with a fracture of 1 or both struts**

Produces a potentially unstable anatomical situation

“FLOATING SHOULDER”

IS ONE TYPE OF DOUBLE DISRUPTION OF
SSSC

FLOATING SHOULDER INJURIES

How it affects ?

- Alter glenohumeral-acromial relationship
- Muscular forces are altered
- One fracture makes the other more unstable
- Surgery indicated if any significant displacement

FLOATING SHOULDER INJURIES

How it affects ?

- Severe injury frequently associated with trauma to chest, lung or head
- The proximity of the brachial plexus as well as axillary artery and vein to clavicle and scapular neck make them susceptible to injury in a floating shoulder

DISTAL AND PROXIMAL FRAGMENTS

FRACTURE OF SURGICAL NECK OF SCAPULA PRODUCE :

D- Distal fragment consisting of glenoid and coracoid process

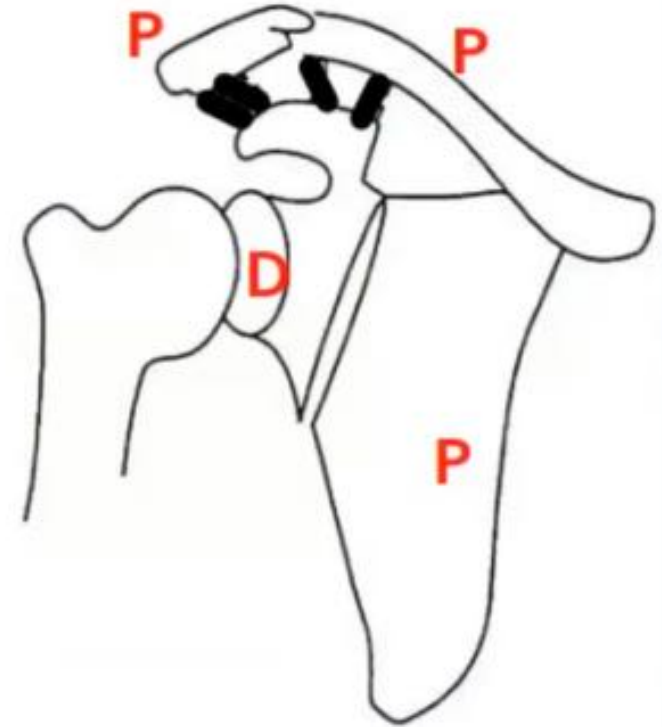
P- Proximal fragment consisting of the acromion , scapular spine and scapular body

Distal fragment is attached to proximal by

- Coracoacromial ligament

Attached to axial skeleton by

- Clavicular shaft
- CC ligament

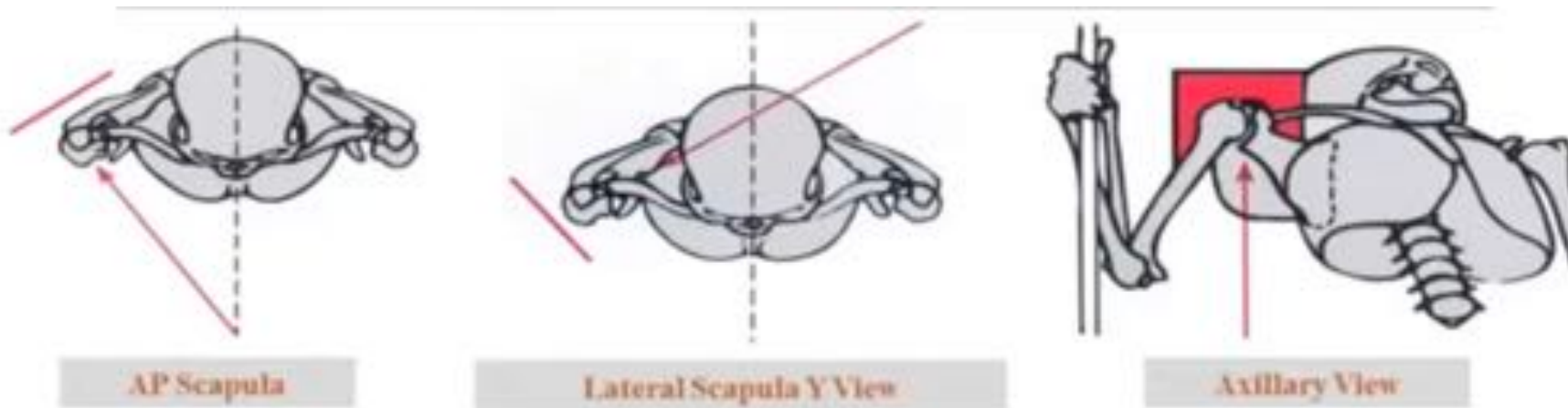


DRAWBACK

- Discussions on floating shoulder mostly concentrate on the Osseo ligamentous connection of the scapula with the axial skeleton, without taking into account the role of the scapula-axial (spine, chest) muscles and the muscles of the rotator cuff.
- Essential for the stabilization of the thoraco scapular interface are the trapezius, rhomboids, serratus anterior, and levator scapulae, which control the relationship of the scapula with the spine and the chest.
- In addition, the trapezius attaches to the scapula at the scapular spine and acromion and across the acromioclavicular joint, as far as the lateral end of the clavicle.
- In case of a fracture in this region, this wide insertion reduces fragment displacement (e.g., in trans spinous fractures of the scapular neck or acromioclavicular dislocation).
- The muscles of the rotator cuff attaching to the proximal part of the humerus may also considerably influence displacement of the glenoid fragment (e.g., in anatomical neck fractures). In such cases, the pull of rotator cuff muscles contributes to displacement of the glenoid fragment into valgus.

DIAGNOSIS

- SHOULDER TRAUMA SERIES



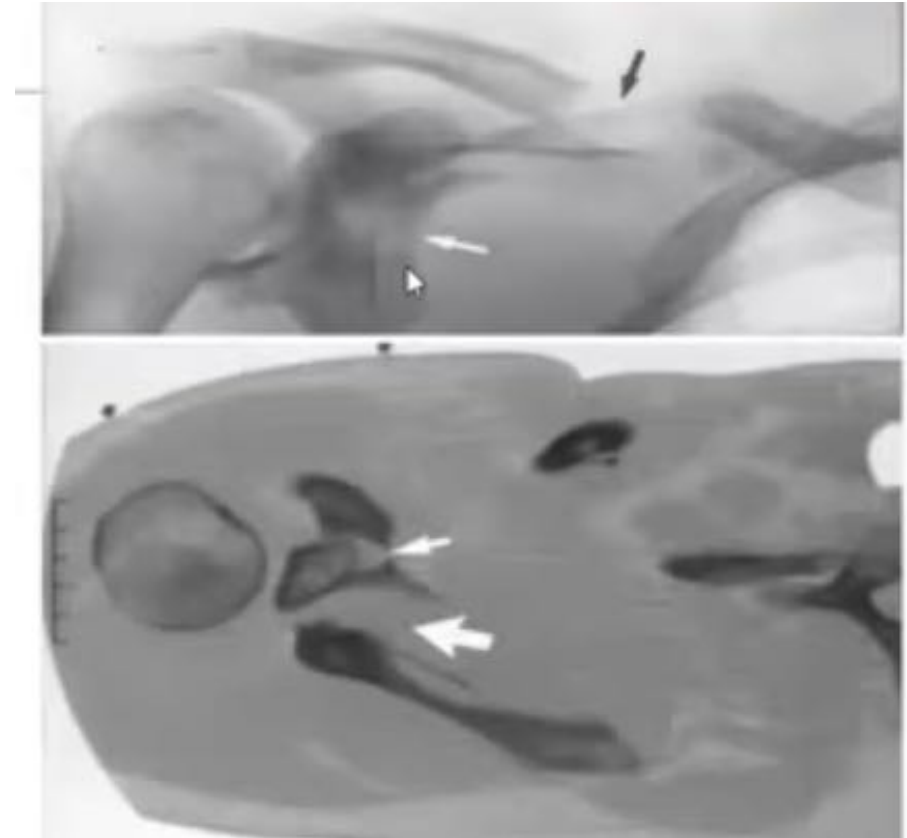
DIAGNOSIS

- CT SCAN

Given the difficulty of diagnosing floating shoulder on plain radiographs, CT is recommended

To define osseous injury in more detail

To evaluate degree of displacement from normal SSSC anatomy



DIAGNOSIS

Floating shoulder : Myths and reality, Bartonicek et al JBJS reviews:Oct 2018

- Radiographs are inadequate to determine the exact fracture pattern for fractures of the surgical neck and body of the scapula. Therefore, examination should include 3-dimensional computed tomographic reconstructions, in standardized views, with subtraction of the surrounding bones.



Displacement of a 2-part intraosseous fracture of the scapular body with typical overlap of fragments of the lateral border: anteroposterior radiograph (Fig. 3-A), 3-dimensional CT reconstruction, anterior view (Fig. 3-B), and 3-dimensional CT reconstruction, posterior view (Fig. 3-C).

RADIOGRAPHIC EVALUATION

Important factors to assess on radiographs include:

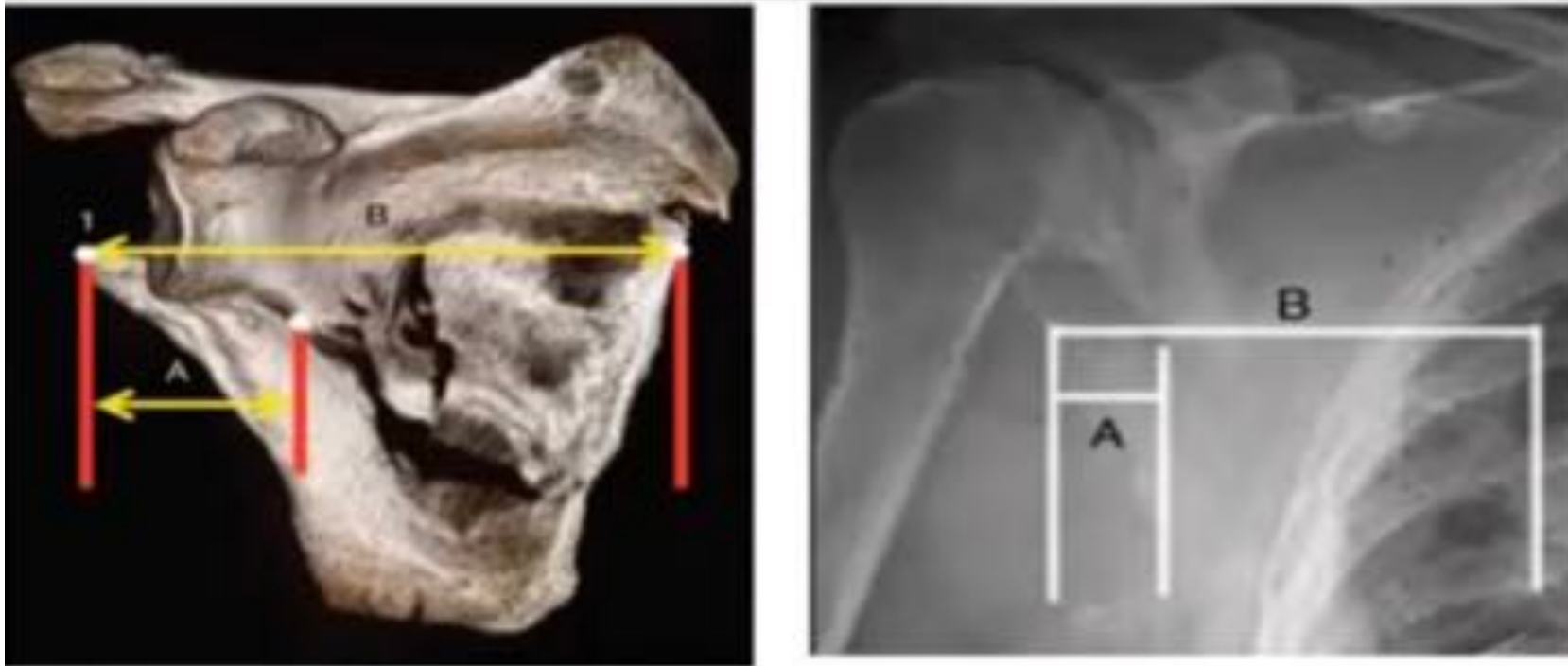
❖ AMOUNT OF CLAVICULAR DISPLACEMENT

❖ GLENOID

- INTRA-ARTICULAR INVOLVEMENT
 - EXTENT OF COMMUNITION
- LATERAL BORDER OFFSET (MEDIALIZATION)
 - ANGULATION

LATERAL BORDER OFFSET

MEDIALIZATION



A combination of medialization of proximal fragment (the glenoid)
Lateralization of the distal fragment (the body)

ANGULATION

Different methods

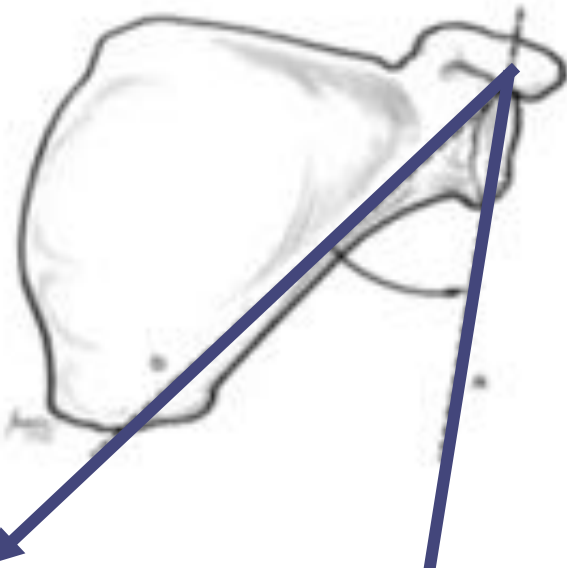
- Two methods are currently used for measuring the angular displacement of the scapular neck fracture fragment on plain radiograph

1. GLENO-POLAR ANGLE

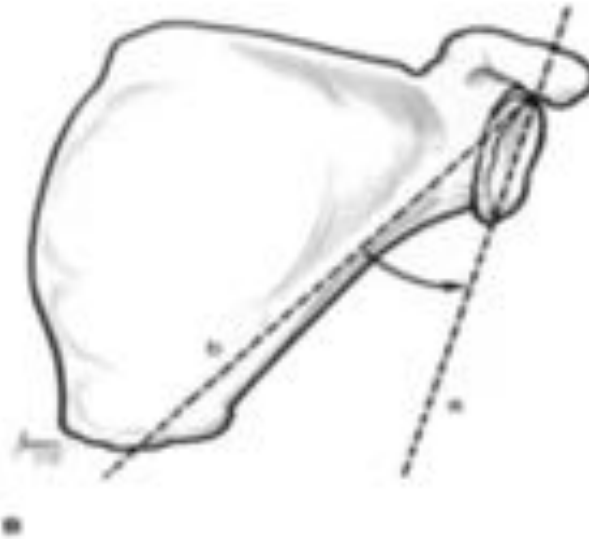
2. GLENOID INCLINATION ANGLE IN AP

GLENO-POLAR ANGLE

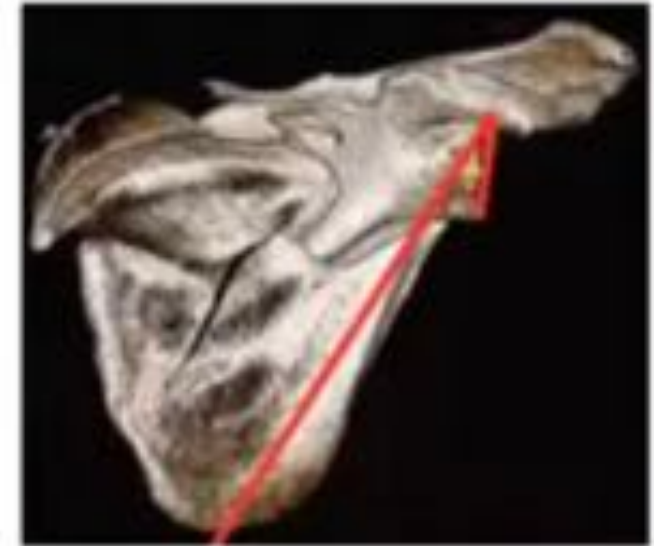
TO ASSESS ANGULATION



Line connecting cranial
point of glenoid cavity
With caudal part of
scapula

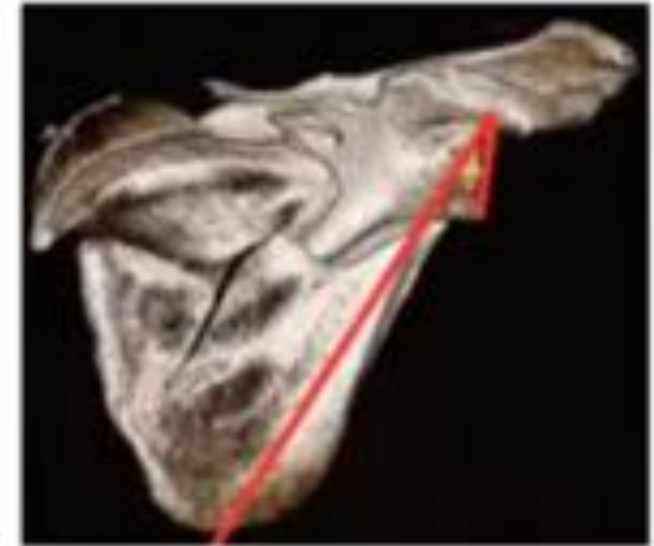
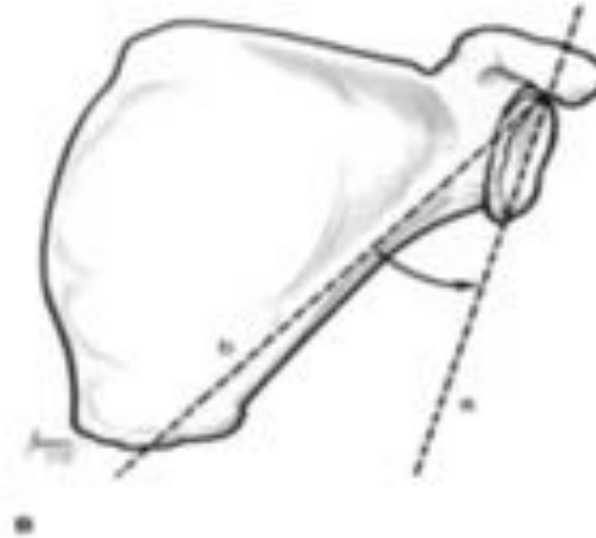
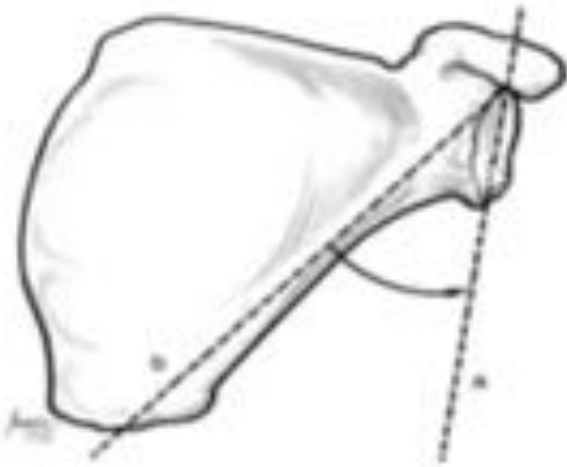


Line joining most cranial
With most caudal point of
glenoid cavity



GLENO-POLAR ANGLE

TO ASSESS ANGULATION



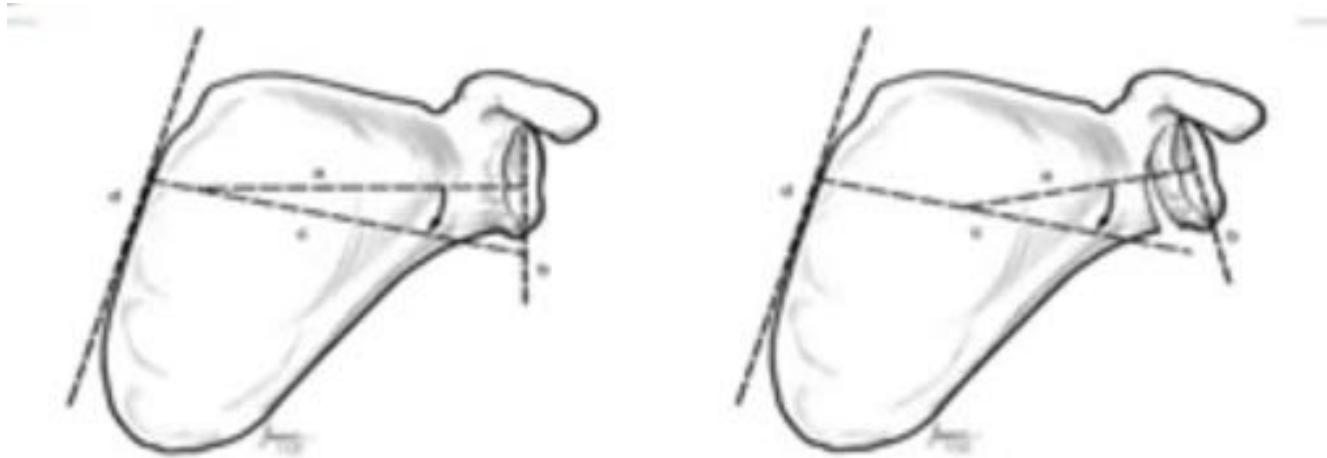
GPA provides a value for the obliquity of the glenoid articular surface in relation to the scapular body

NORMAL – 30-45 degree

Pomero et al **GPA < 20 – Severe glenoid rotational malalignment**

GLENOID INCLINATION ANGLE

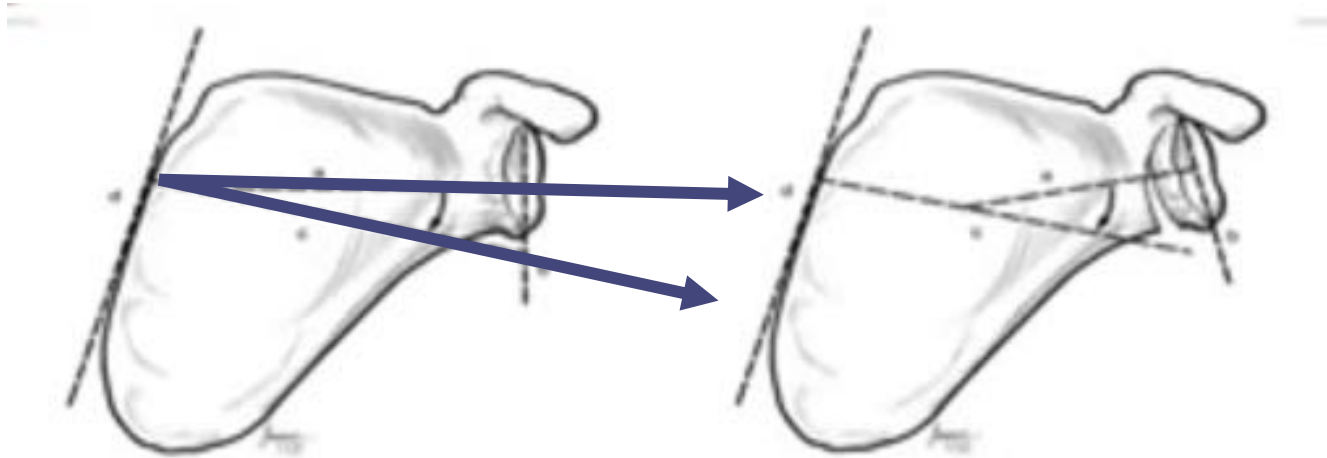
To assess angulation



The second method used to assess the rotational malalignment of the glenoid is to measure the inclination angle of the glenoid on the anteroposterior view of the patients injured shoulder

GLENOID INCLINATION ANGLE

To assess angulation



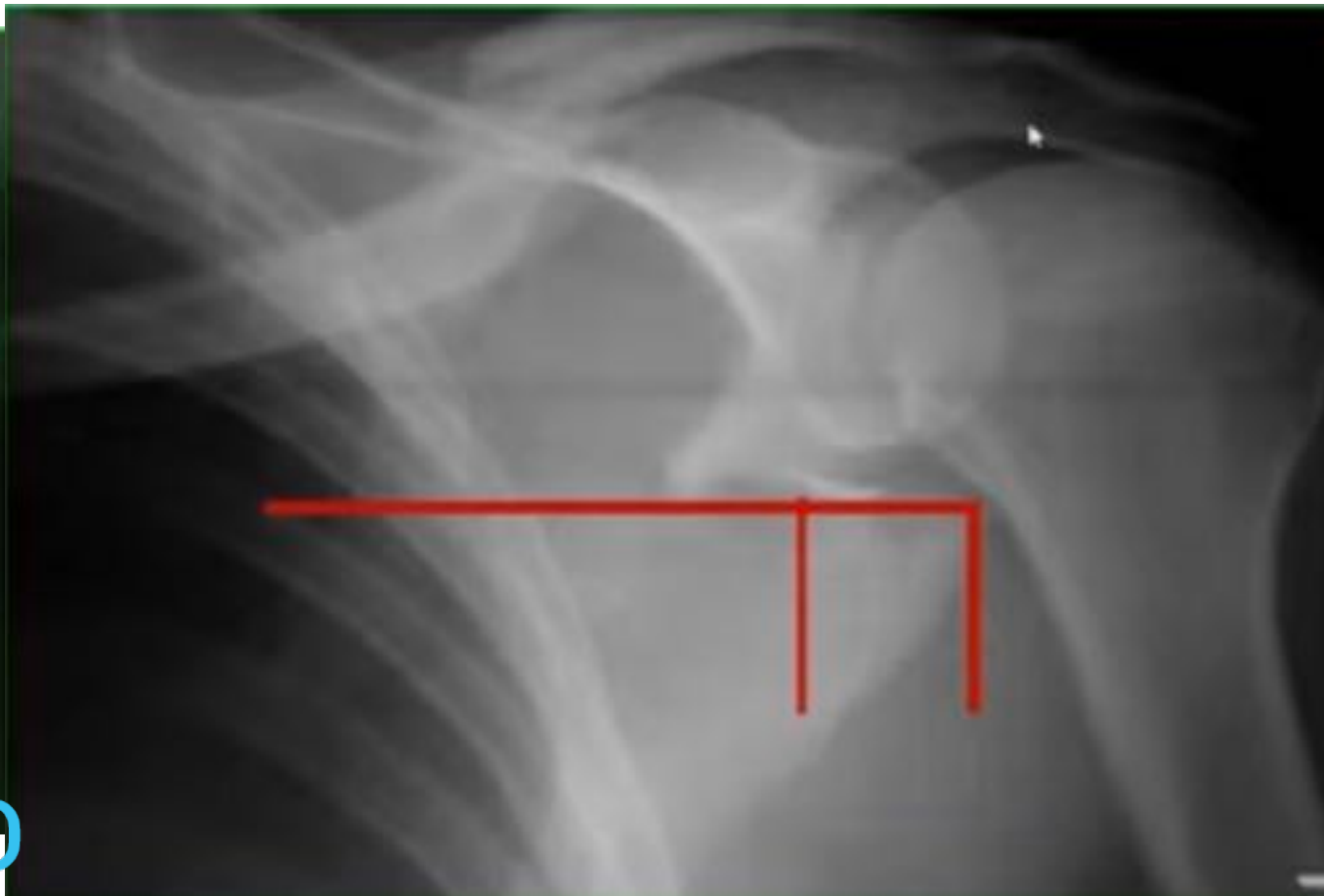
Line a – drawn perpendicular to the line connecting cranial-caudal point of glenoid cavity

Line b – drawn perpendicular to tangent along the medial border of scapula

Using this angle , caudal dislocation of glenoid is defined

CASE SCENARIO

Case of floating shoulder



GPA <20 DEGREE

LATERALIZATION

CASE SCENARIO

Case of floating shoulder



WHY FIX SSSC INJURIES ?

- MALALIGNMENT
- ARTHROSIS
- ROTATOR CUFF DYSFUNCTION
- SCAPULOTHORACIC DYSKINESIA
- IMPINGEMENT TYPE PAIN



MANAGEMENT

- Because the degree of ligament disruption is difficult to assess on radiographs , indications for non surgical and surgical management are **not well defined**
- **A definitive algorithm** for management based on scientific evidence is not possible at this time

MANAGEMENT

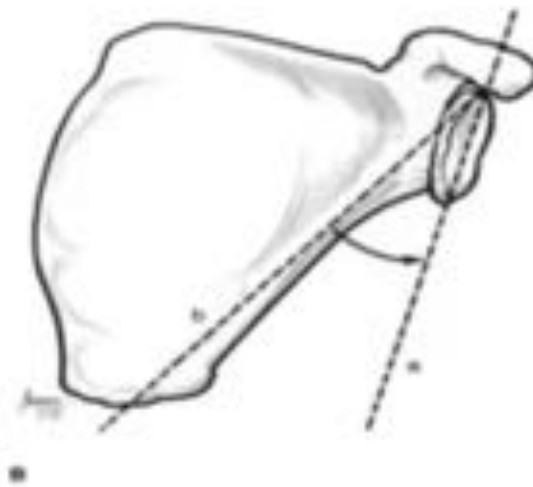
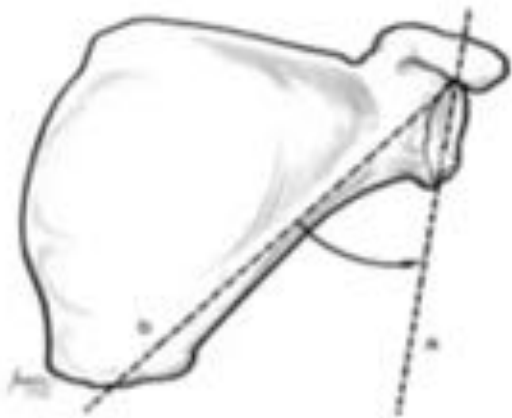
- **HOWEVER** Review of literature does provide insight into key elements to consider in deciding how to treat the patient with a floating shoulder
- **MINIMALLY DISPLACED FRACTURES TYPICALLY DO WELL WITH NON SURGICAL CARE**

MANAGEMENT

- **The current recommendations for surgical intervention in articular and extra articular fractures are largely based on quantification of five common measures**

- 1. GLENOPOLAR ANGLE**
- 2. ARTICULAR STEP OFF**
- 3. LATERAL BORDER OFFSET**
- 4. TRANSLATION**
- 5. ANGULATION**

GLENO POLAR ANGLE



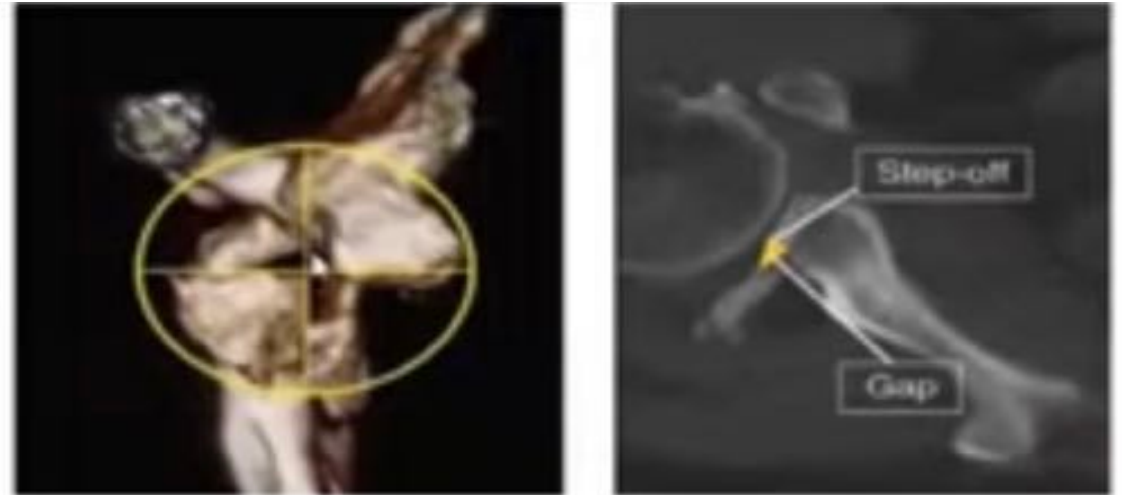
NORMAL – 30-45 degree

Romero et al **GPA < 20 – Severe glenoid rotational malalignment**

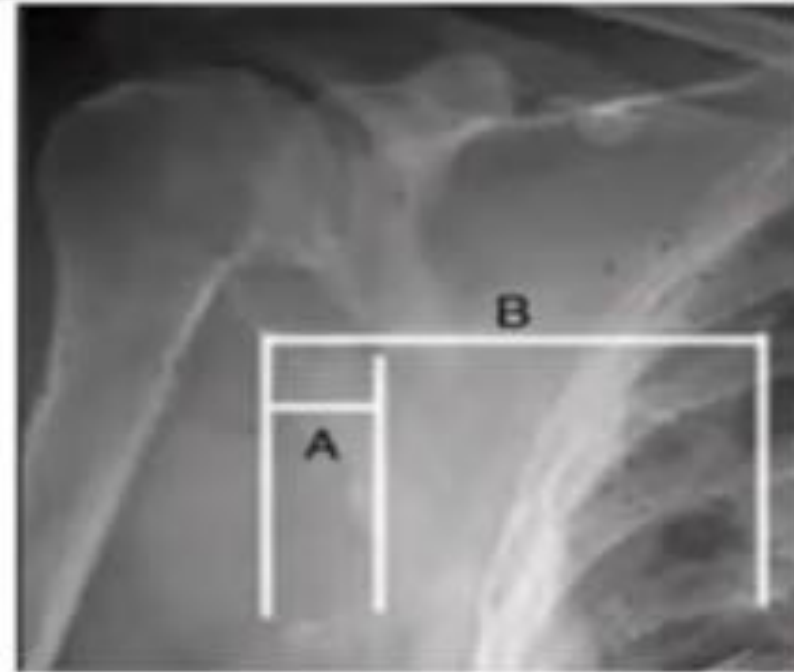
ARTICULAR STEP OFF

- An articular step off of approximately 4-5 mm
- OR
- A fragment size of 20% or more of the glenoid

INDICATION FOR SURGICAL INTERVENTION



LATERAL BORDER OFFSET



> 20MM LATERALIZATION – SURGICAL INTERVENTION

ANGULAR DEFORMITY AND TRANSLATION

- Parameters of displacement in sagittal plane
 - Affects scapular glide on the thoracic wall
 - Angular deformity > 45 degrees
 - Translation 100% with no cortical contact
- } SURGERY



FLOATING SHOULDER INJURIES

IF CLAVICLE IS INVOLVED ?

SHOULD BE FIXED IF DISPLACED

- Reduces risk of nonunion
- Reduces tension on brachial plexus
- Restores anatomical relationship
- Improves function
- May reduce and stabilize glenoid fracture



CLAVICLE FIXATION

ALWAYS FIX CLAVICLE

- Approached through an incision directly over the subcutaneous border
- Intramedullary device , precontoured plates and locking plates preferred

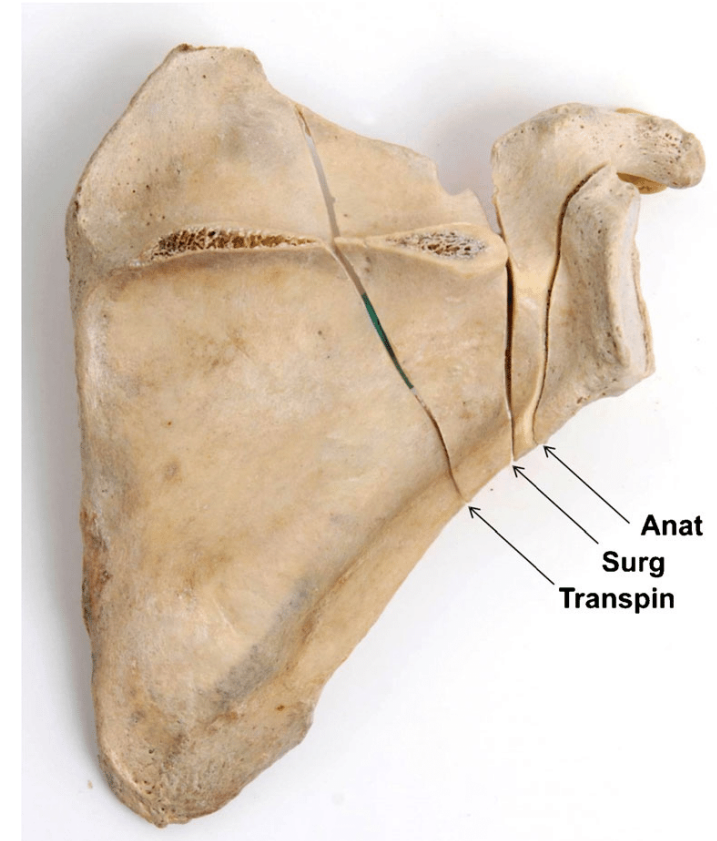
GLENOID NECK FRACTURES

Divided into

- Anatomical Neck
- Surgical neck

Anatomical neck always unstable

Surgical neck stability depends on ligamentous injury



SURGICAL MANAGEMENT

- Goss suggests – FIX BOTH
- Some authors feel if clavicle fixed , it will be enough
- However if scapular fracture remains displaced it should be fixed
- Sequence of fixation has to be individualized



CASE SCENARIO 1



CASE SCENARIO 1



TREATMENT — CLAVICLE PLATING ONLY



CASE SCENARIO 2



CASE SCENARIO 2



TREATMENT — FIX BOTH

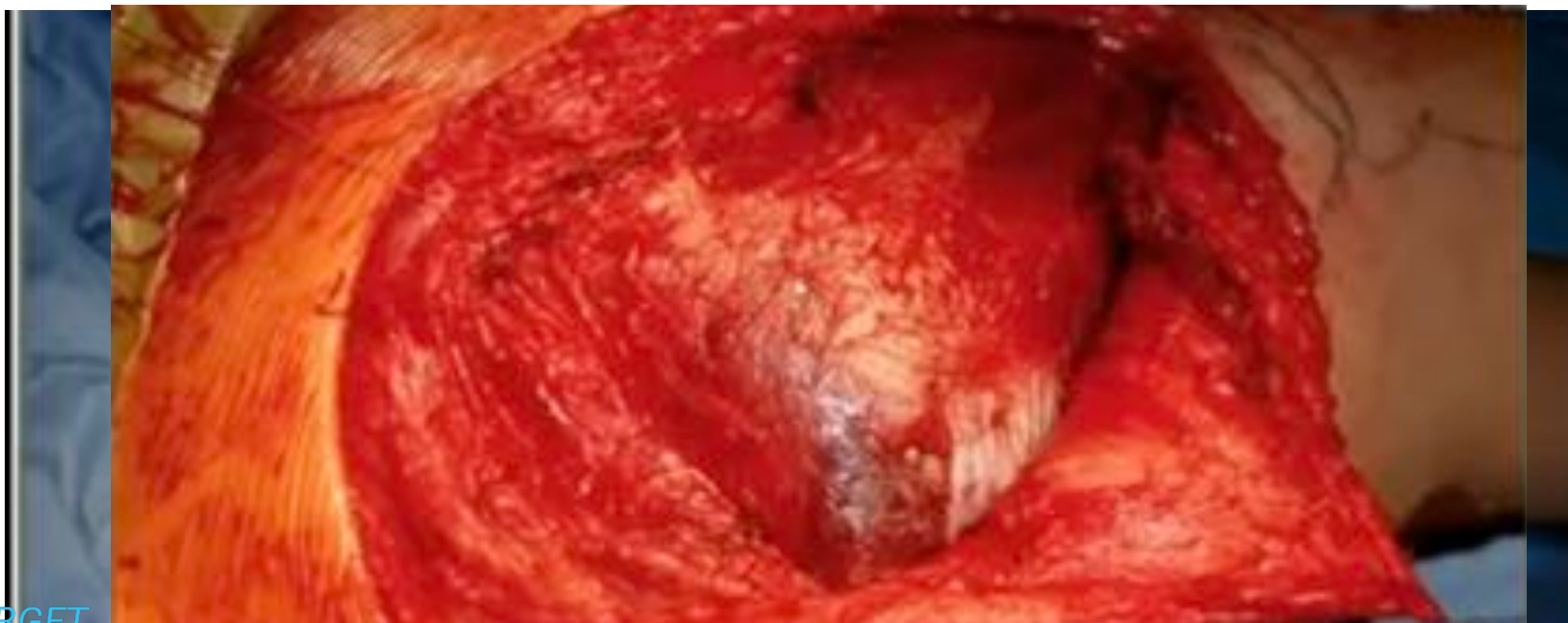


APPROACHES

- WORKHORSE – **JUDET APPROACH**
- LATERAL POSITION
- INVERTED L INCISION



JUDET POSTERIOR APPROACH



JUDET POSTERIOR APPROACH

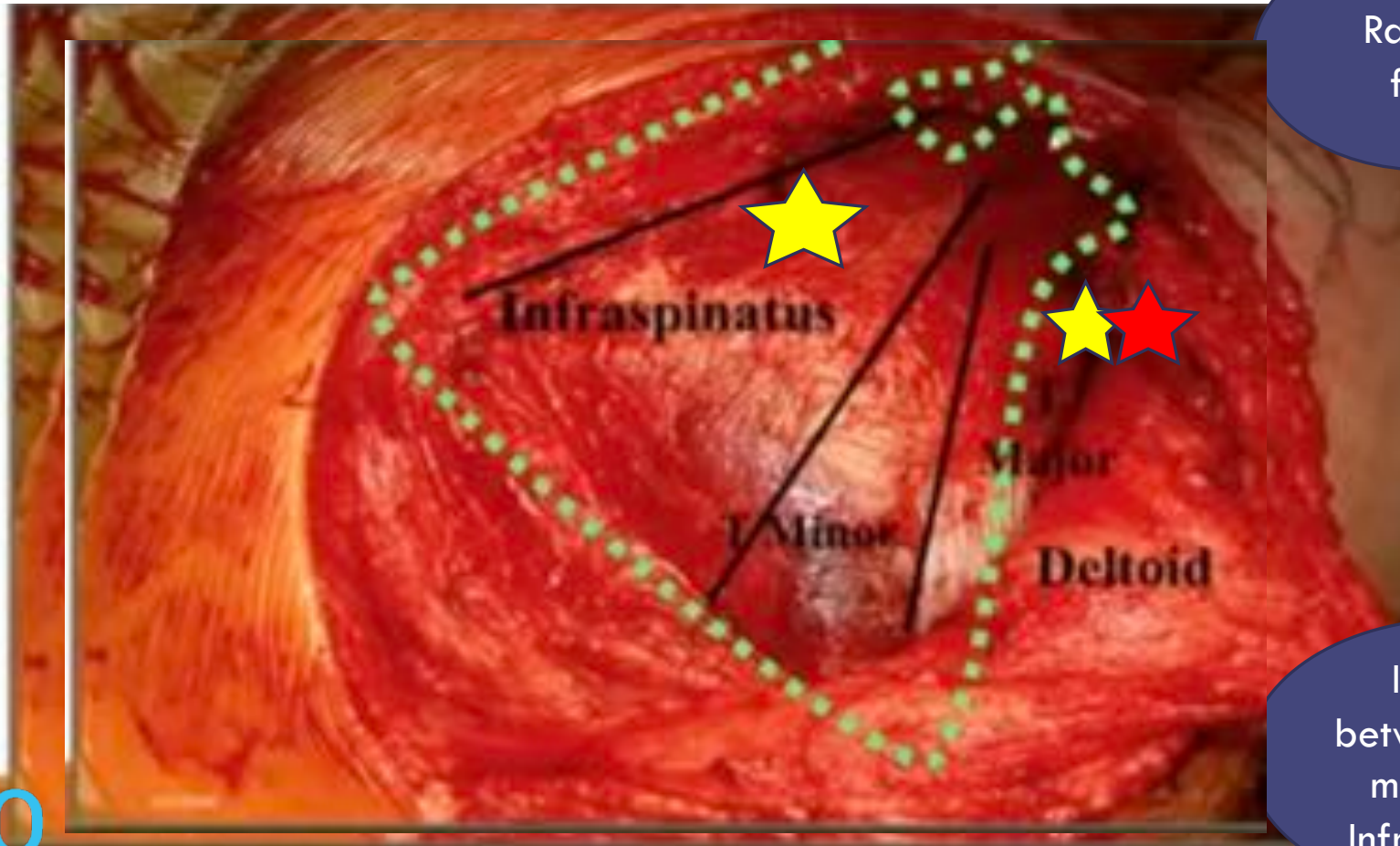
Suprascapular
nerve

Raise a
flap

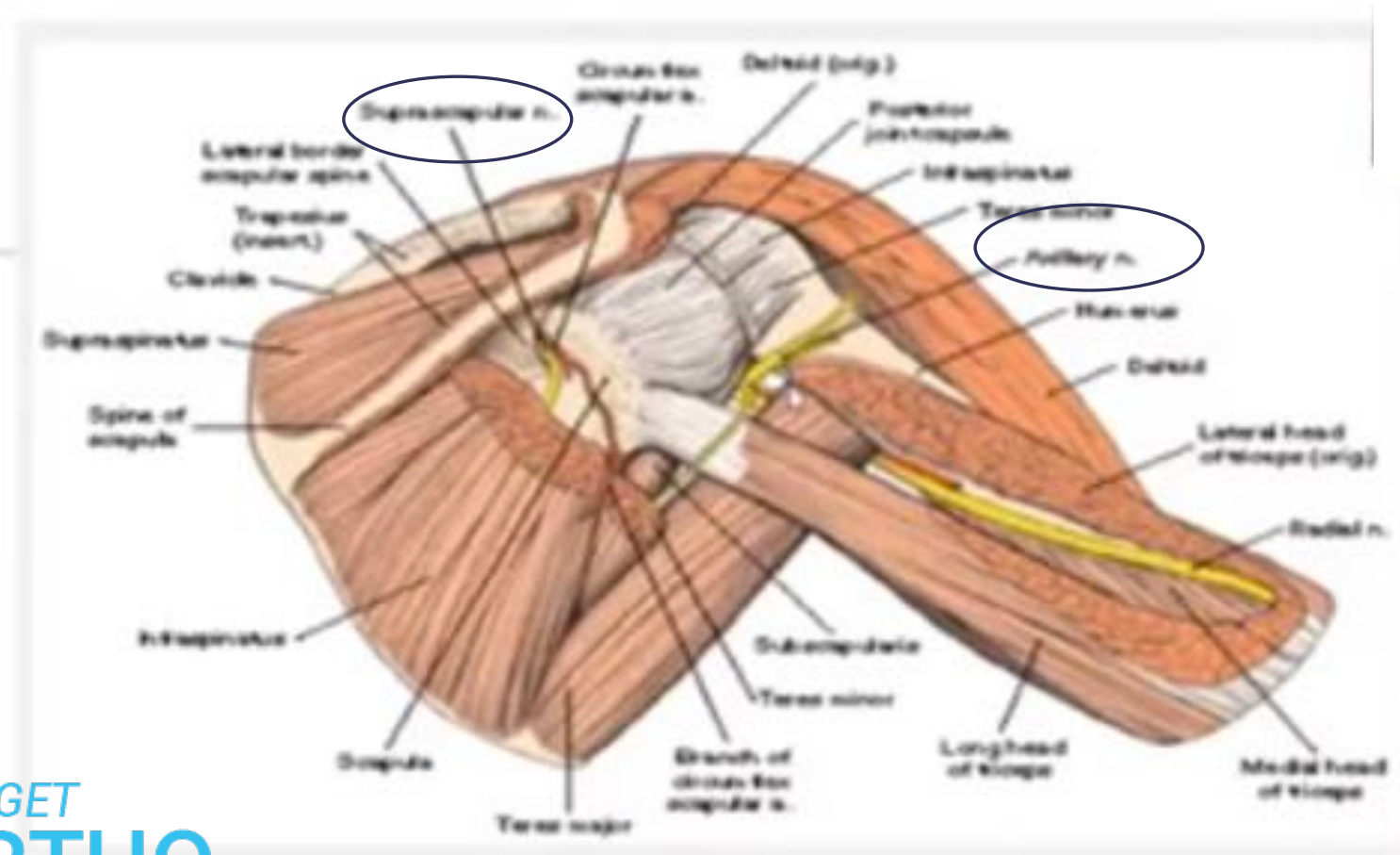
Axillary nerve

Circumflex
vessels

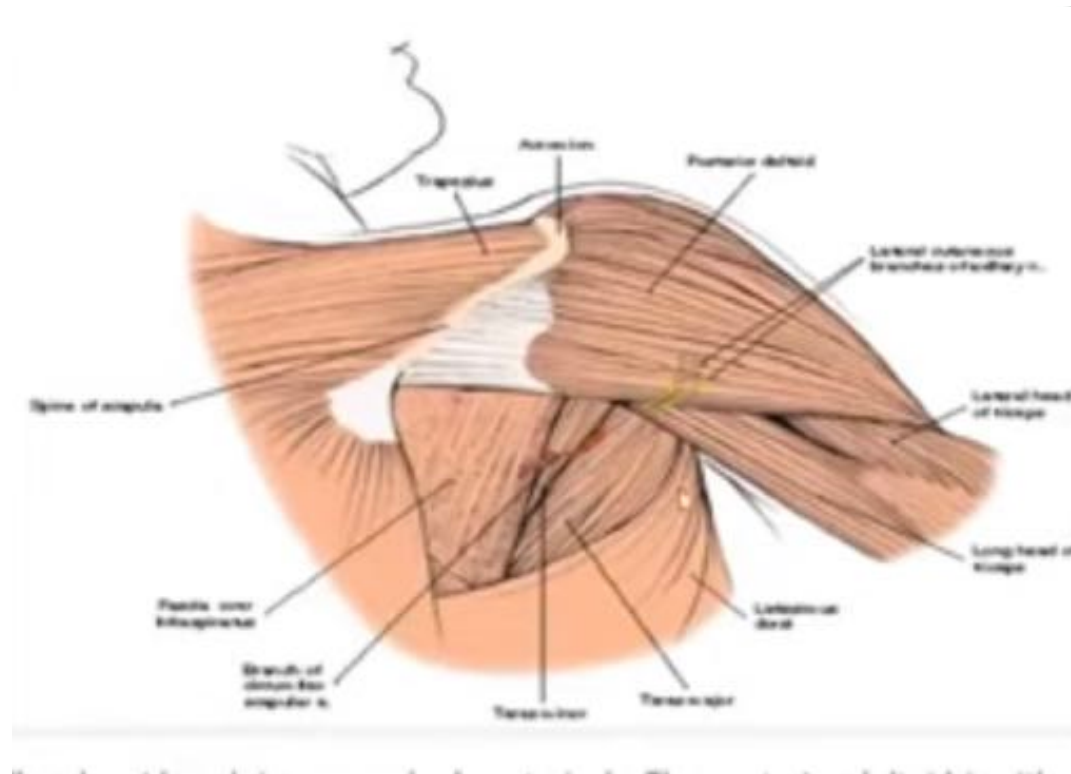
Interval
between teres
minor and
Infraspinatus



JUDET POSTERIOR APPROACH



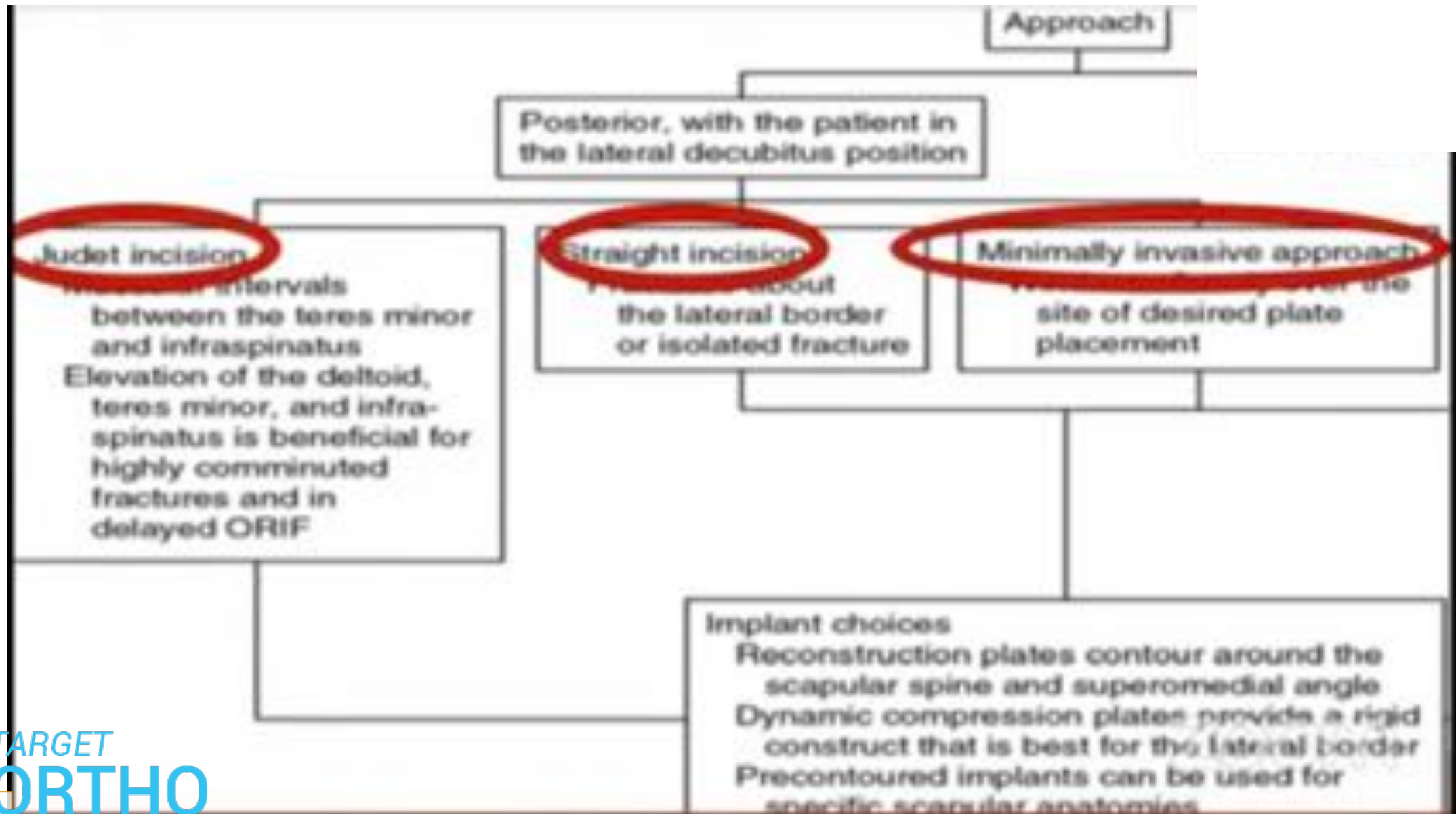
GLENOID NECK APPROACHED POSTERIORLY
POSTERIOR DELTOID SPLIT IN LINE OF ITS FIBERS/DETACHED AT ITS ORIGIN
AND RETRACTED DISTALLY



OTHER MODIFICATIONS

- VERTICAL INCISION OR REVERSE L
- LIMITED DISSECTION
- WORK THROUGH WINDOWS





BONE STOCK

- Thick, solid bone for fixation is at a premium because much of the scapula is paper thin

- There are however four satisfactory areas-

1. Glenoid neck
2. Lateral scapular border
3. Base of scapular spine

4. Coracoid process



ORIF + PLATING



FIXATION DEVICES



- 3.5 or 2.7 reconstruction and LCDC plates
- Locking implants useful with long comminuted zones and may allow shorter plates and less dissection

LITERATURE ON TREATMENT OF SSSC INJURIES

NON OPERATIVE

- **Edwards** – JBJS 2000

Treated non operatively with a shoulder immobilizer , especially when displacement less than 5mm

- **Van Noort et al**

Treated conservatively in patients with well aligned glenoid

In scapular fractures with absence of caudal displacement of the glenoid

Inferior angulation of Glenoid of at least 20 degree

SURGICAL MANAGEMENT

- Unstable displaced fractures of surgical or anatomical neck of scapula
- Surgical procedure via JUDET approach



LITERATURE ON TREATMENT OF SSSC INJURIES

OPERATIVE

- **Goss – JOT**

Recommended stabilization of both sides and stated that conservative treatment causes drooping of shoulder

- **Ada and Miller**

Reported high incidence of rotator cuff dysfunction in patients with displaced clavicular and scapular fractures resulting in loss of normal lever arm of rotator cuff

Hence recommended ORIF

LITERATURE ON TREATMENT OF SSSC INJURIES

OPERATIVE

- **Romeo et al.** reported a poor outcome after scapular neck fractures with malalignment; they measured the glenopolar angle to assess the rotational malalignment of fractures involving the glenoid. In their series patients with scapular fractures, which were displaced by more than 1 cm, had poorer results than those with undisplaced fractures.

ALGORITHM

SSSC INJURIES



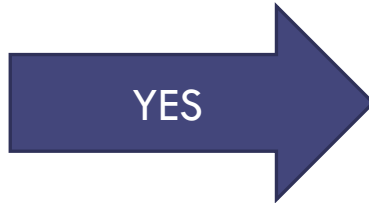
- Less than 5 mm displacement
- No caudal displacement

NO



OPERATIVE MANAGEMENT

YES



CONSERVATIVE MANAGEMENT



1. CLAVICLE PLATING
2. SCAPULA REDUCED/UNREDUCED
3. SCAPULA FIXATION

CASE SCENARIO



