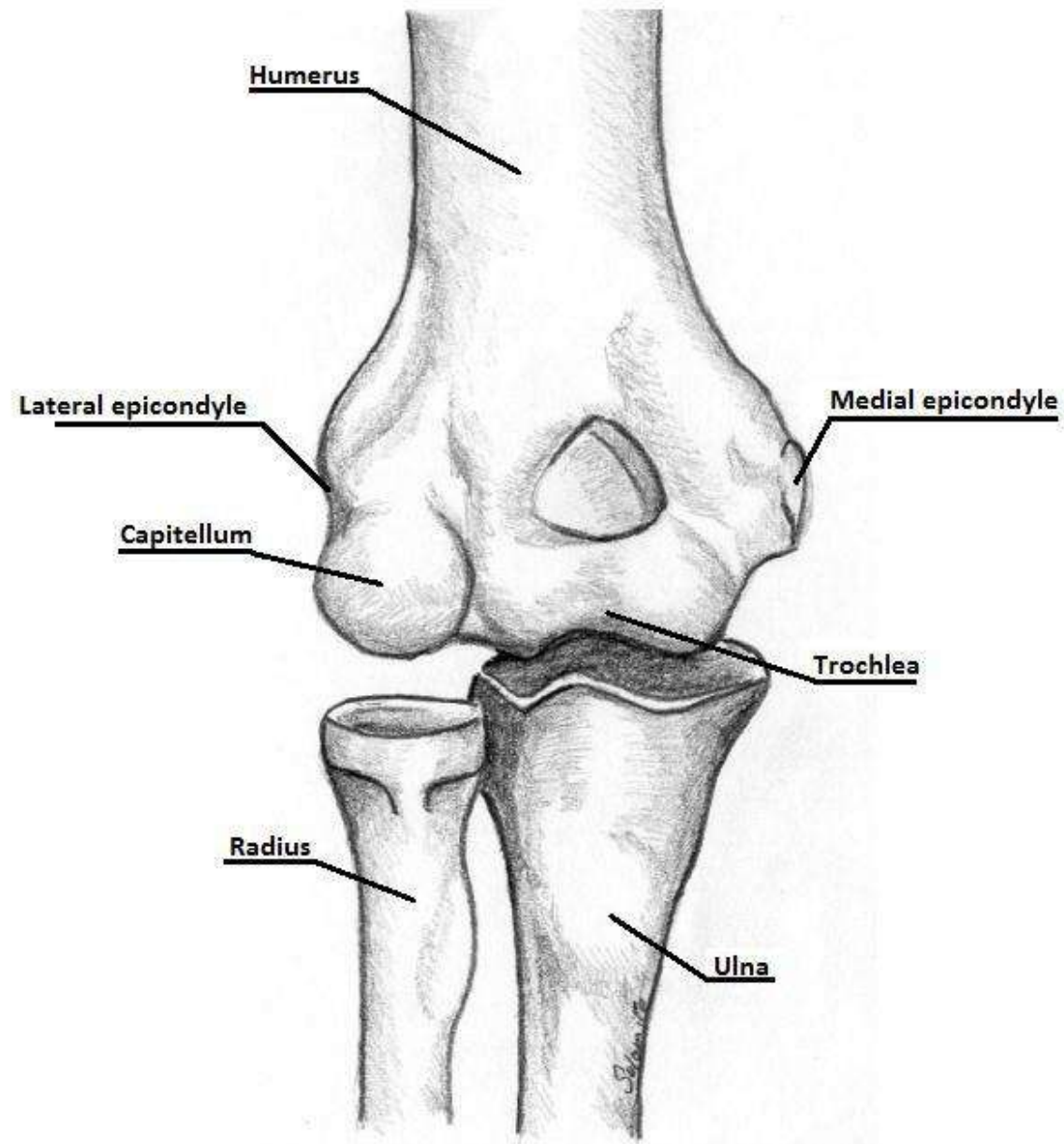


Injuries around the Elbow





Elbow Joint

- Second most common dislocation in Adults
- Complex joint
 - 1) Hinge type of joint (Flexion, Extension) – Humeroulnar and Radio capitellar Joint
 - 2) Pivot Joint (Supination, Pronation) – Proximal Radio-Ulnar joint

Elbow Instability

TRAUMATIC TYPES

ACUTE ELBOW DISLOCATIONS

SIMPLE

COMPLEX (A/W Fractures)

CHRONIC ELBOW DISLOCATIONS

LATERAL ELBOW INSTABILITY

MEDIAL ELBOW INSTABILITY

RECURRENT ELBOW DISLOCATION

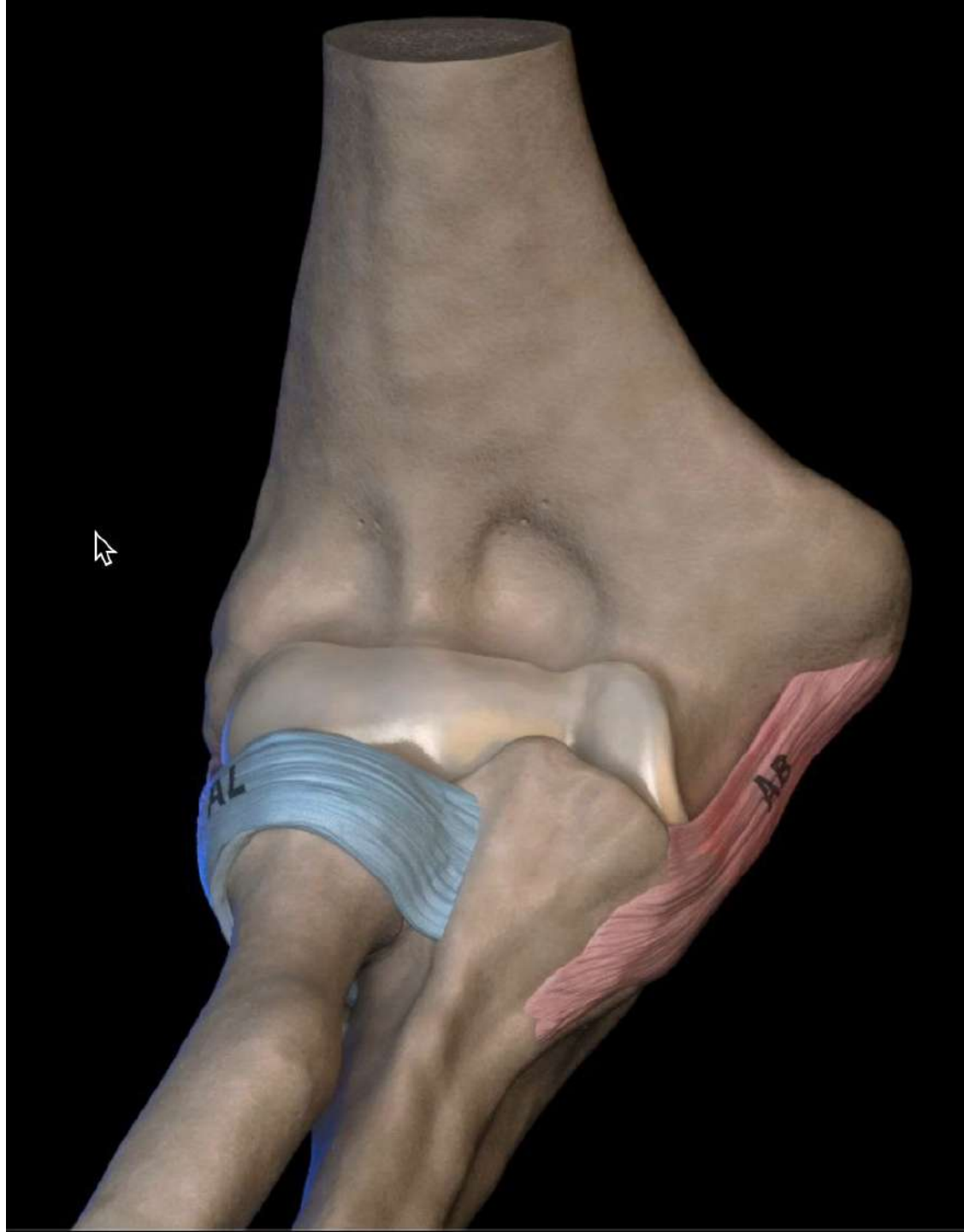
CHRONIC NON-REDUCED ELBOW D/L

NON-TRAUMATIC TYPES

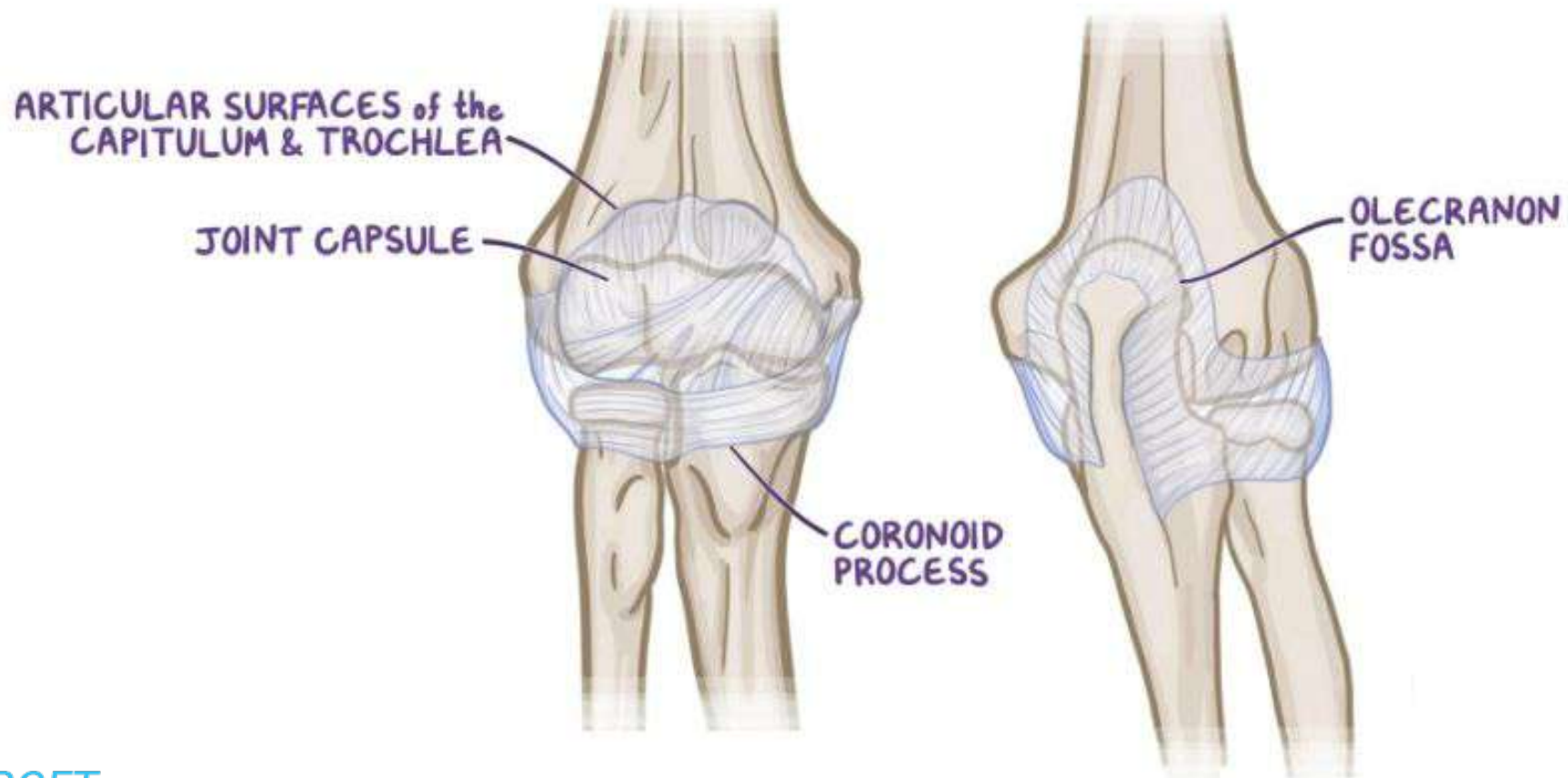
RHEUMATOID ARTHRITIS

CONNECTIVE TISSUE DISORDER

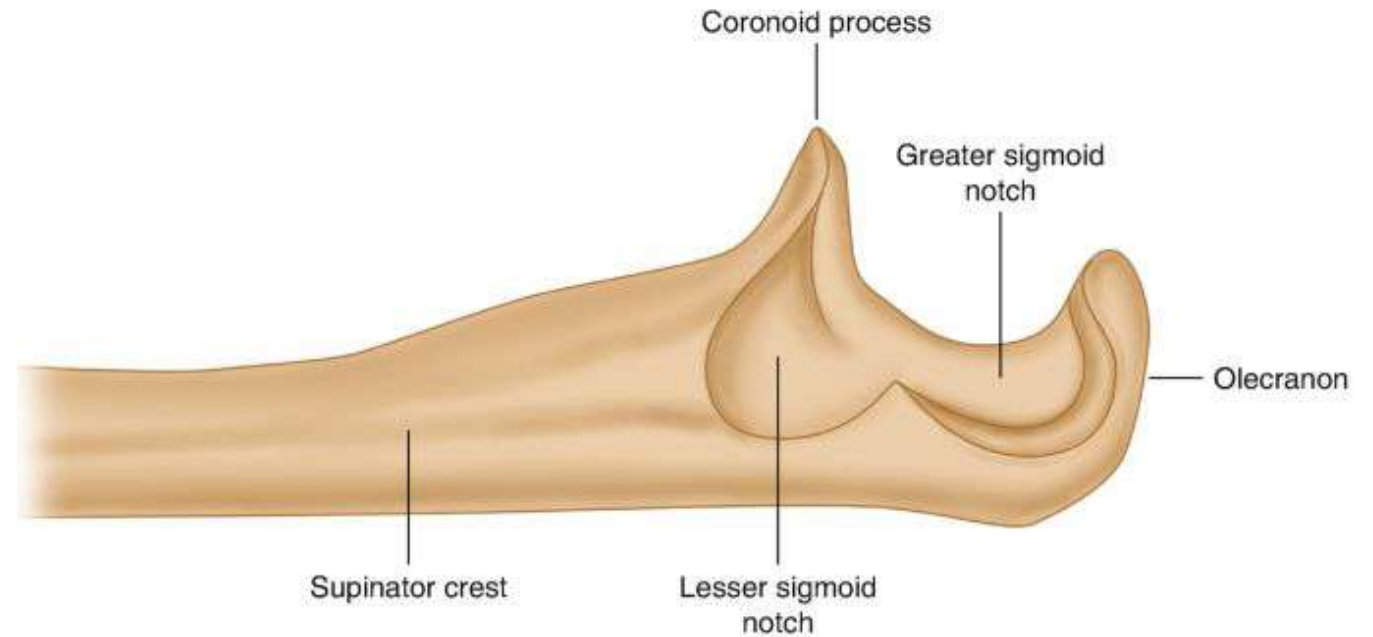
GOUTY ARTHRITIS



Joint Capsule



Proximal Ulna

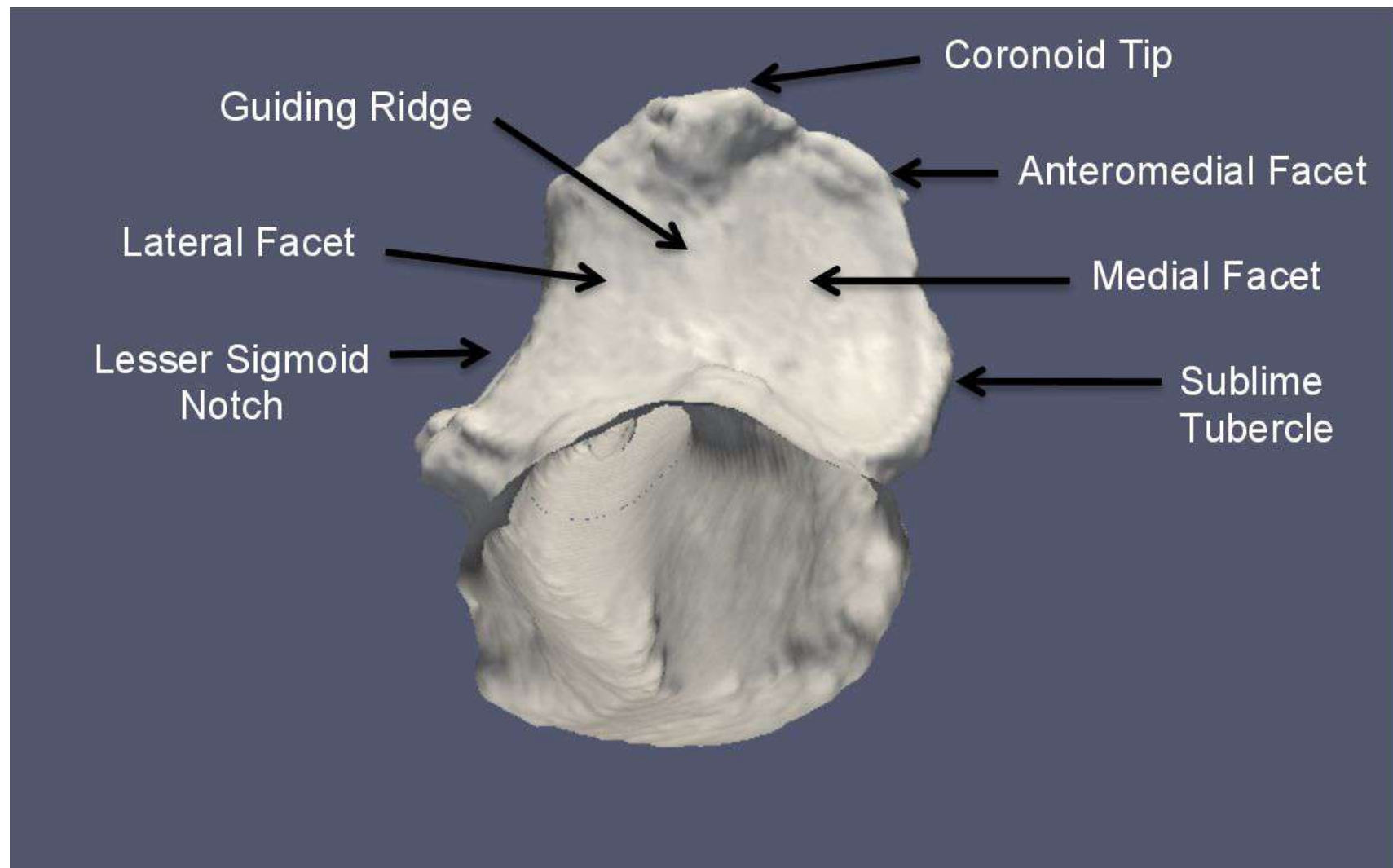


Greater Sigmoid notch articulates with the Trochlea

Lesser Sigmoid notch articulates with the Radial head

Lateral Ulnar collateral ligament attaches Distal to lesser sigmoid notch

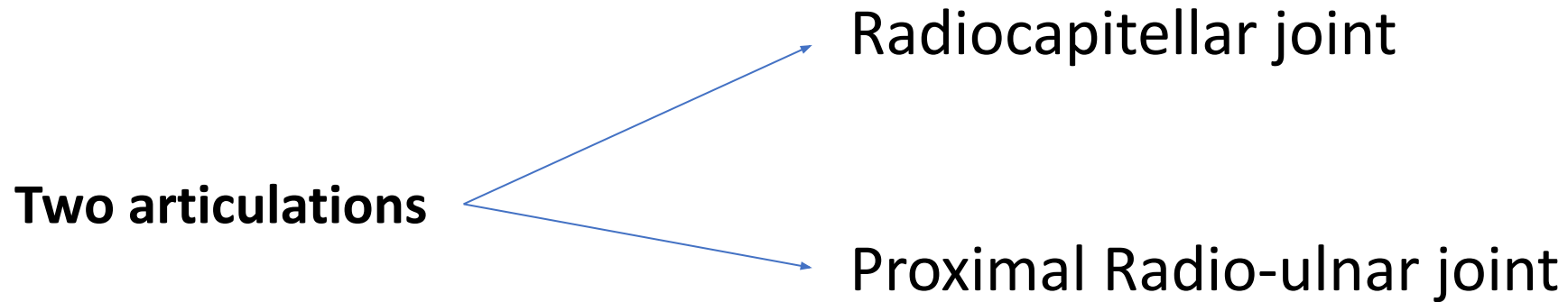
Coronoid Process



Parts of the Coronoid Process

- Tip
 - Body
 - Anterolateral facet
 - Anteromedial facet
-
- Sublime Tubercle – Inferomedial border of anteromedial tubercle
Attachment of **Anterior bundle of MCL**

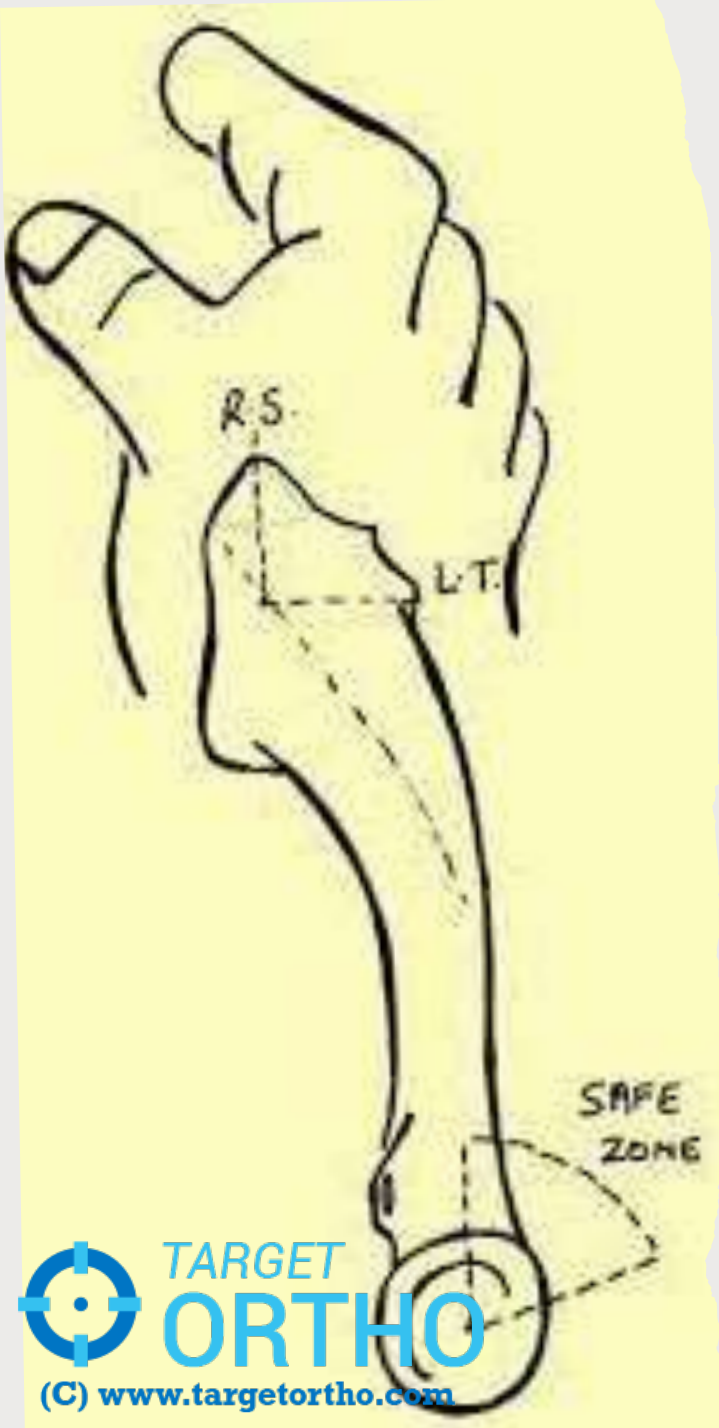
Radial Head



- Secondary Valgus stabilizer
- Restraints to Posterolateral rotatory instability (PLRI)

Safe Zone

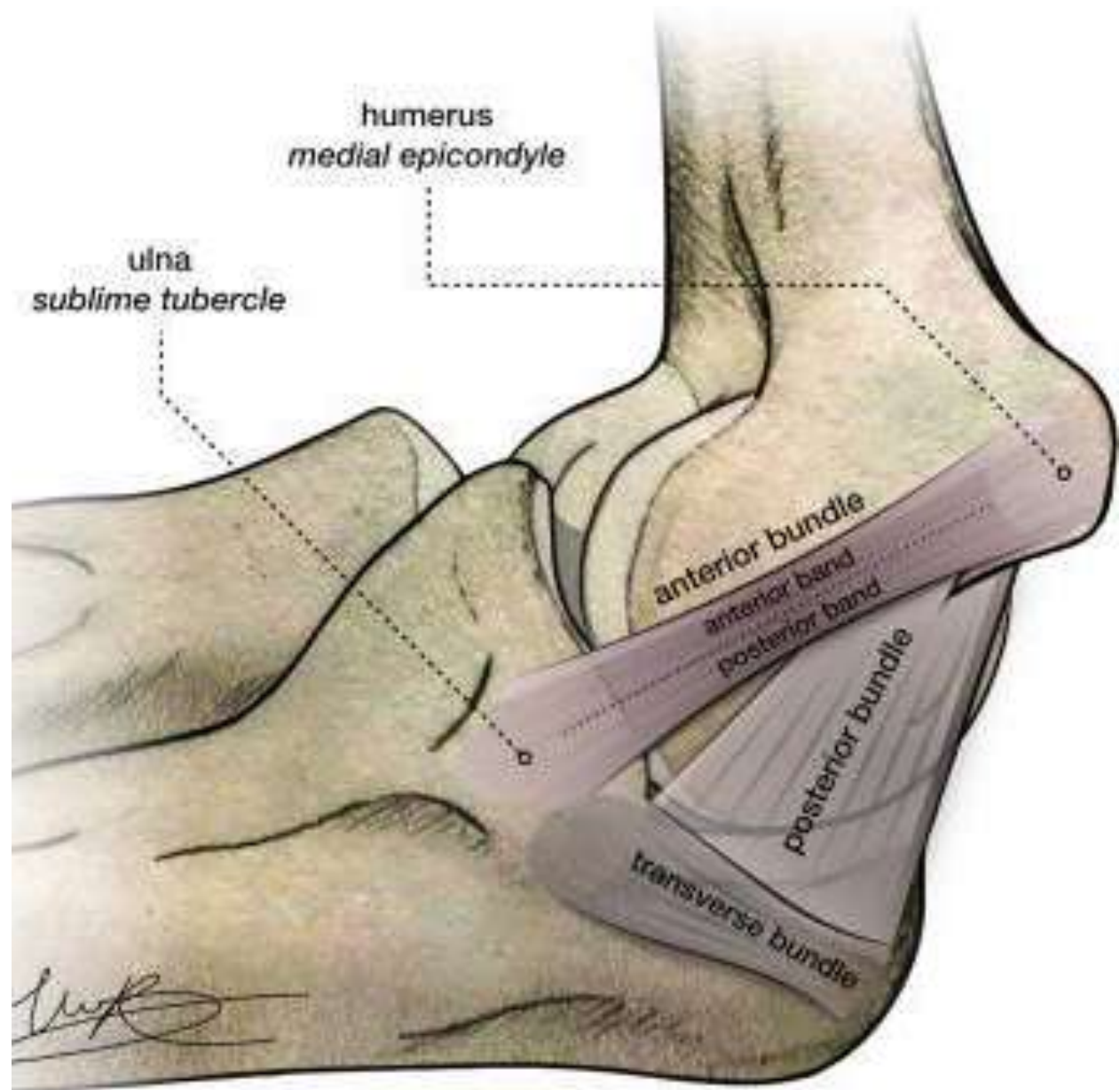
- Radius articulates with the Ulna in 280 degree arc
 - The posterolateral 80 degrees is non-articular
 - Hence it is safe for fixation without causing loss of motion
-
- The zone corresponds to a region between longitudinal lines along **Radial styloid** and **Lister's tubercle** in mid prone forearm position





Radial head plate placement

MCL Ligament



Medial Collateral Ligament

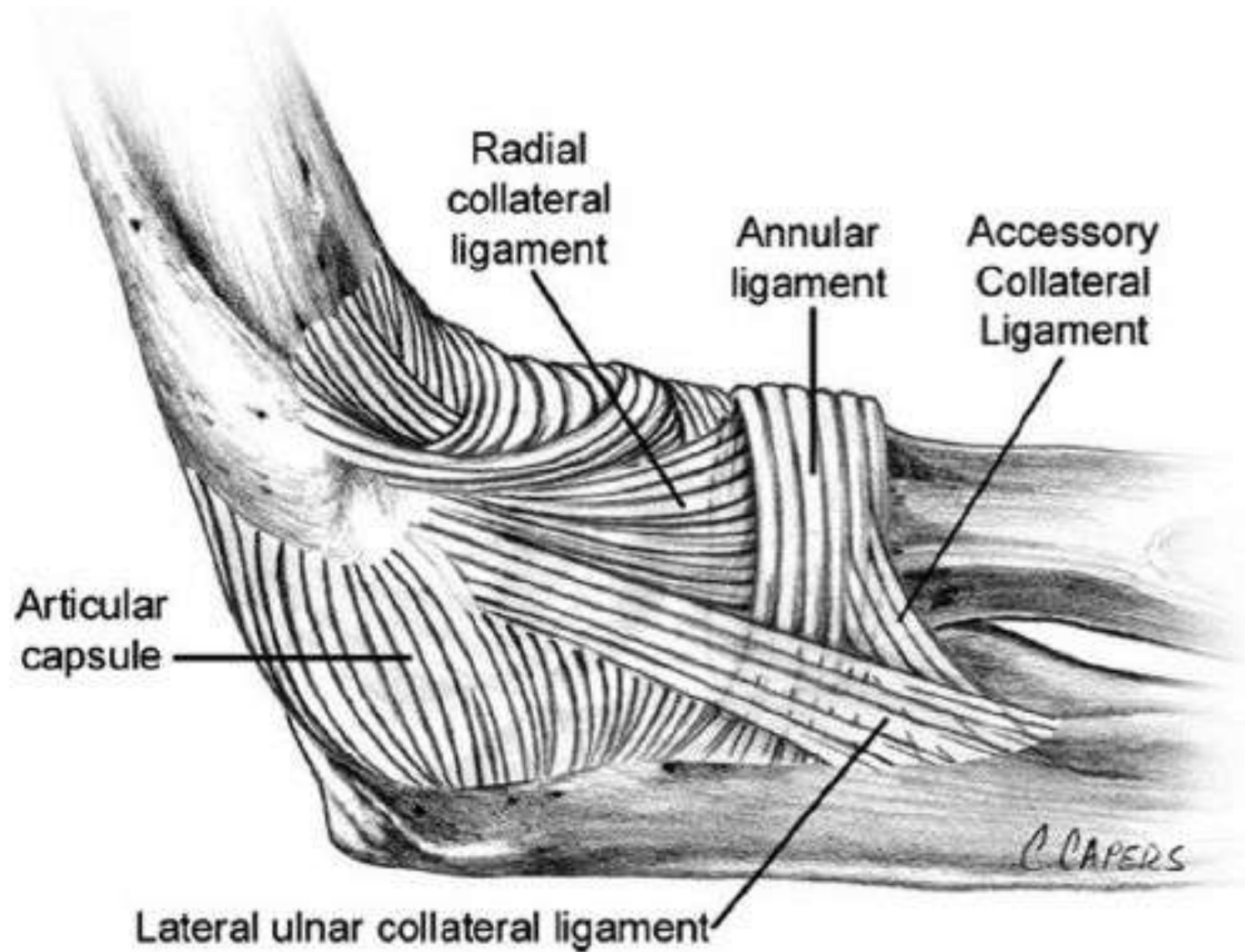
Anterior Bundle (most important)

- Medial epicondyle to Sublime tubercle
- Most important for stability
- Restraint to valgus and posteromedial rotatory instability

Posterior bundle

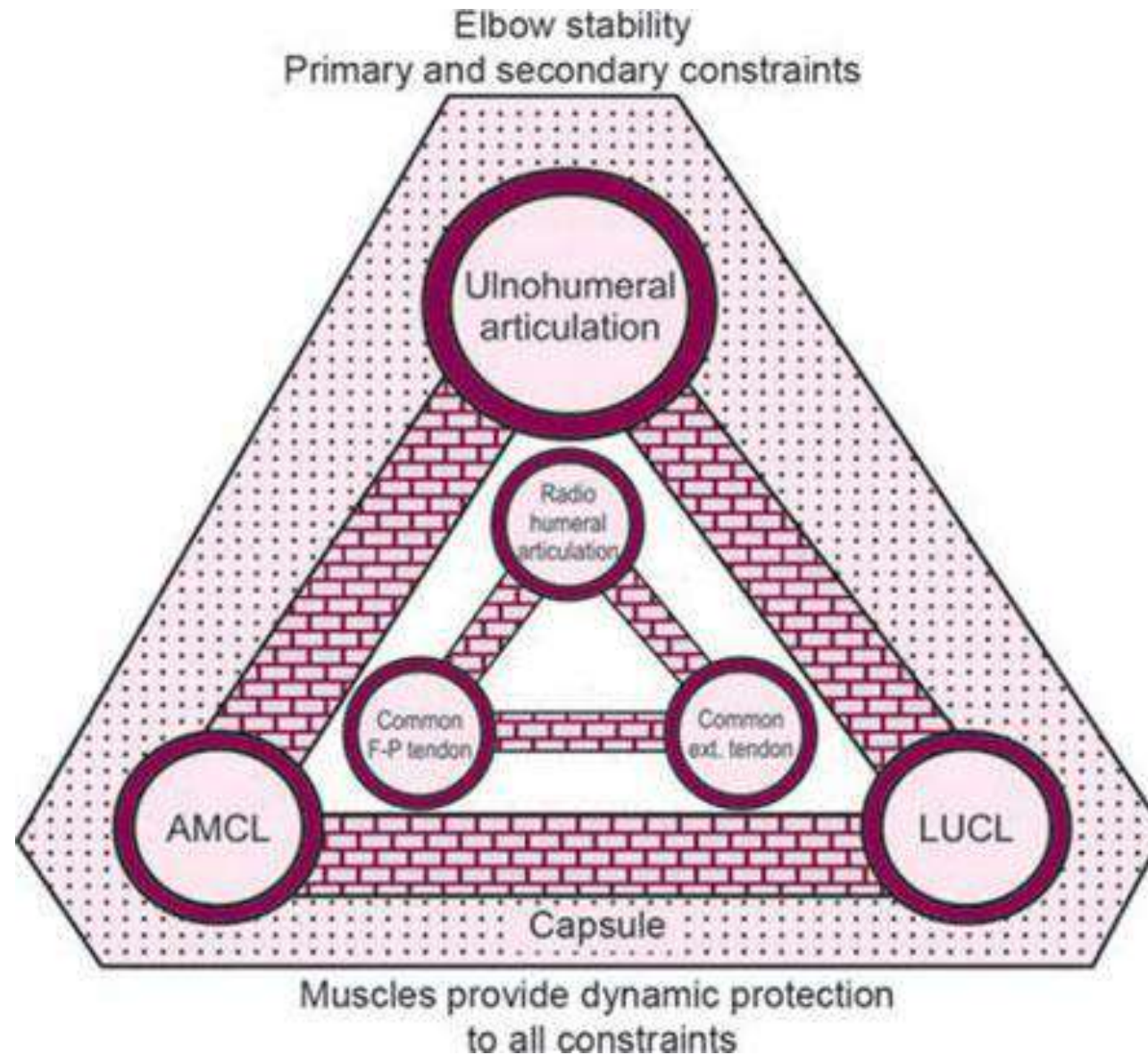
Transverse Ligament

LCL Complex



LCL complex

- Annular ligament - attaches on lesser sigmoid notch of ulna
 - Radial collateral ligament – Lateral Epicondyle to Annular Ligament
 - Lateral Ulnar collateral ligament - Lateral Epicondyle to Supinator crest
-
- Restraint to Varus and Posterolateral rotatory instability (PLRI)



Muscles

Flexor Pronator mass – Dynamic stabilizer when elbow is under Valgus

Extensor mass – Dynamic stabilizer when elbow is against Varus

Stability of the Elbow

- **Static constraints**
- **Dynamic constraints**
Muscles around the elbow joint

STATIC CONSTRAINTS

PRIMARY STATIC CONSTRAINTS

- Ulna-humeral articulation
- MCL (mainly anterior bundle)
- LCL (mainly LUCL)

SECONDARY STATIC CONSTRAINTS

- Radio-capitellar articulation
- Common Extensor origin
- Common Flexor origin

Most important Valgus Stabilizer of the elbow is :

A) Anterior bundle of MCL

B) Radial head

C) Flexor pronator mass

D) LUCL

Most important Valgus Stabilizer of the elbow is :

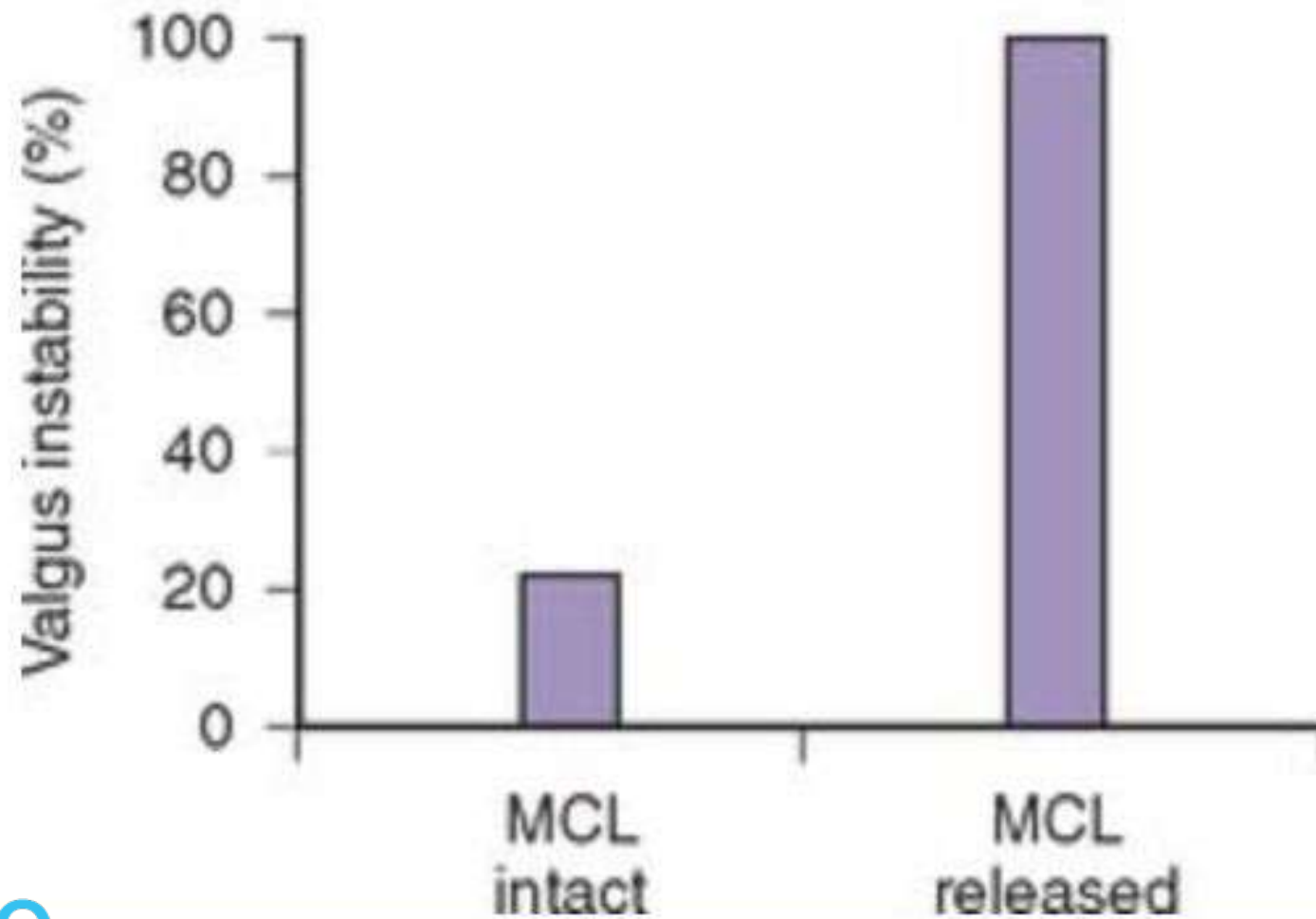
A) Coronoid process

B) Radial head

C) Flexor pronator mass

D) LUCL

RADIAL HEAD REMOVED



Most important Varus Stabilizer of the elbow is :

(2016 FNB)

A) Coronoid process

B) MCL Anterior bundle

C) Extensor mass

D) LUCL

Primary Posterolateral rotatory Stabilizer of the elbow is :

A) Coronoid process

B) Radial head

C) Anterior band MCL

D) LUCL

VALGUS STABILIZER	VARUS STABILIZER	PLR STABILITY	PMR STABILITY
PRIMARY – MCL ANTERIOR BUNDLE SECONDARY – RADIAL HEAD ARTICULATION FLEXOR PRONATOR MASS	PRIMARY – CORONOID PROCESS SECONDARY- LUCL EXTENSORS	PRIMARY – LUCL SECONDARY- RADIAL HEAD	MCL



Radial Head fractures

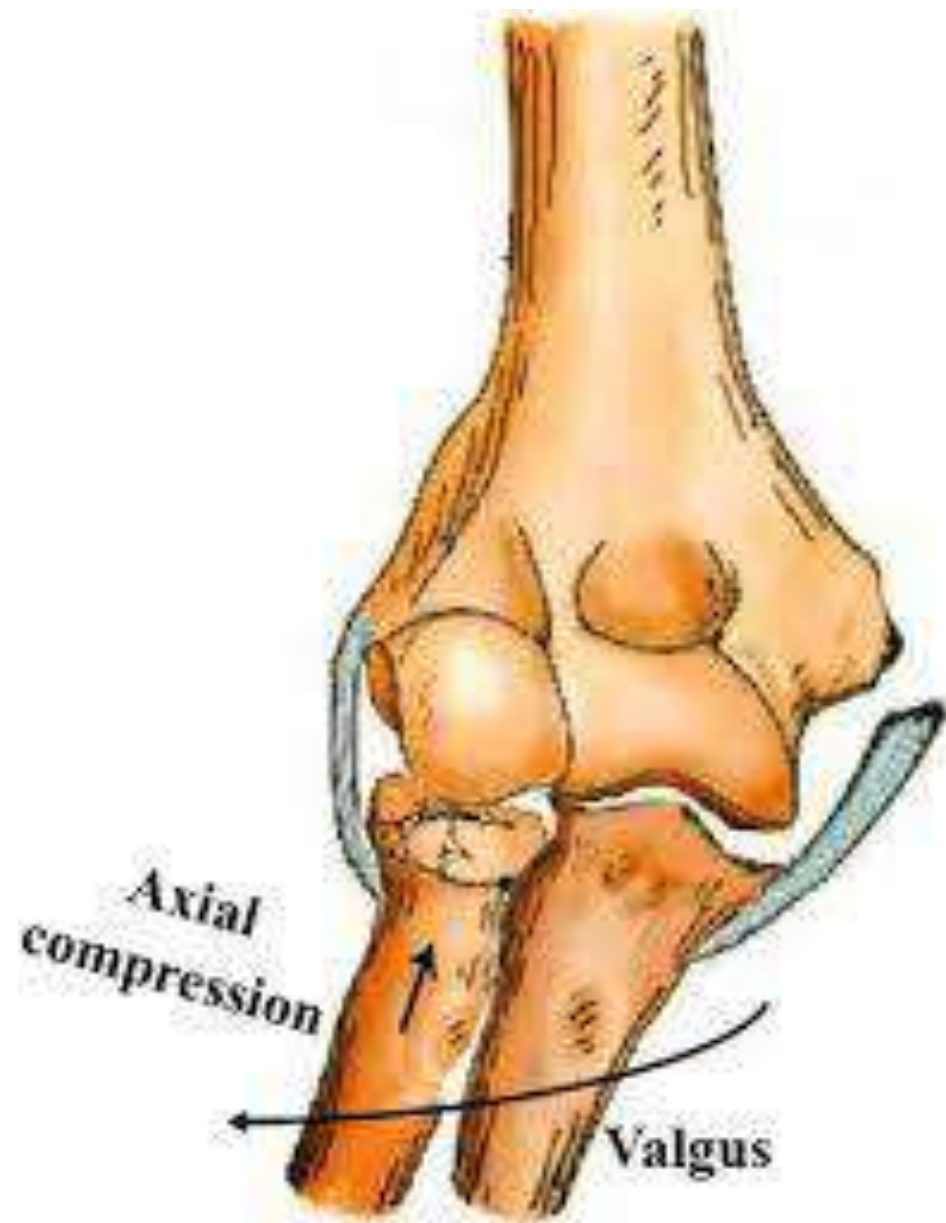
Most common
elbow fractures
in adults

20-50 years

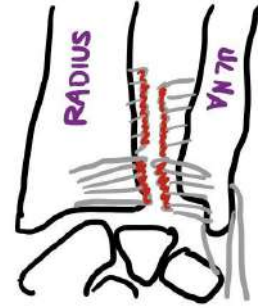
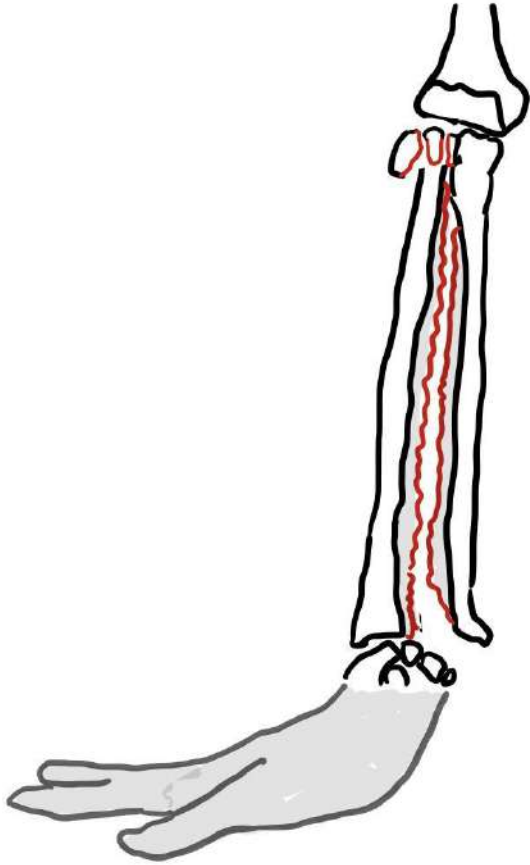
Female > Male

Isolated
fracture

Terrible triad of
elbow



ESSEX LOPRESTI INJURY

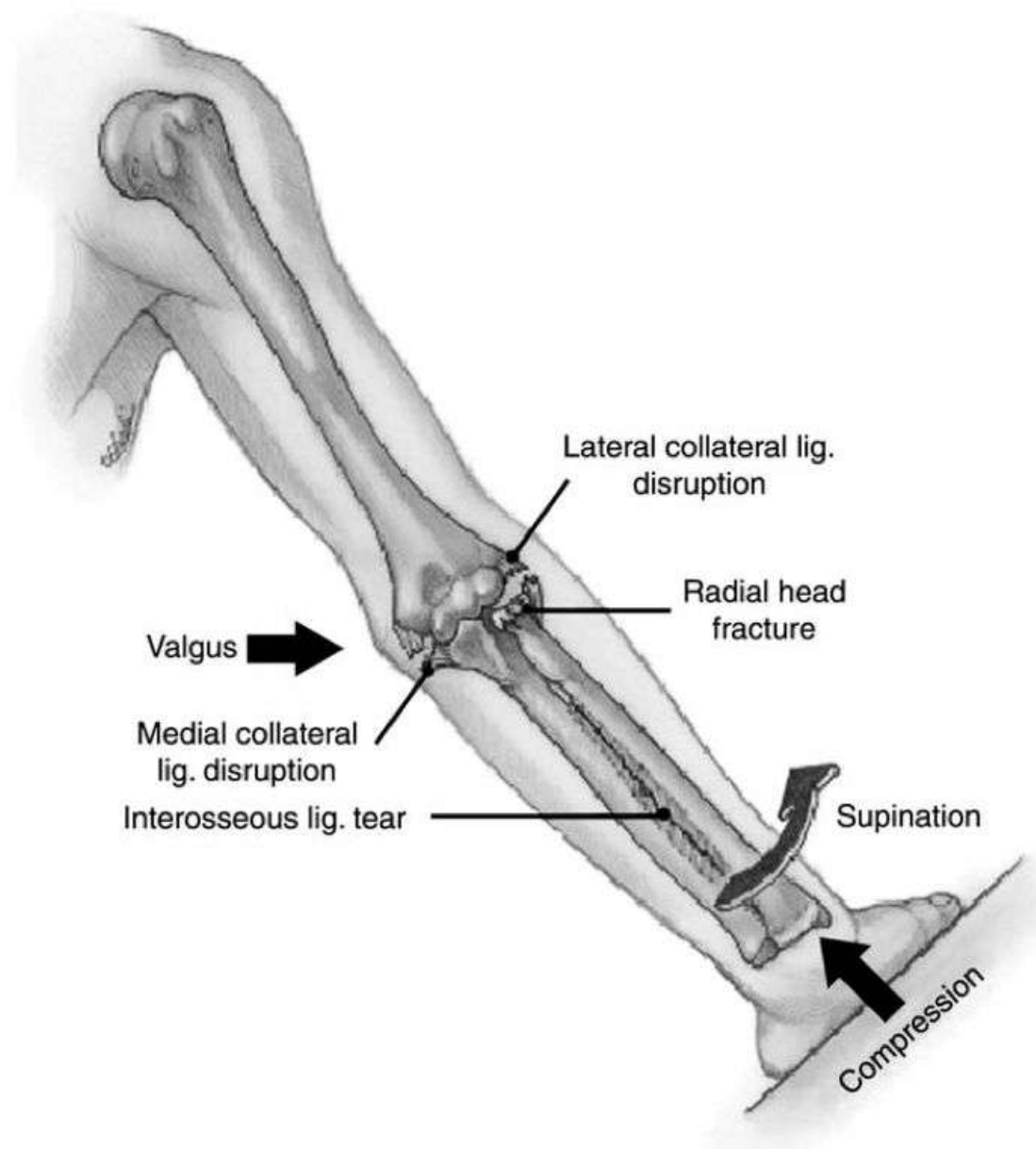


Distal radio-ulnar joint
subluxation

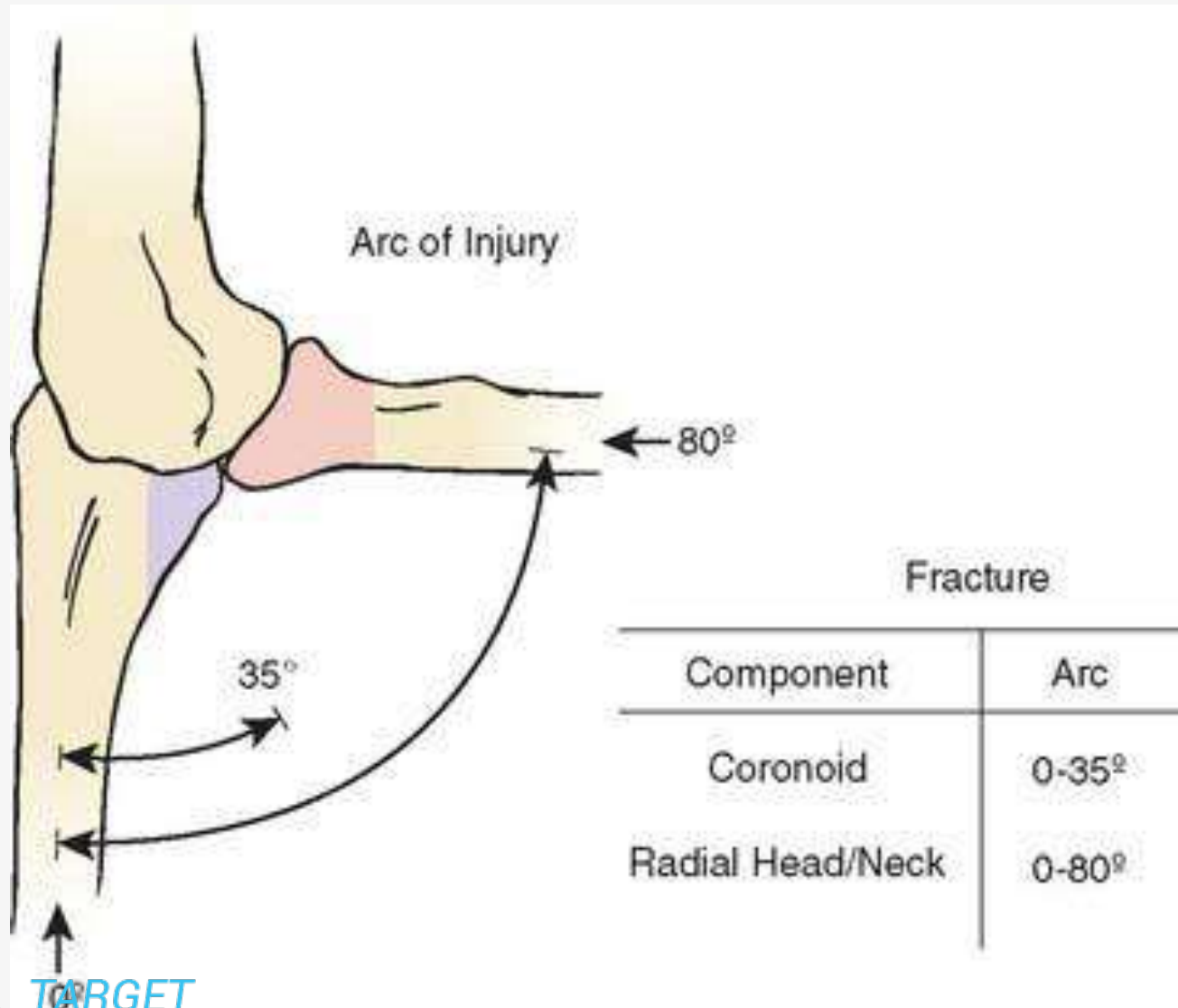
Interosseous membrane
rupture



Radial head fracture

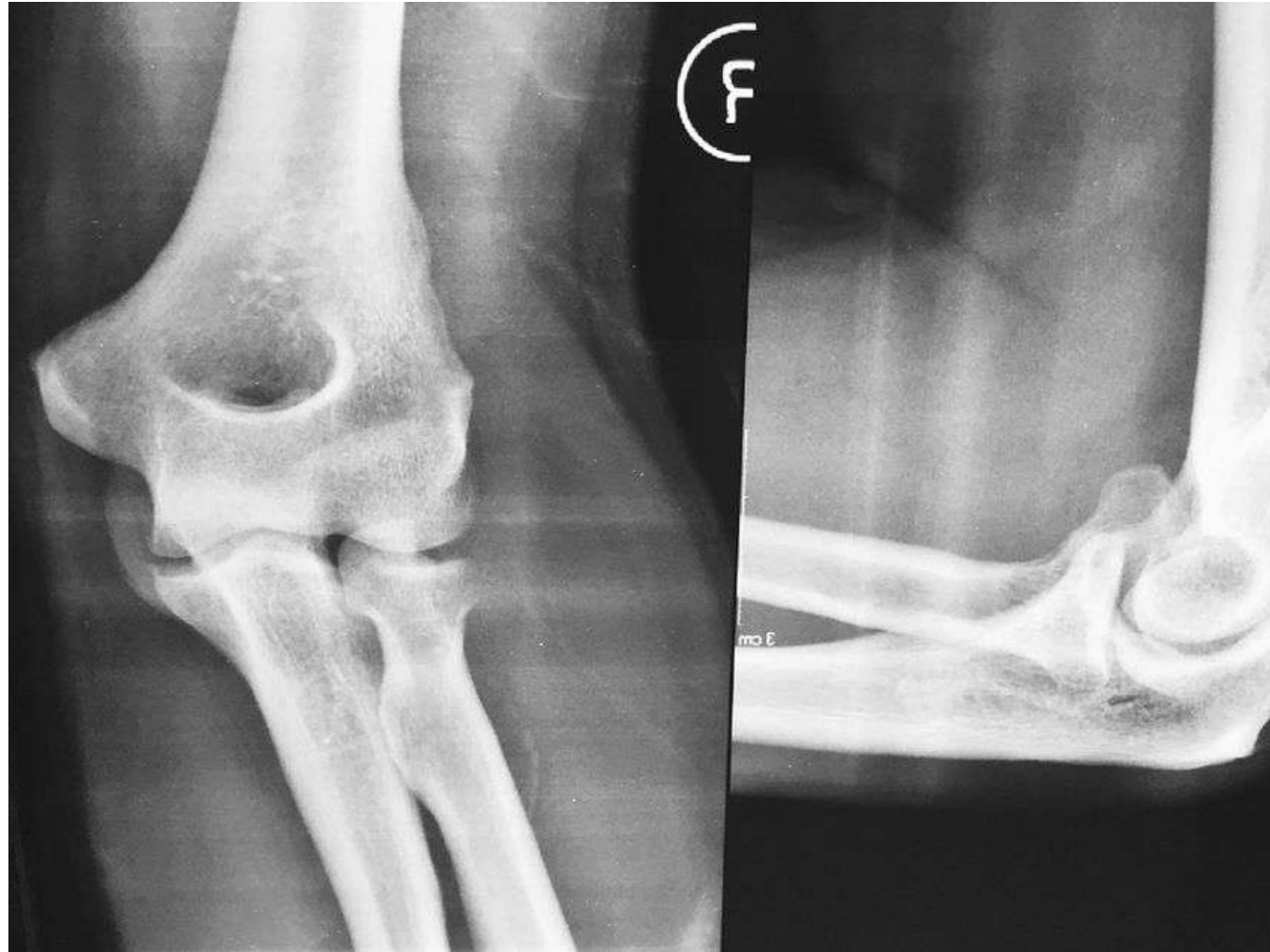






Amis and Miller recently enhanced our understanding of this and other fractures by correlating the fracture and the angle of flexion. As is seen experimentally, either the coronoid or radial head may be fractured with the elbow in full extension, but the radial head can be fractured at greater degrees of flexion, approaching 80 degrees of the flexion arc.

X-RAY – Radial Head fractures





Anterior fat pad
Posterior fat pad

Fracture of the radial head
the articular surface

Joint effusion or
Intra-articular
Hemorrhage displacing
the fat pads

The fat pads

Any special views?

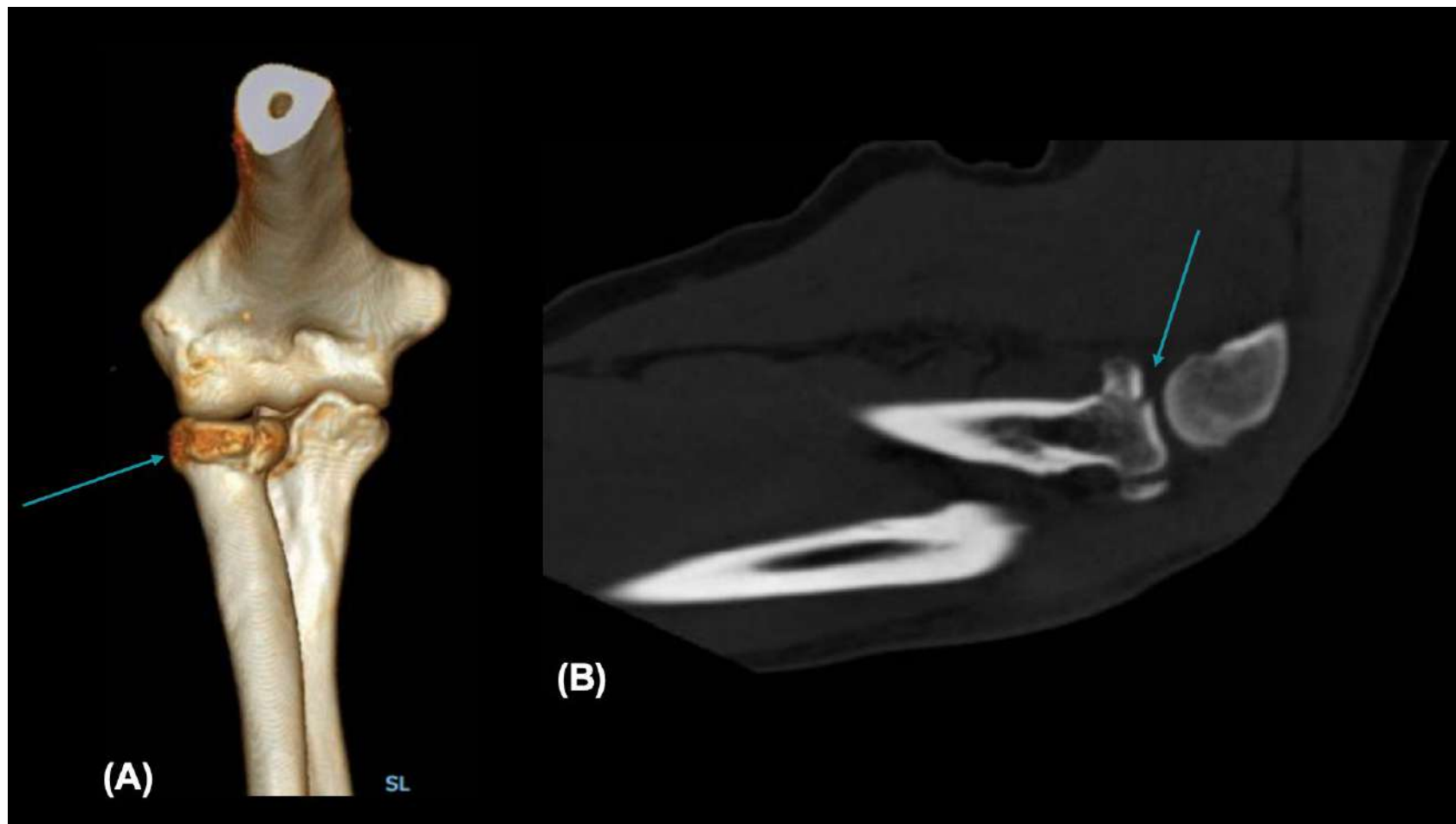


Greenspan view

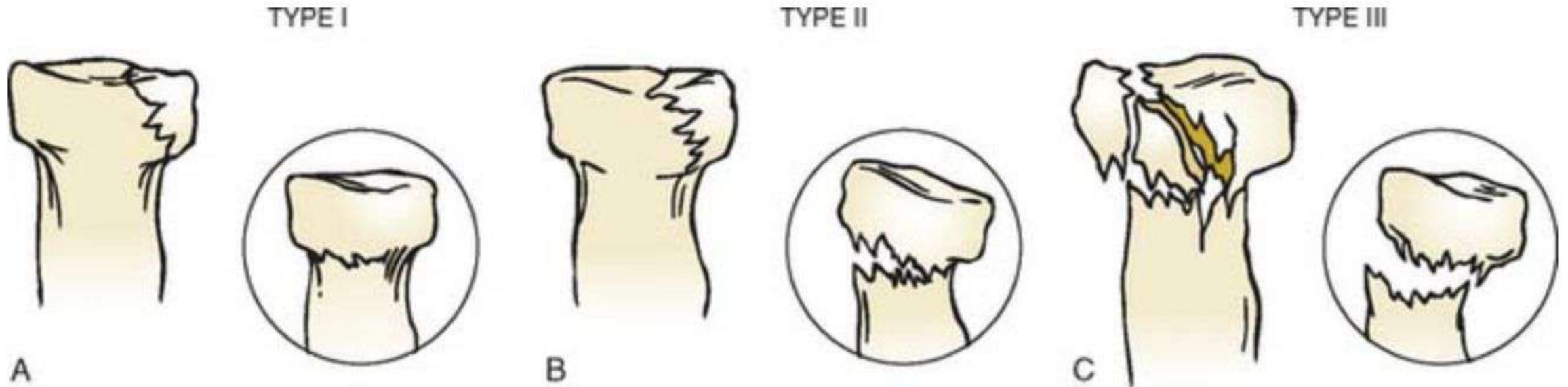
- Radio-capitellar view
- Oblique lateral view of Elbow
- Aiming the beam 45 degree cephalad



CT scan

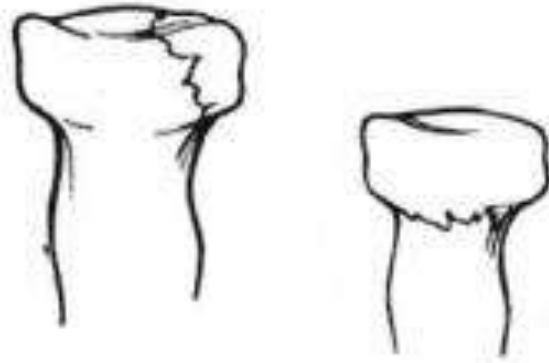


MASON CLASSIFICATION

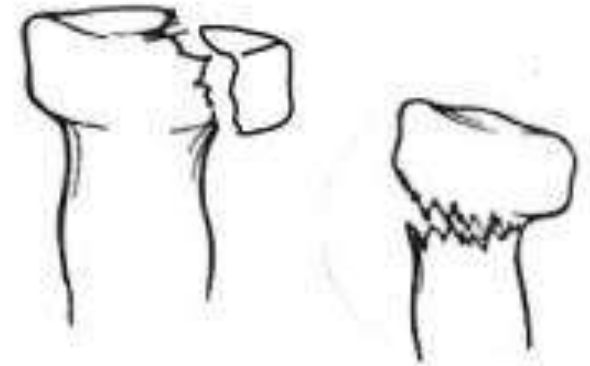


JOHNSTON, HOTCHKISS AND BROBERG MODIFICATION OF MASON CLASSIFICATION

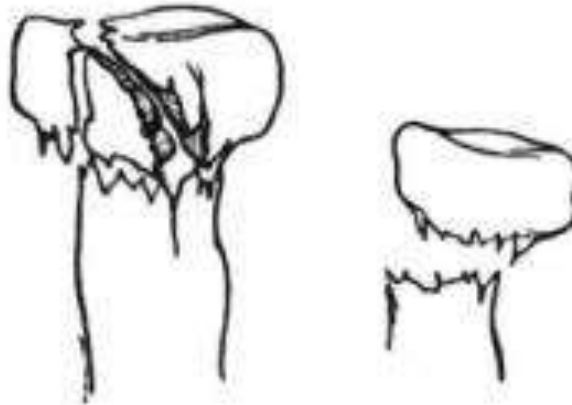
TYPE I



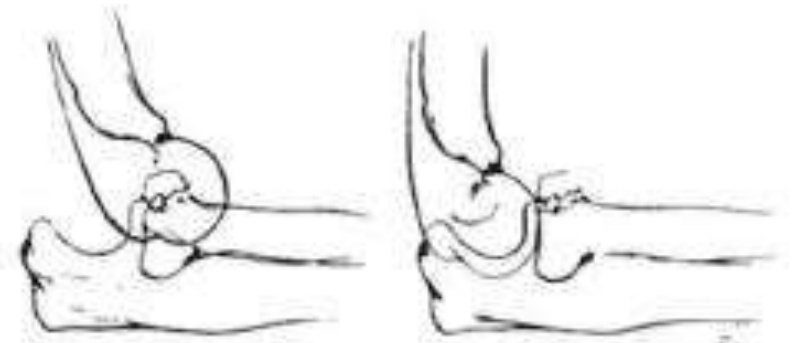
TYPE II



TYPE III



TYPE IV



(after reposition)

Table 1 Classification and description of radial head fractures

Description of classification according to various authors					
Type	Mason	Johnston	Hotchkiss	Broberg and Morrey	Rineer
I	Without displacement	Without displacement	< 2 mm dislocation	< 2 mm dislocation	Cortical contact between fragments > stable No cortical contact between fragments > unstable
II	With displacement	With displacement	> 2 mm dislocation	> 2-3 mm dislocation and involves > 30% of radial head	
III	Comminuted	Comminuted	Comminuted	Comminuted	
IV	-	Fracture associated with dislocation of the elbow		Fracture associated with dislocation of the elbow	

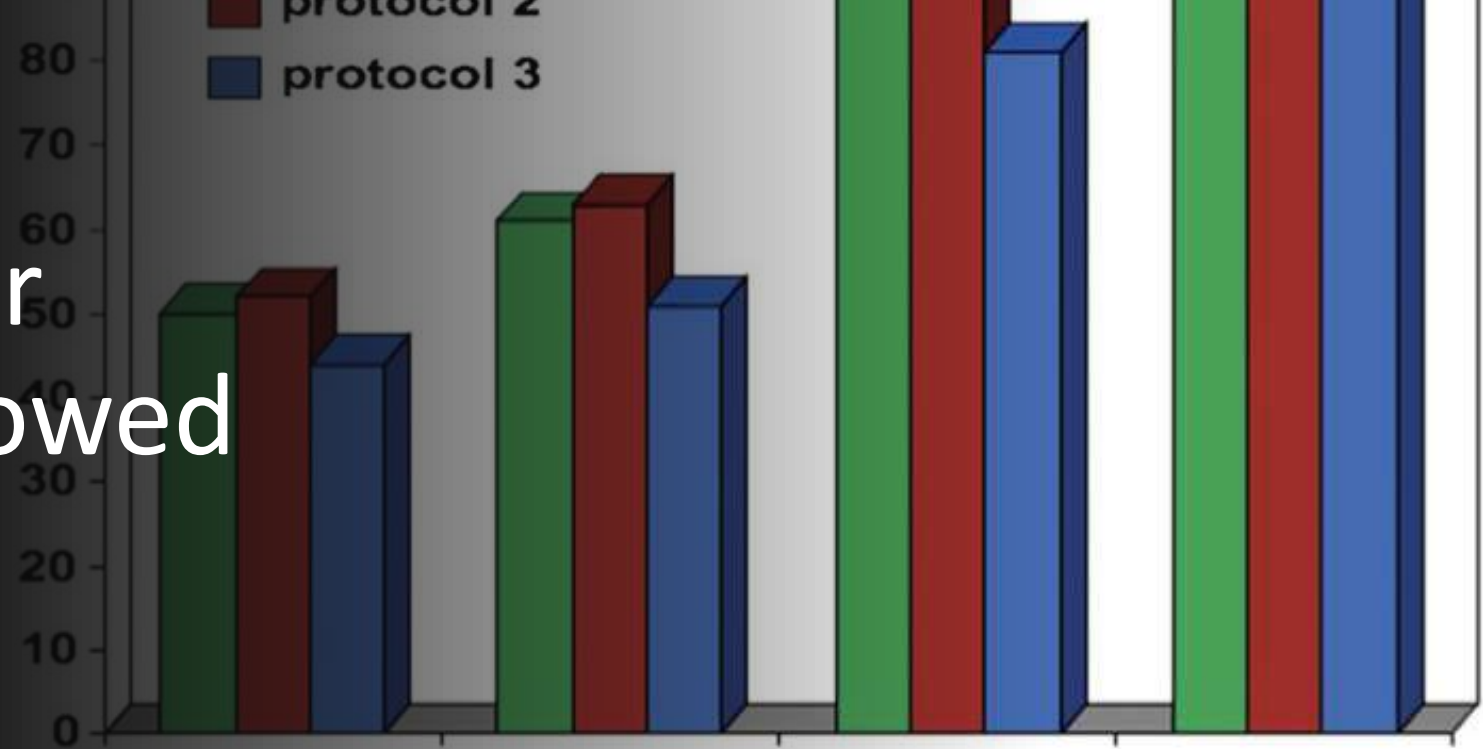
Treatment

Non-Operative

- Undisplaced
- No block to forearm rotation
- No crepitus in forearm rotation

Operative

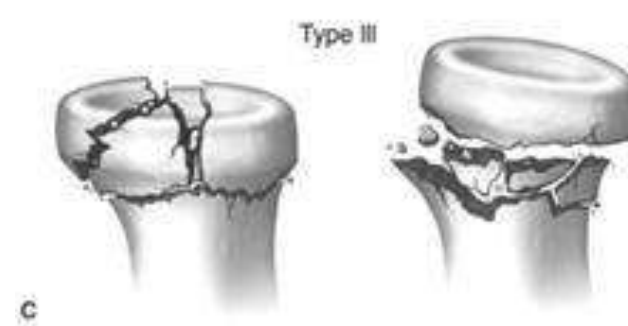
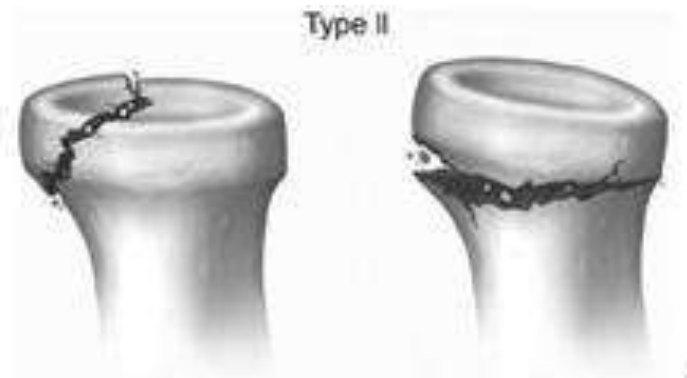
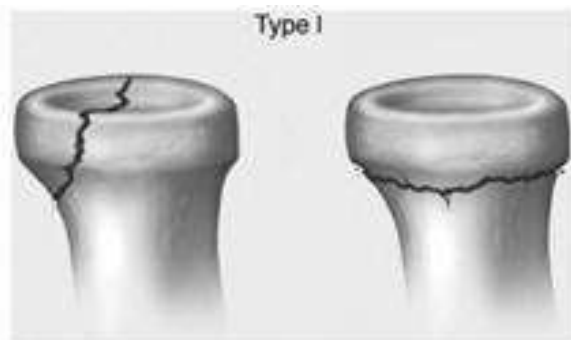
Immobilization for 3 days (Sling) followed by **Active** ROM Exercises



ORIGINAL ARTICLE

Comparison of Early Mobilization Protocols in Radial Head Fractures

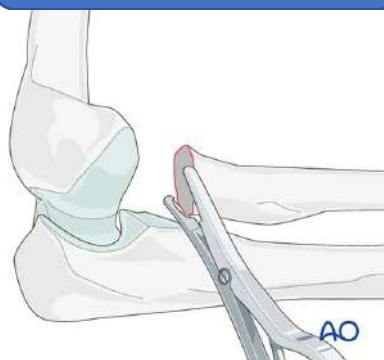
*Nikolaos K. Paschos, MD, Grigorios I. Mitsionis, MD, Haris S. Vasiliadis, MD,
and Anastasios D. Georgoulis, MD*



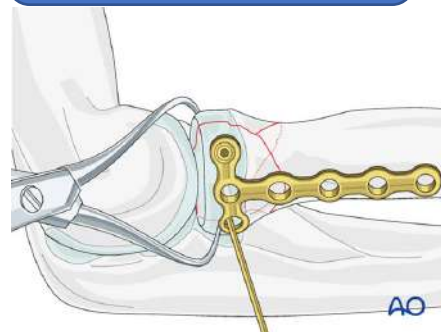
Conservative
Sling application
Early active ROM

<25%,
Non
recon

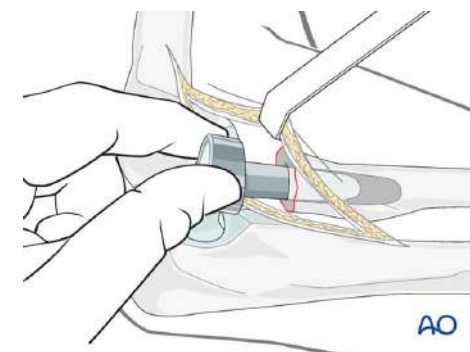
Radial head
excision



Radial head
fixation



Radial head
Replacement



Radial Head Excision

In unreconstructable radial head fractures, the excision is indicated:

- in isolated radial head fracture
- in low energy fracture
- in radial head fracture without associated fracture or ligament injury

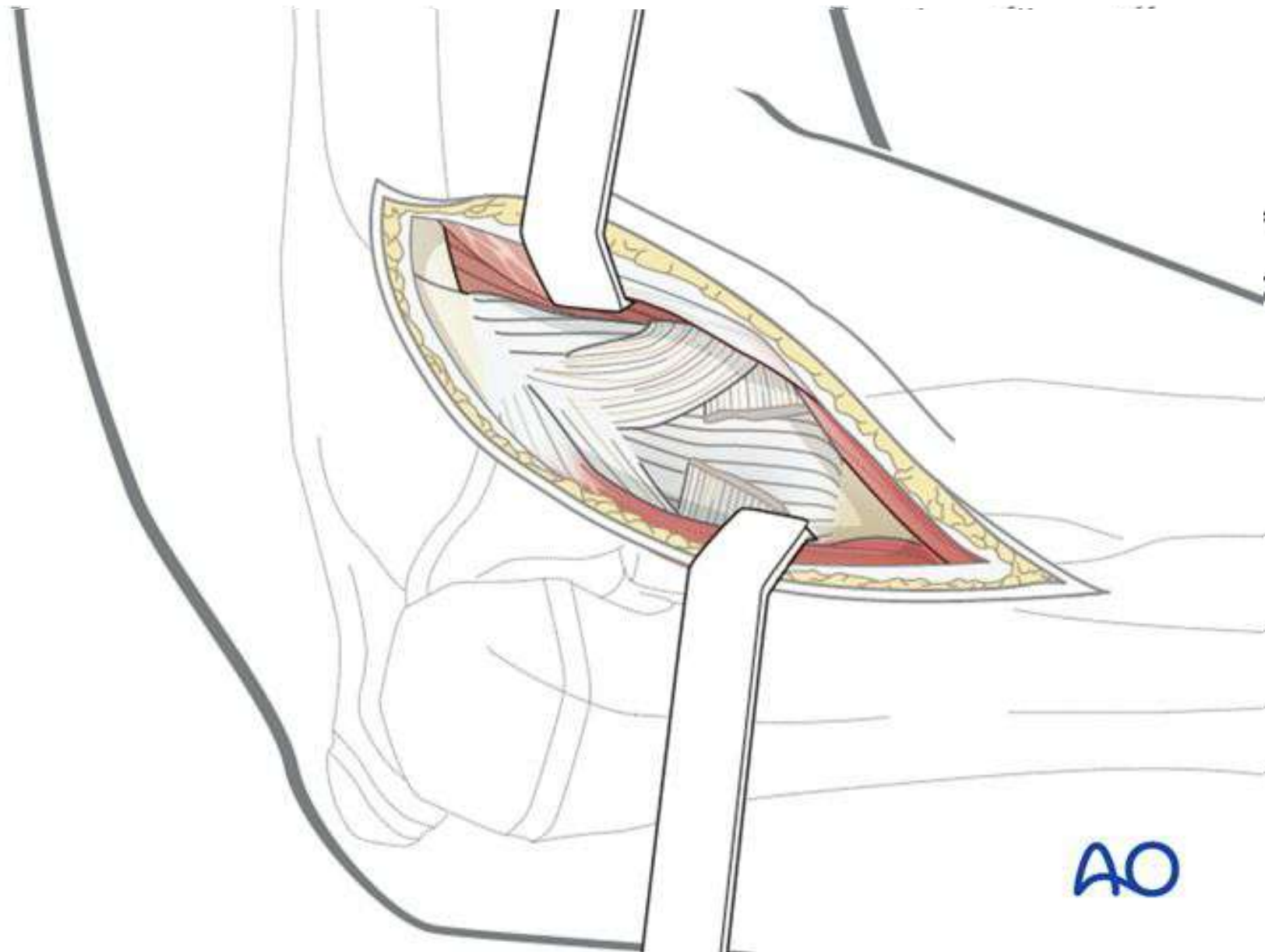
Radial head excision can produce **instability of elbow or forearm** (Essex-Lopresti lesion). Thus, it is contraindicated when the elbow joint is unstable (eg, coronoid fracture and / or collateral ligament rupture), or when the interosseous membrane and DRUJ have been injured.

Radial prosthesis

Approach

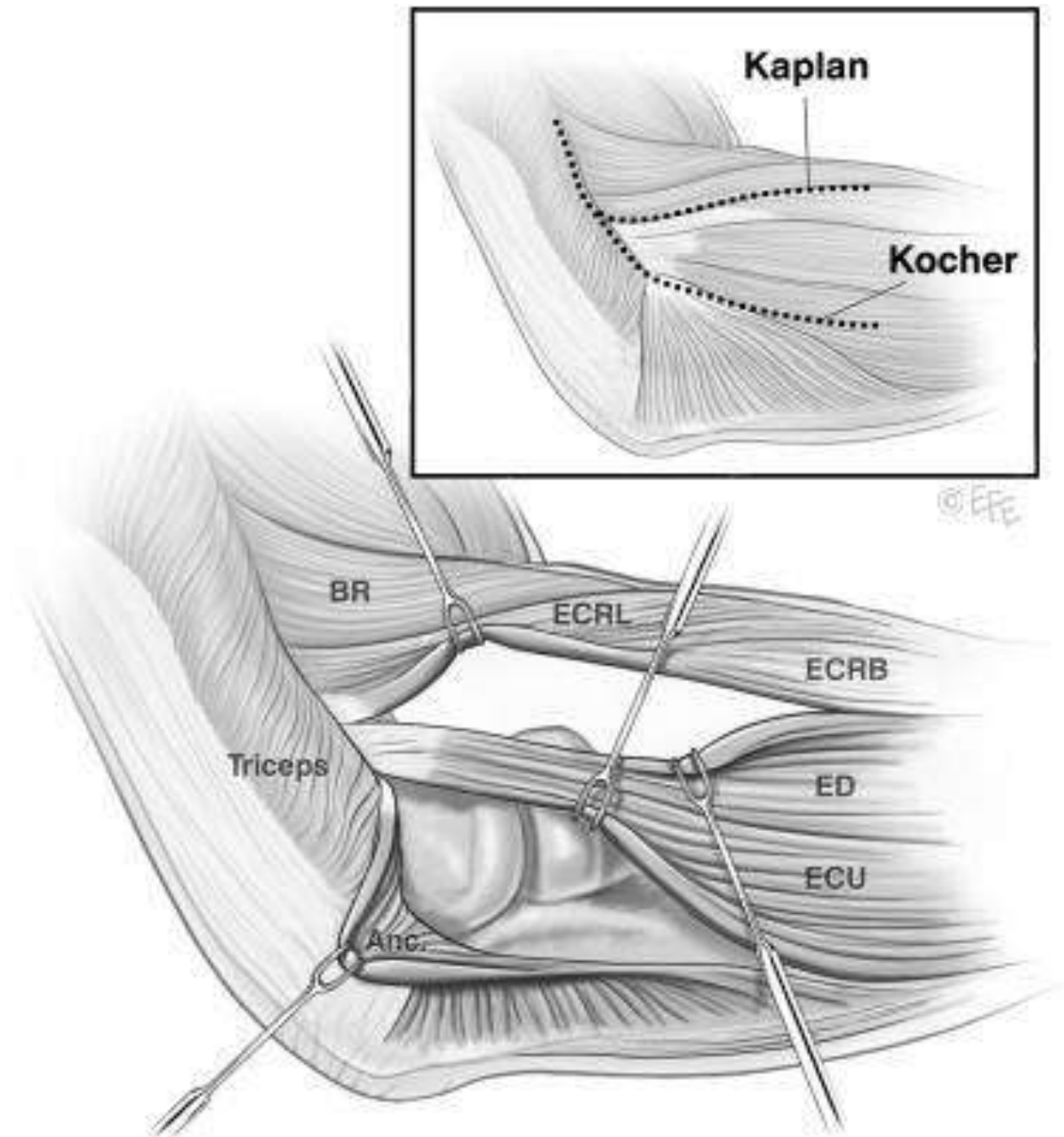
- Kocher
- Kaplan
- EDC Split

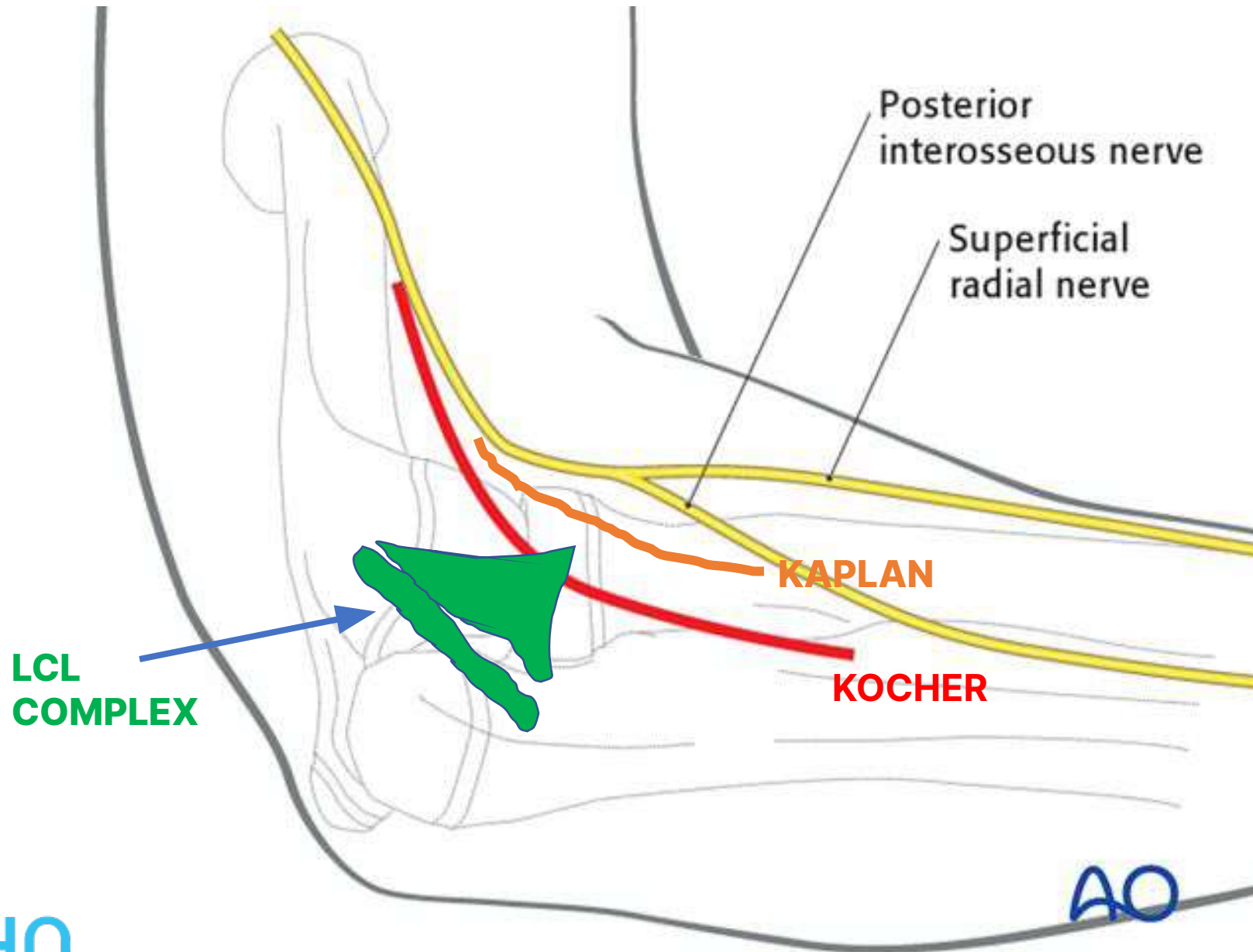
Kocher Approach



- Fully pronating the forearm protects the posterior interosseous nerve by moving it away from the operative field.
- Beware of incising the capsule too far anteriorly as the radial nerve lies over the front of the anterolateral portion of the elbow capsule.
- Beware of dissection distal to the annular ligament or strenuous retraction, because the posterior interosseous nerve lying within the supinator muscle is at risk.
- No retractor should be placed around the radial neck.

KAPLAN APPROACH



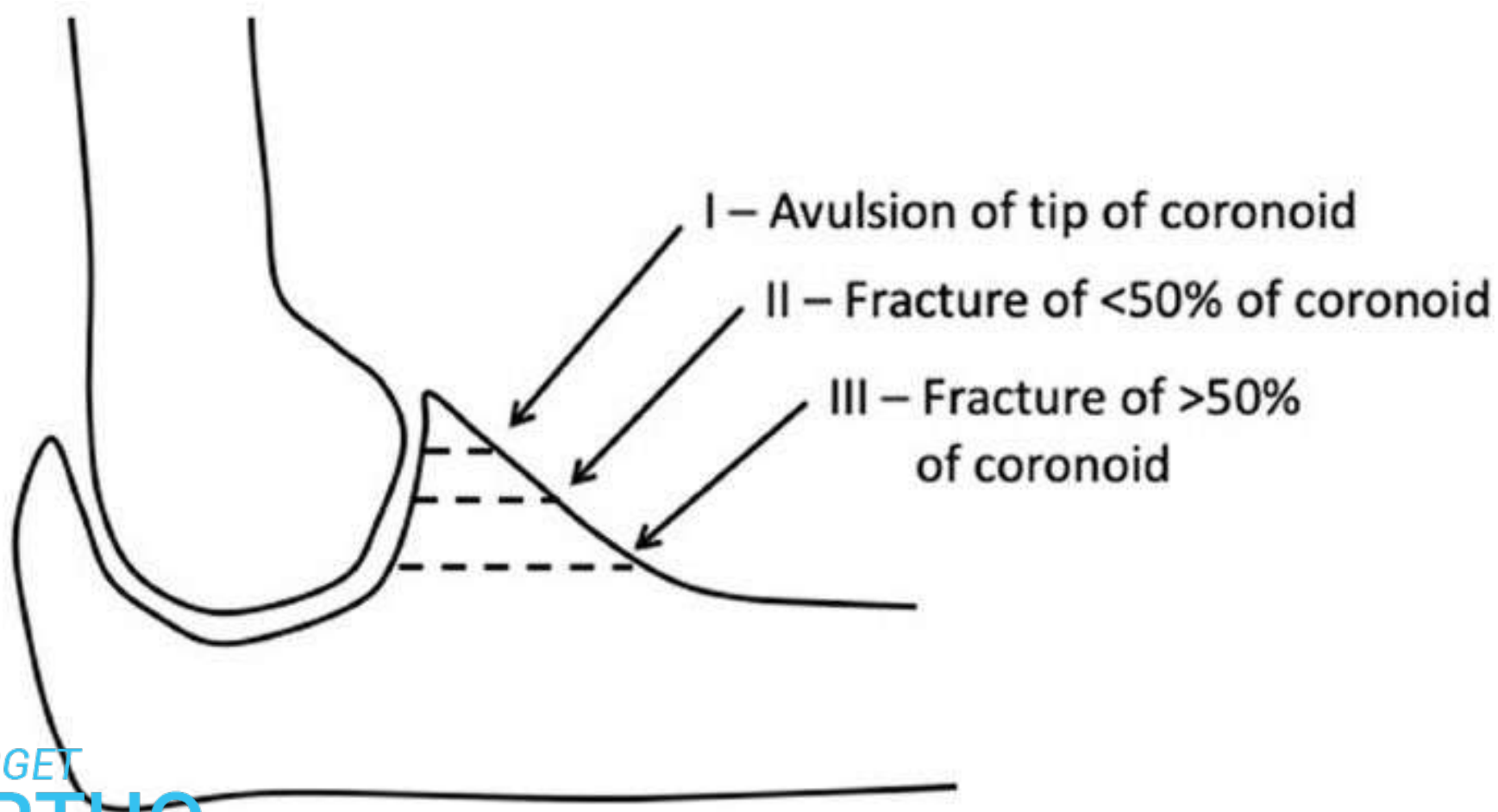


Coronoid fracture

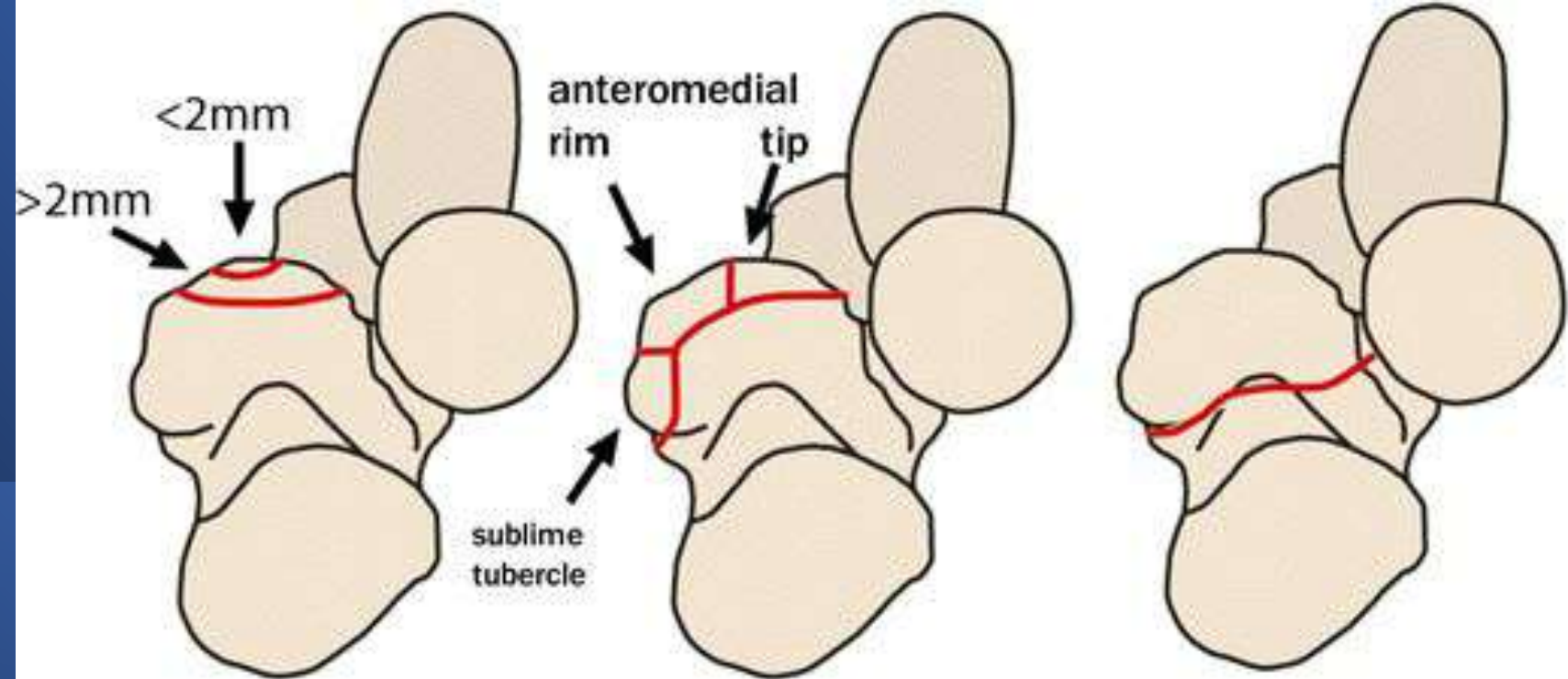
Coronoid Fracture

- Anterior buttress of Elbow
- Prevents Posterior Elbow Dislocation
- Fracture Coronoid leads to Functional MCL incompetency
- Isolated Coronoid with Elbow instability can be ignored unless Anteromedial fragment involved
- Fracture of Coronoid >50% of Height will lead to Elbow Instability

Regan-Morrey classification



O'Driscoll Classification



Type I

Transverse fractures of the tip

Subtype I: < 2mm
Subtype II: > 2mm

Type II

Fractures involving the anteromedial facet

Subtype I:
anteromedial rim
Subtype II:
anteromedial rim and tip
Subtype III:
anteromedial rim and

Type III

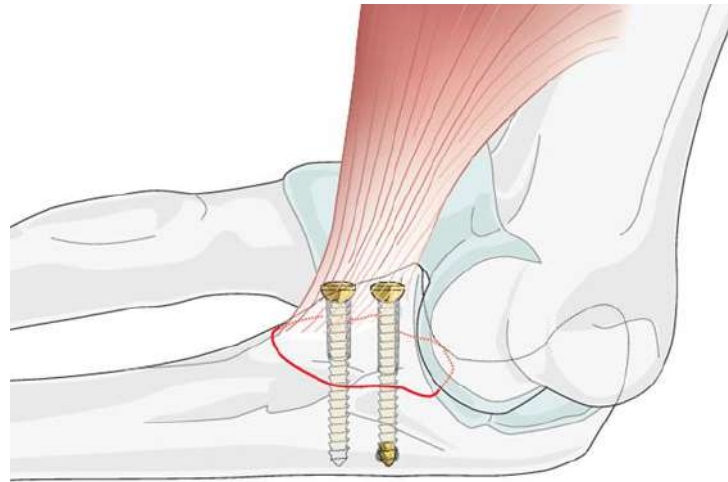
Fractures at the coronoid base

Subtype 1:
Coronoid body and base
Subtype 2:
Transolecranon basal coronoid fracture

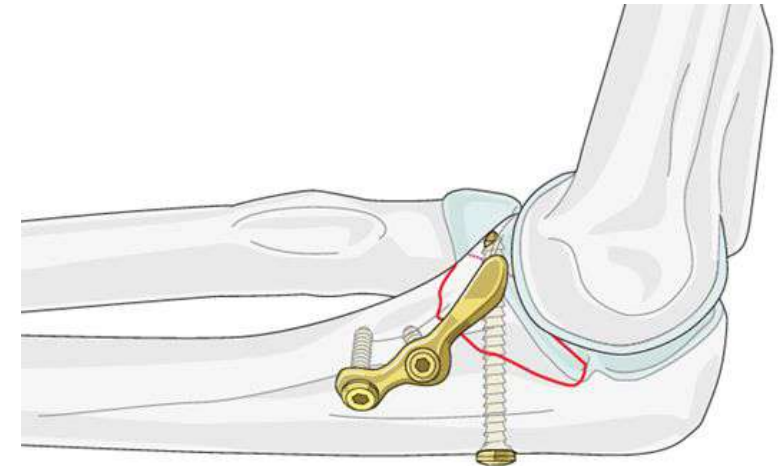
TYPE 1	TYPE 2	TYPE 3
PLRI RADIAL HEAD TERRIBLE TRIAD OF ELBOW	PMRI DISLOCATIONS WITH CORONOID ONLY	TRANSOLECRANON FRACTURE DISLOCATION



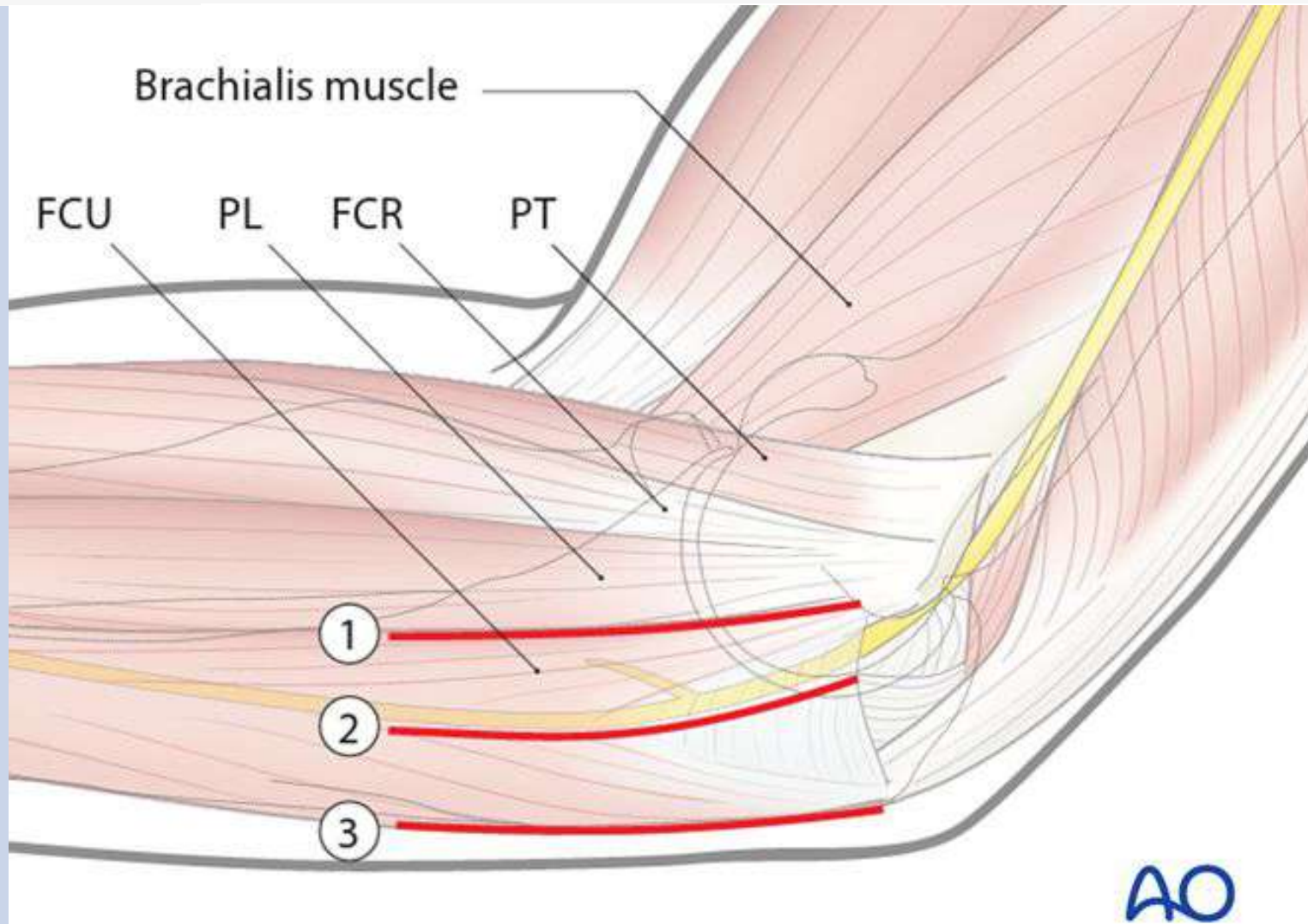
TRANSOSSEOUS SUTURES



SCREW FIXATION



ANTEROMEDIAL FACET
BUTTRESS PLATE FIXATION



1. Hotchkiss over the top approach
2. FCU Split approach – Floor of ulnar nerve approach
3. Taylor and scham approach

Indications of Medial approach

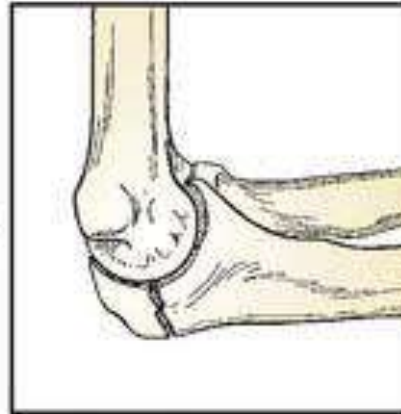
- Coronoid fracture fixation – if radial head is intact
- Coronoid plating – AM facet fractures
- MCL repair
- Ulnar nerve transposition

A lateral X-ray of the elbow joint. The humerus is at the top, and the radius and ulna are below it. There is a clear, comminuted fracture of the olecranon process of the ulna. The text "Olecranon fracture" is overlaid in orange.

Olecranon fracture

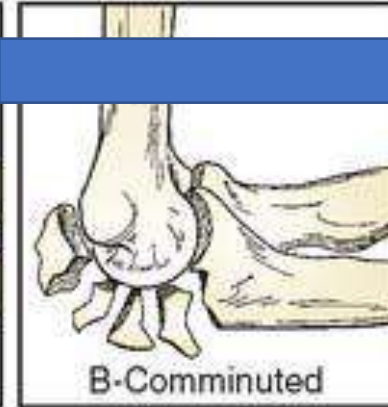
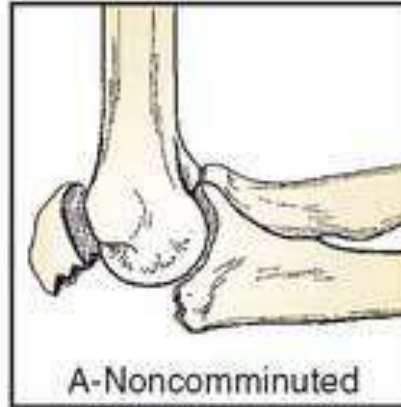
CLASSIFICATION OF OLECRANON FRACTURES (Morrey)

Type I
Undisplaced



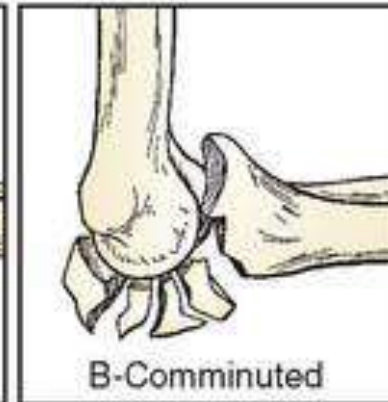
CONSERVATIVE

Type II
Displaced-
stable



TENSION
BAND WIRING

Type III
Unstable



PLATING

MORREY OLECRANON CLASSIFICATION

Elbow Dislocation

Most common nerve injury in Elbow Dislocations ?

Median nerve

Ulnar nerve

Radial nerve

PIN

Most common nerve injury in Elbow Dislocations ?

Median nerve

Ulnar nerve

Radial nerve

PIN

Simpson classification of elbow dislocation

Both Radius and Ulna	Posterior	Lateral (m/c)
		Medial
	Medial	
	Lateral	
	Divergent	Anteroposterior
		Mediolateral
Ulna alone	Anterior	
	Posterior	
Radius	Anterior	
	Posterior	
	Lateral	

CLASSIFICATION

- BASED ON TIME

1. ACUTE
2. OLD DISLOCATION
3. RECURRENT DISLOCATION

- BASED ON WOUND

1. OPEN
2. CLOSED



Next step ?

A) CT scan

B) MRI scan

C) Reduction

D) USG

Treatment

- Closed Reduction

Which reduction method is used for Elbow dislocations?

a) Hotchkiss method

b) Tavernier method

c) Kocher's method

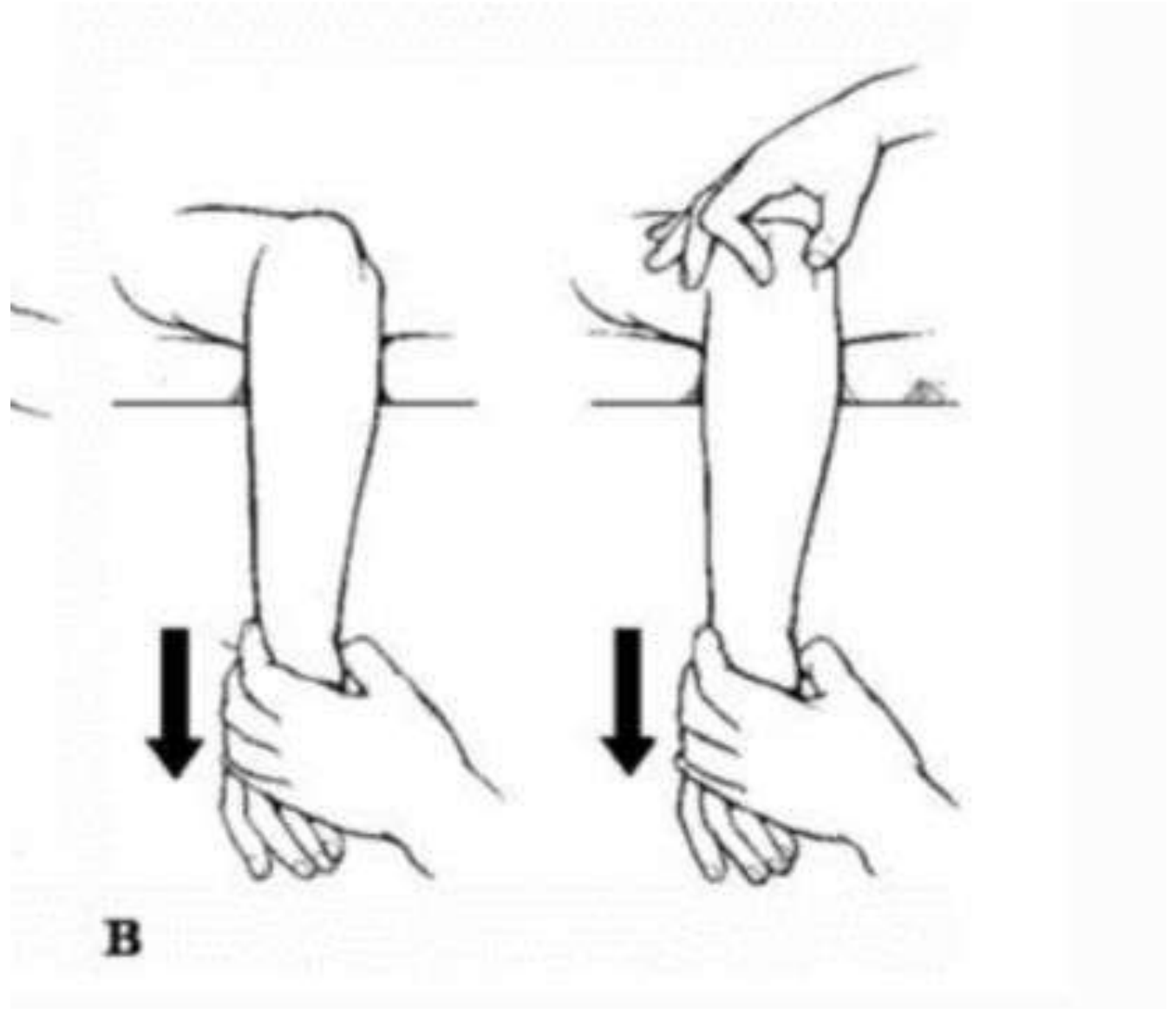
d) Parvin's method

PARVIN'S METHOD



- FLEXION OF 30 DEGREES
- TRACTION – COUNTER TRACTION
- MEDIAL LATERAL ALIGNMENT CORRECTION
- FOREARM SUPINATED
- SLIGHT ANTERIOR FORCE TO OLECRANON AND FLEX THE ELBOW

MEYN & QUIGLEY METHOD (1 PERSON)





Look for stability

- **Imaging**

Look for asymmetry in joint space

- **Clinically**

Feel for Crepitus

Check ROM – Flexion and
Extension in Supination, Pronation
and Neutral



Open reduction

Indications –

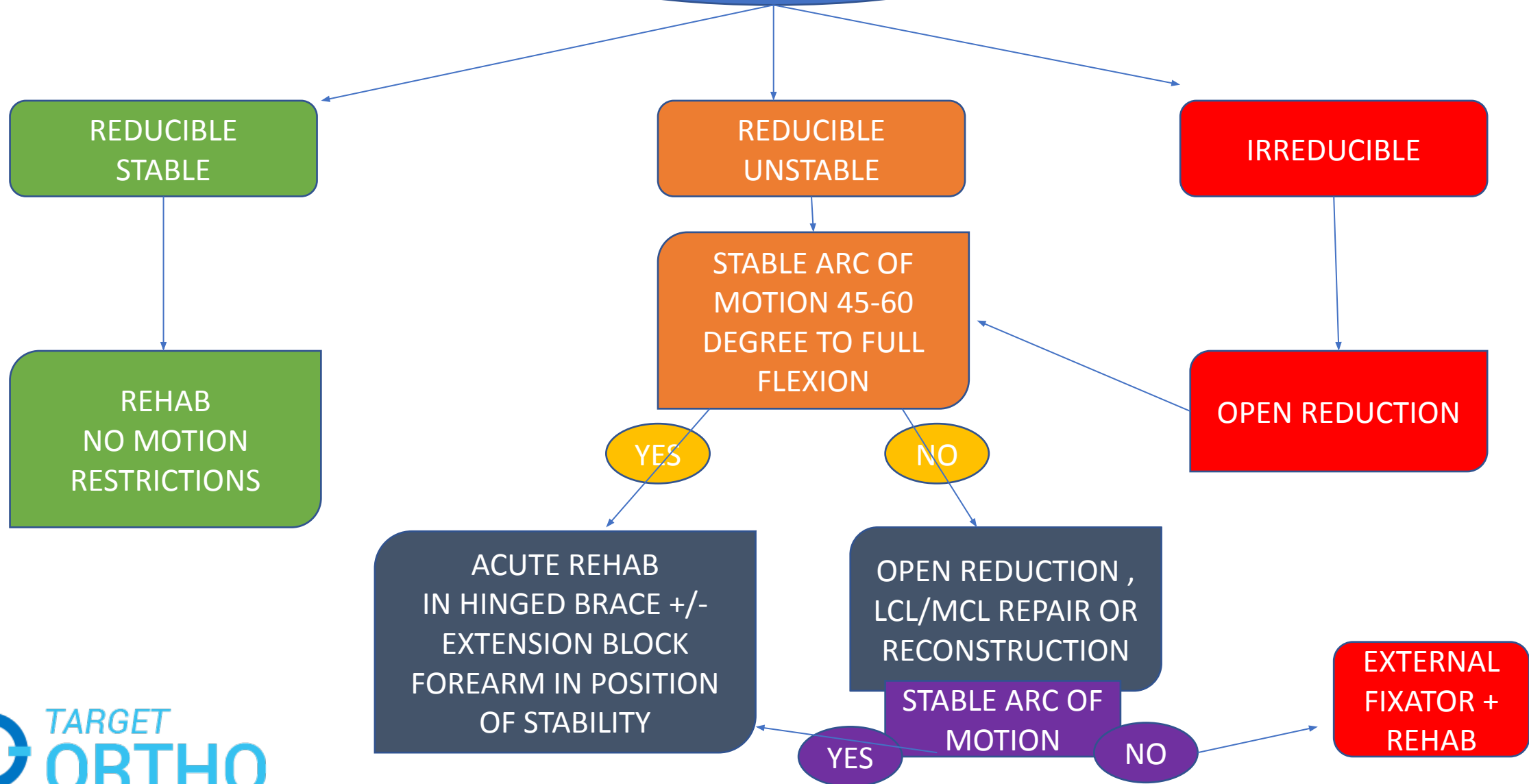
- Open dislocation
- Vascular injury
- If elbow is irreducible
- After closed reduction, elbow dislocates in <30-degree flexion
- Associated fracture in post reduction x-ray
- Non congruous reduction

Two approaches

- Single Posterior Approach
- Lateral + Medial approach



SIMPLE ELBOW DISLOCATIONS

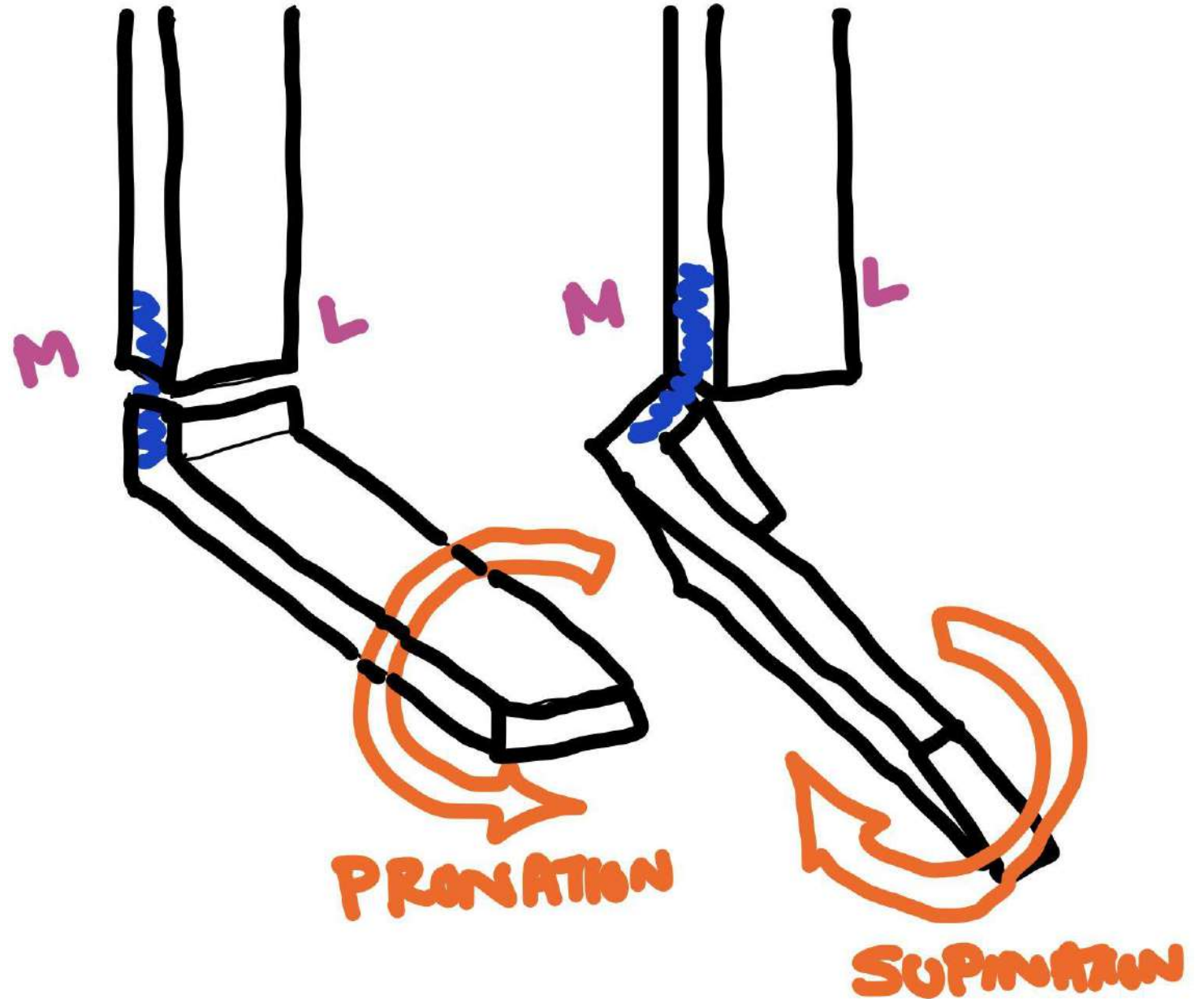


Immobilization position

90 DEGREE FLEXION +

- LCL repaired , MCL intact = PRONATION
- MCL repaired , LCL intact =. SUPINATION
- Both are repaired =. NEUTRAL

POSITION OF IMMOBILIZATION



Complex Elbow Dislocations

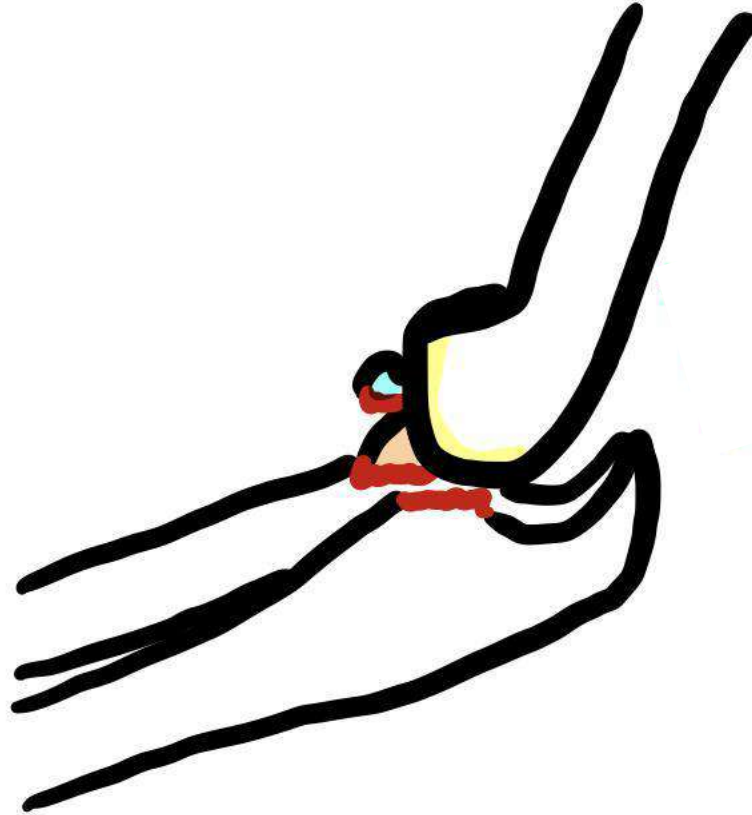
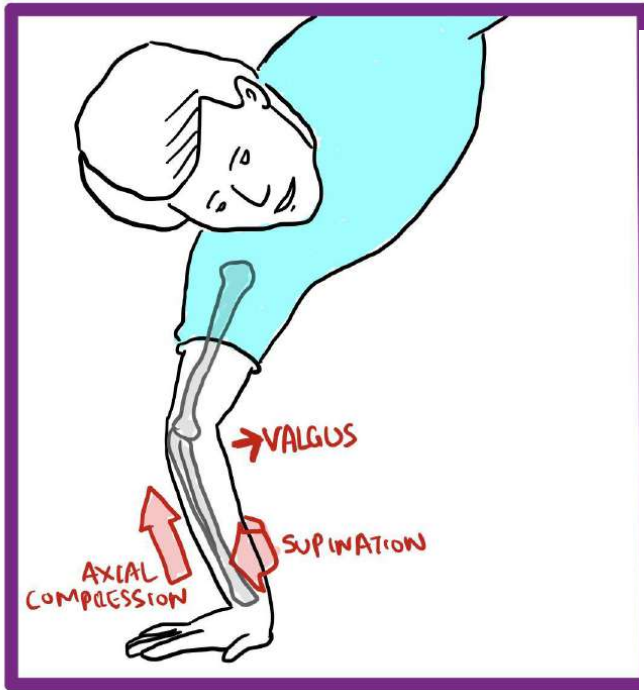
- Elbow dislocations +

Coronoid fracture

Radial head fracture

Radial head + Coronoid fracture

Hotchkiss Terrible Triad Elbow



Radial Head #

Coronoid Process #

Posterior Elbow
Dislocation

Why is it so terrible ?

- Extremely unstable
 - Loss of joint congruence
 - Instability
- Fracture fragments are quite small
 - Difficulty to repair
- Patient don't routinely do well
 - Unaware of magnitude of injury
 - Residual instability
 - Stiffness and arthritis

Stages

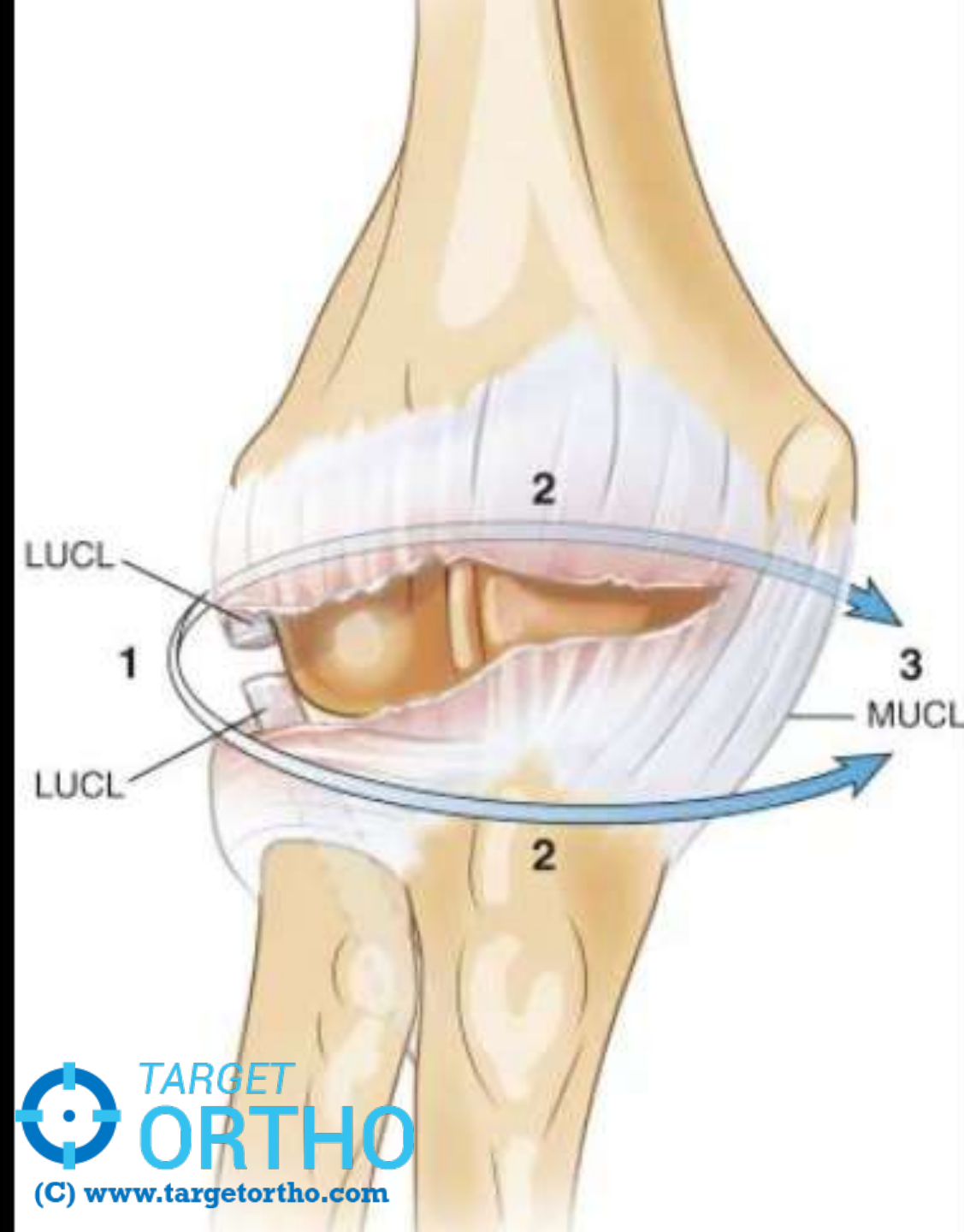
1 – LUCL injury

2 – Anterior and posterior capsule

3A – Sprain of MCL

3B – Rupture of MCL

3C – All soft tissues stripped



Imaging

- Pre and Post reduction X-Ray
- CT scan with 3D – Understand fracture pattern



Radio-capitellar line



TARGET
ORTHO

(C) www.targetortho.com

McLaughlin Line

Treatment of Complex Elbow Dislocations

CONSERVATIVE

- Concentric reduction achieved
- No instability while checking ROM
- Small fracture of Radial head with no block to rotation
- Small Coronoid fracture (<10% size)



Posterior Skin incision

Deep Lateral approach

Radial head fracture fixable?

YES

Radial head fixation

NO

Radial neck osteotomy

YES

Coronoid fracture fixable from Lateral approach?

NO

Fix coronoid fracture
Fix or replace radial head
Repair Lateral collateral ligament

Fix coronoid from Deep Medial approach
Repair medial and lateral collateral ligament

ELBOW STABLE ?

ELBOW STABLE ?

YES

NO

DONE

APPLY EXTERNAL FIXATOR

NO

REPAIR MCL

McKee Pugh et al treatment protocol

- Fix or suture coronoid fracture
- Repair/ replace radial head
- Repair LCL
- If still unstable – Repair MCL
- If still unstable – Hinged External Fixator

Which lateral approach is preferred in Elbow Dislocations ?

a) Hotchkiss approach

b) Kaplan approach

c) Kocher's approach

d) Taylor and Scham approach

Which lateral approach is preferred in Elbow Dislocations ?

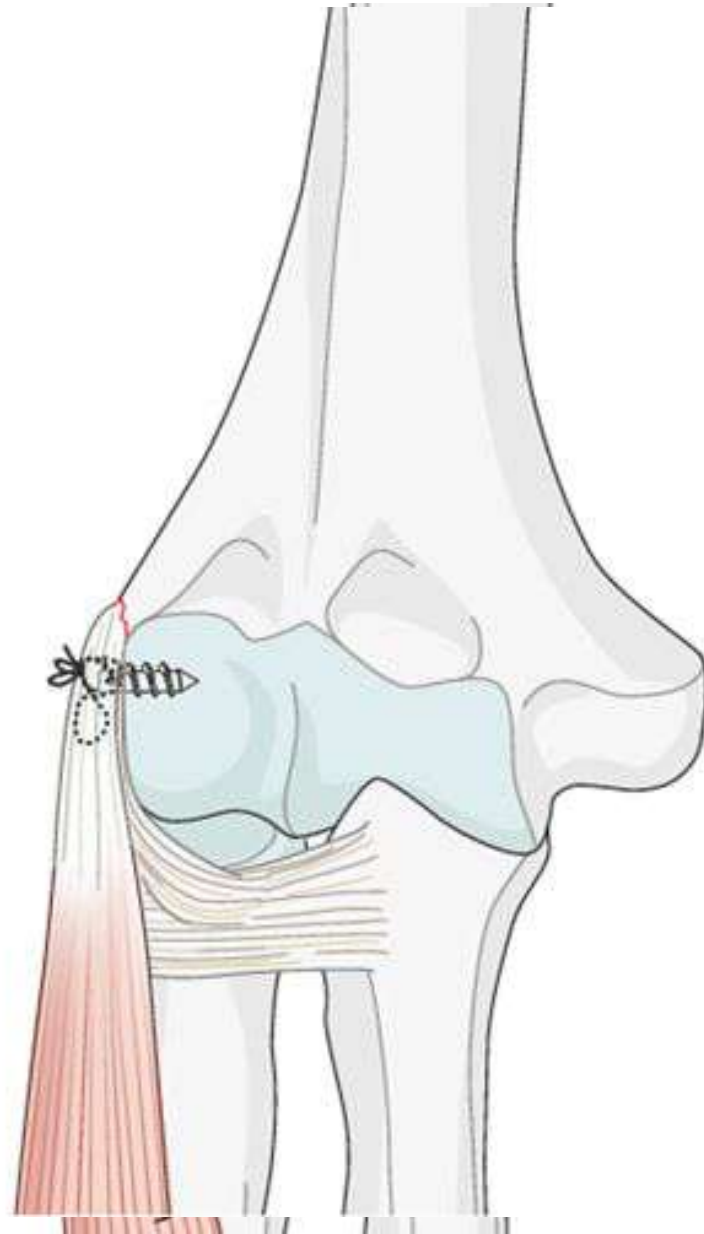
a) Hotchkiss approach

b) Kaplan approach

c) Kocher's approach

d) Taylor and Scham approach

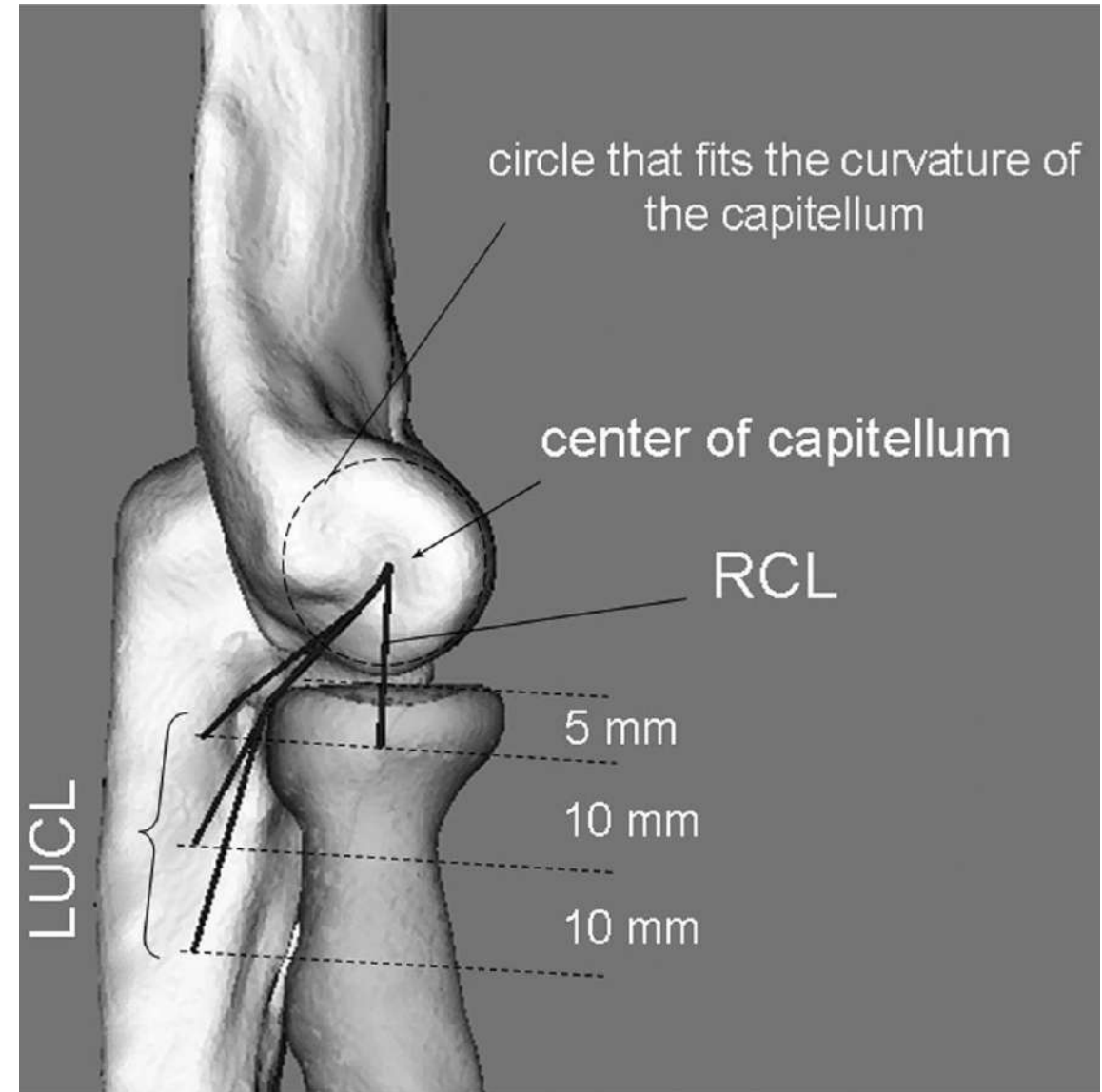
LCL repair



AO

LCL repair

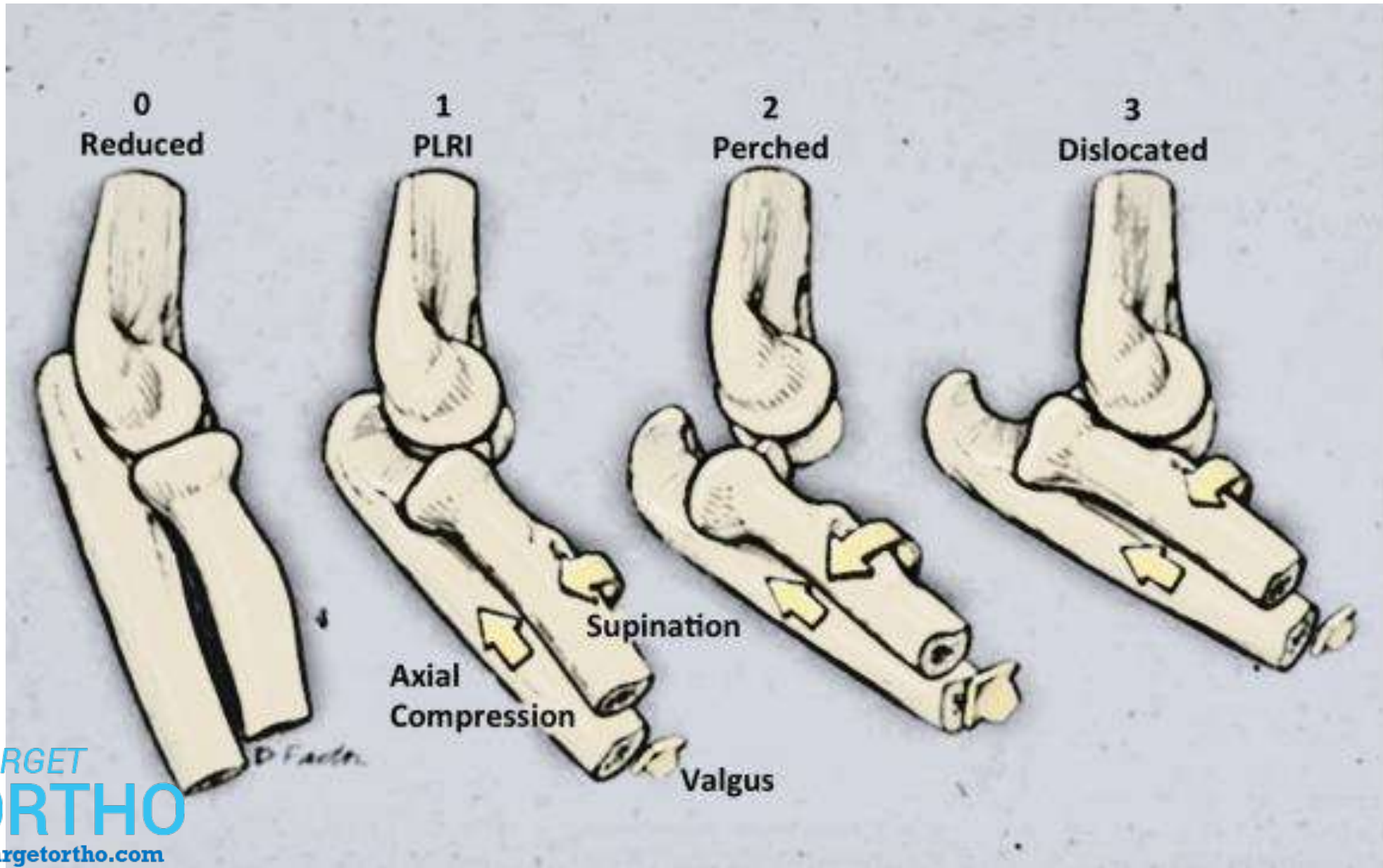
Isometric point for LUCL repair is Center of well fit circle over Capitellum



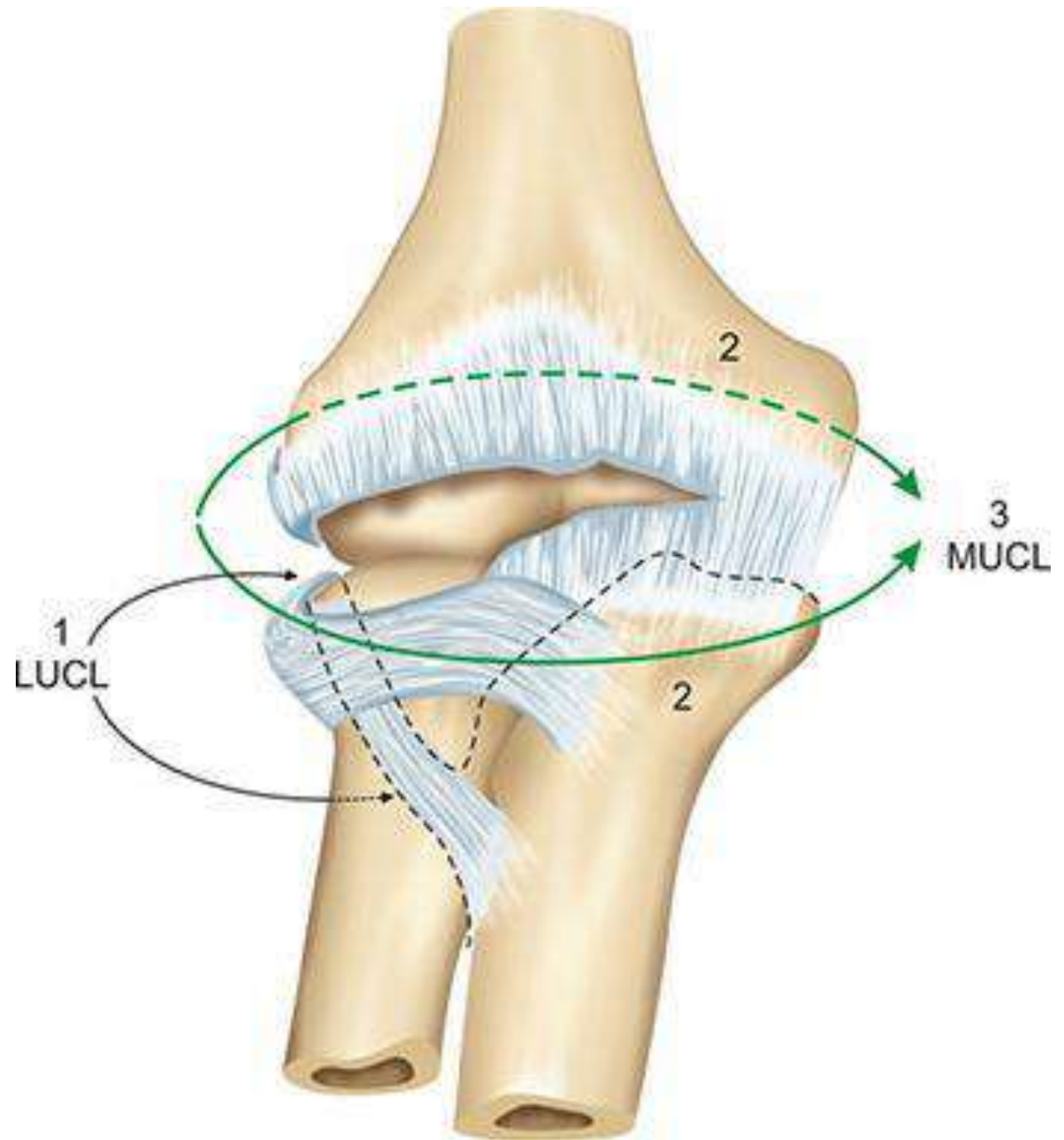
Complications

- Instability
- Malunion
- Nonunion
- Stiffness
- Heterotopic ossification
- Infection
- Ulnar neuropathy
- Hardware failure
- Loosening of radial head prosthesis / overstuffing
- Post traumatic arthritis

O'DRISCOLL RING OF INSTABILITY



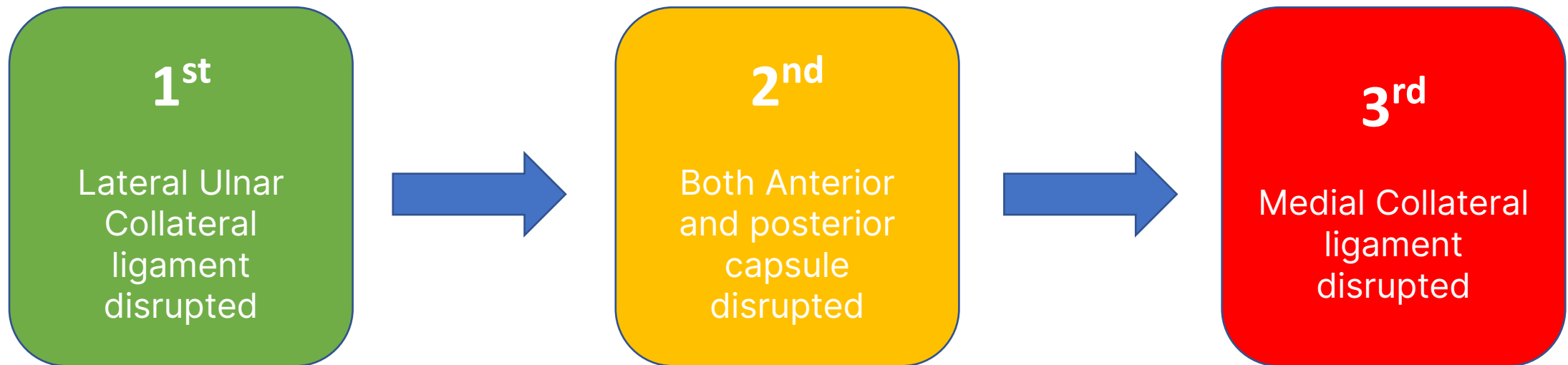
“HORII CYCLE”





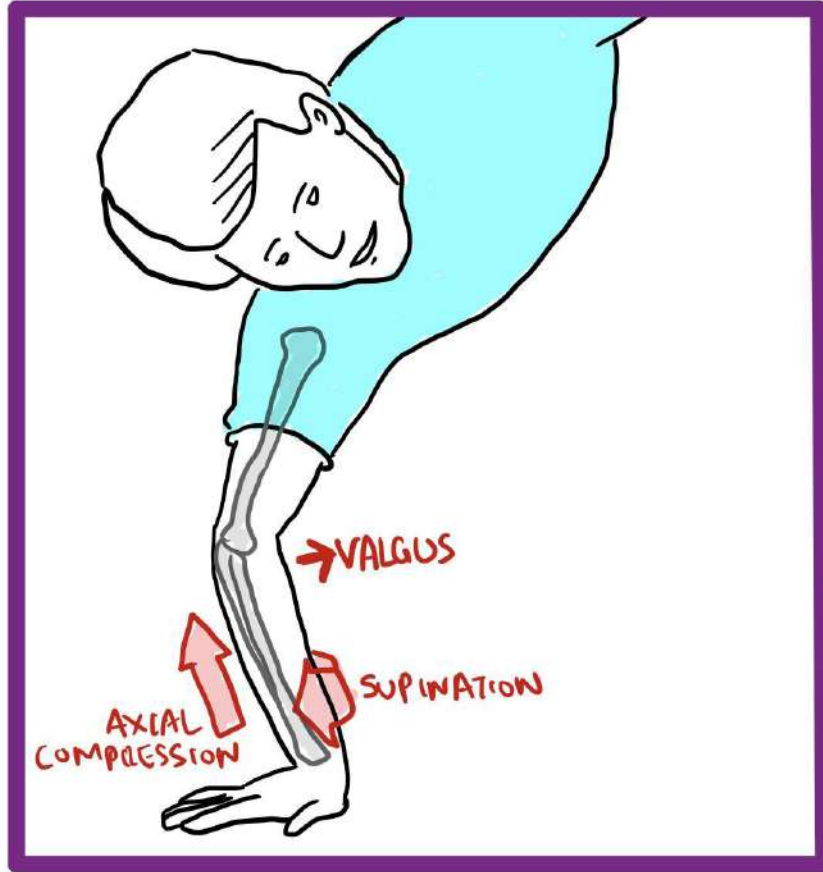
HORII CYCLE

- Describing injury causing Elbow dislocation



REVERSED HORII CIRCLE

Fall on outstretched hand (FOOSH)

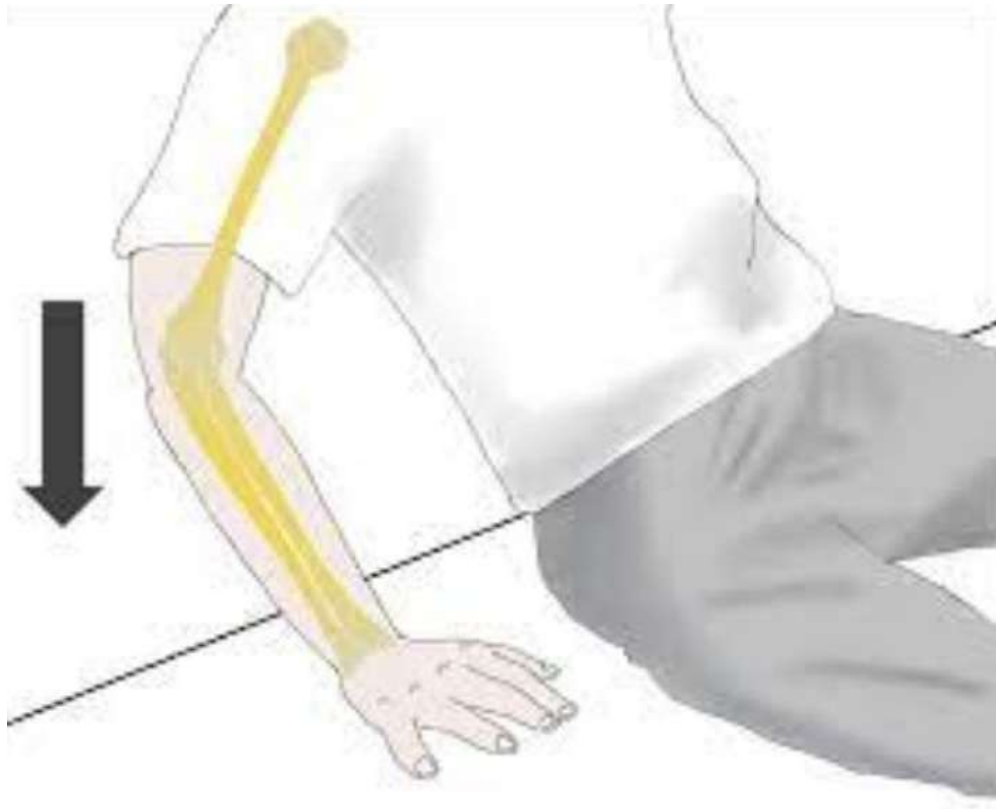


- Common mechanism
- Valgus Posterolateral injury



PLRI

Varus Posteromedial Injury



While falling backwards

Elbow goes into varus and pronation

Coronoid process - Anteromedial facet

LCL injury



PMRI

TRANS-OLECRANON
FRACTURE
DISLOCATION

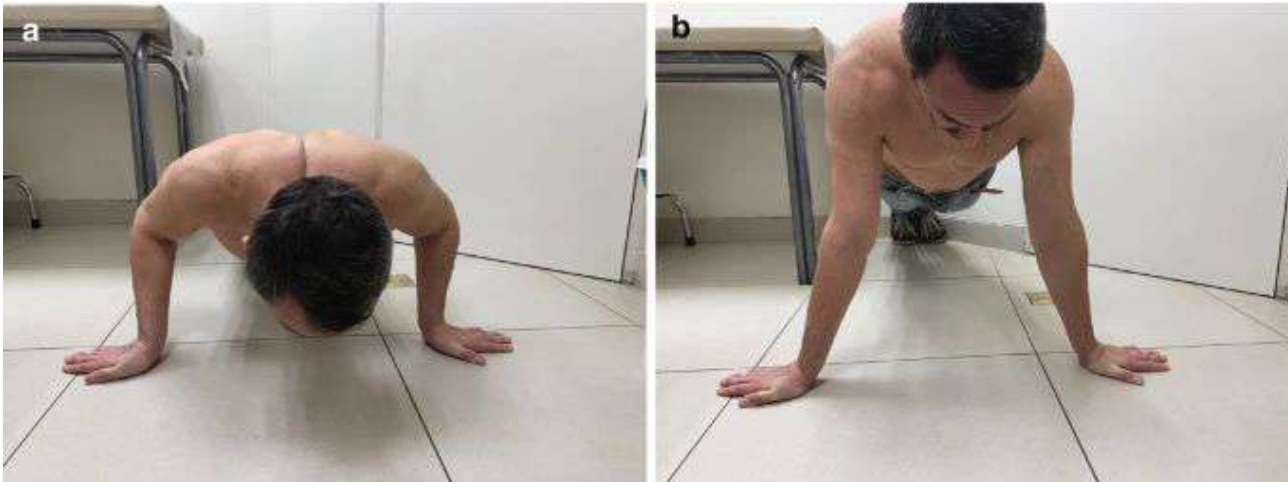


CHRONIC ELBOW INSTABILITY

- Persistence from Acute trauma – PLR, PMR
- Repetitive use – Chronic medial instability

CHRONIC ELBOW INSTABILITY

- For all chronic instability - PUSH UP TEST



- Apprehension test – elbow clicks or moves

CHRONIC ELBOW INSTABILITY

Valgus stress test –

- Valgus Stress Test is used to evaluate medial ulnar collateral ligament Injury of the elbow joint.
- The patient sits with the elbow slightly flexed. While stabilizing the upper arm laterally with one hand, the examiner abducts the patient's forearm in the elbow joint (valgus stress).
- This test is considered positive if the patient experiences pain or excessive laxity is noted and compared to the contralateral side



CHRONIC ELBOW INSTABILITY

•Pivot Shift Test

Supination, valgus stress and compression
(Extension $\square$ 40degree flexion) – Elbow reduces as
Triceps tightens

Because MCL heals, LUCL doesn't hence Pivots on MCL
side

Management

- PLR – Reconstruction of ligament LUCL by Palmaris Longus
- PMR – Reconstruction of Anterior band of MCL by Allograft / Palmaris longus (JOBE TECHNIQUE / DOCKING TECHNIQUE)