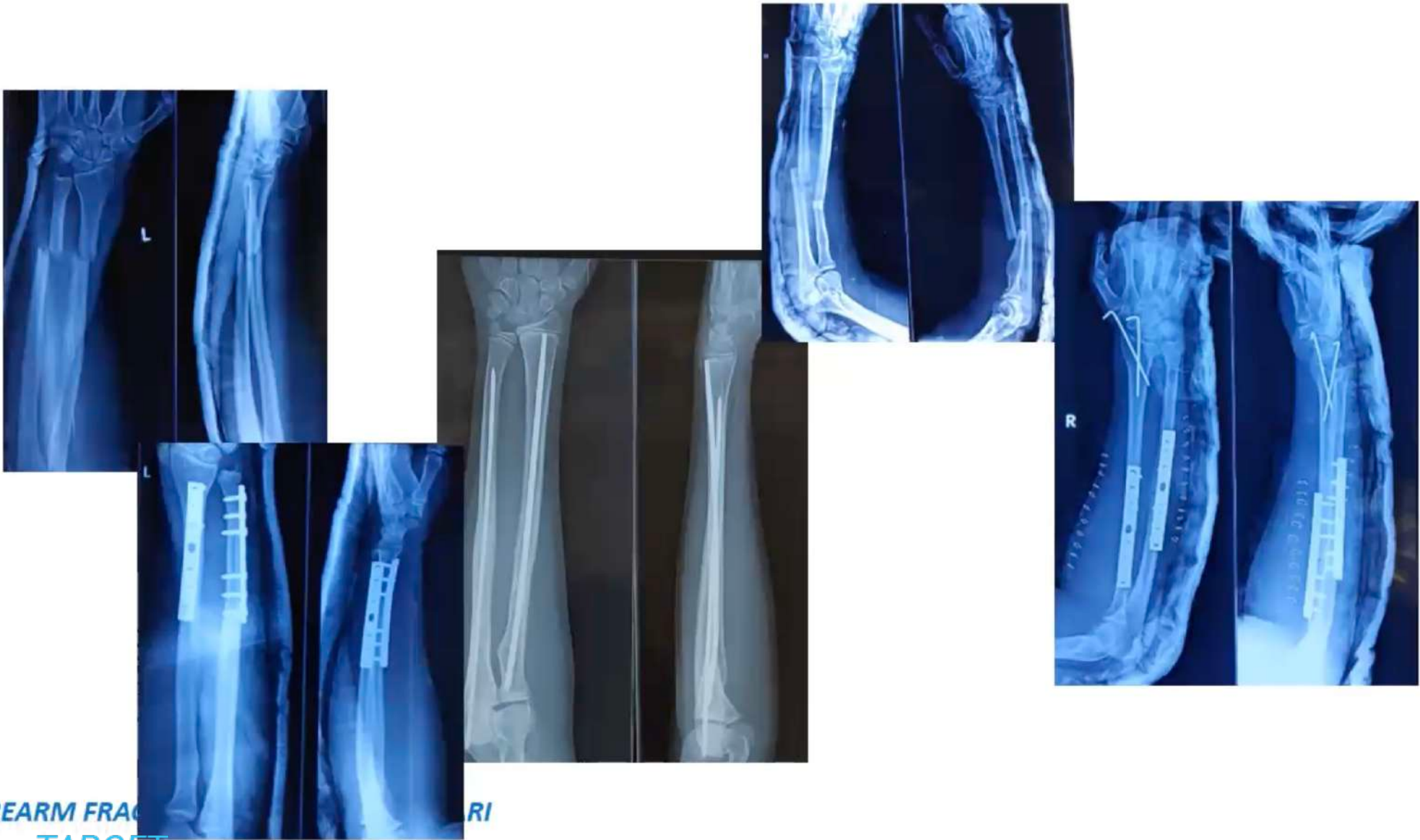


FOREARM INJURIES

DR ANURAG TIWARI



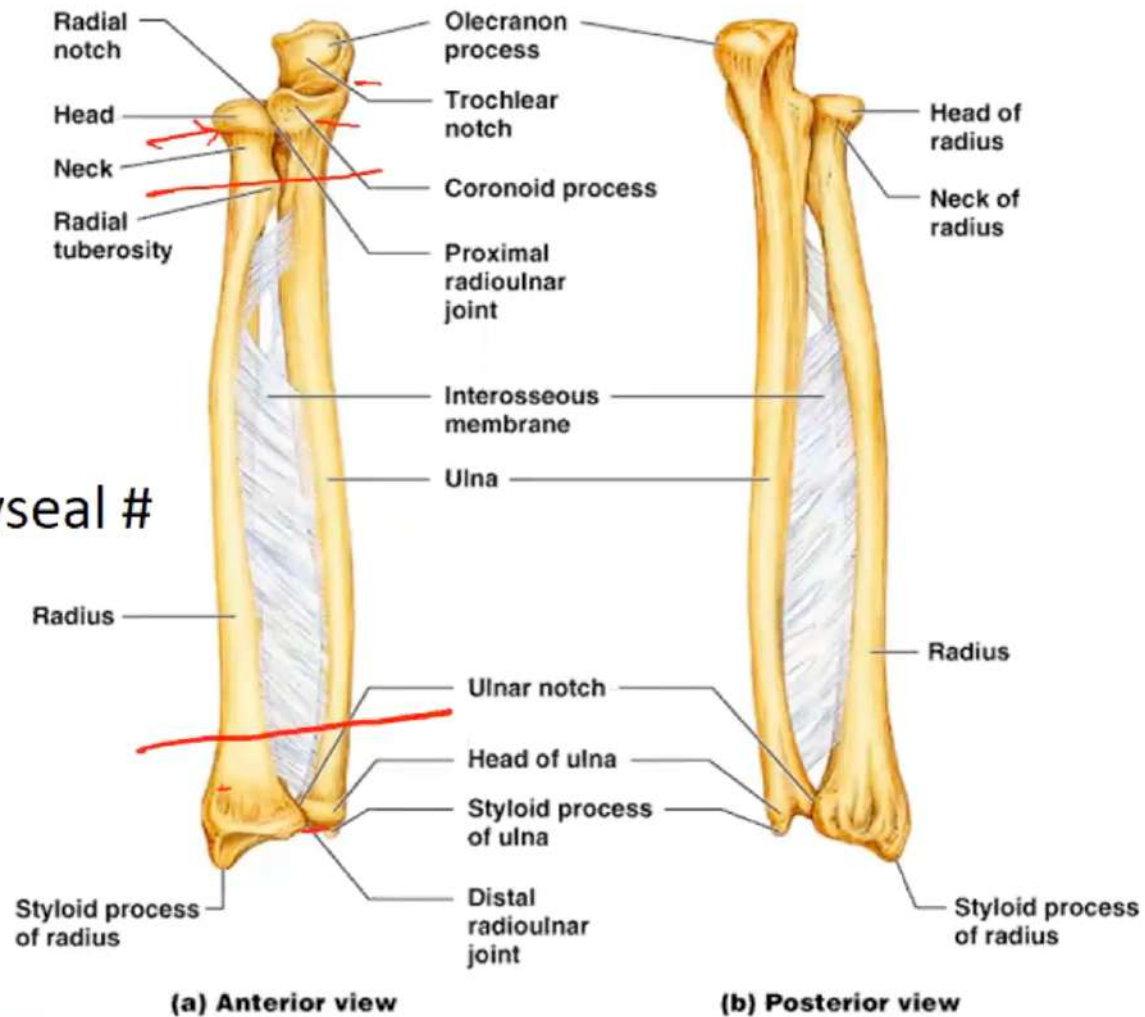
FOREARM FRACTURE

RI

Forearm Injuries

- Olecranon #

- Both bone forearm diaphyseal #
- Monteggia #
- Galeazzi #



FOREARM FRACTURES: DR ANURAG TIWARI

Few Questions...

- Axis of rotation of Forearm Supination- Pronation?
- A. Centre of radial head to ulnar fovea
- B. Centre of radial head to DRUJ
- C. Olecranon tip to Ulna fovea
- D. Olecranon tip to a point on medial distal radius articular surface

- Identify the Injury
- A. Comminuted # olecranon
- B. Monteggia # dislocation
- C. Galeazzi # dislocation
- D. Transolecranon # dislocation

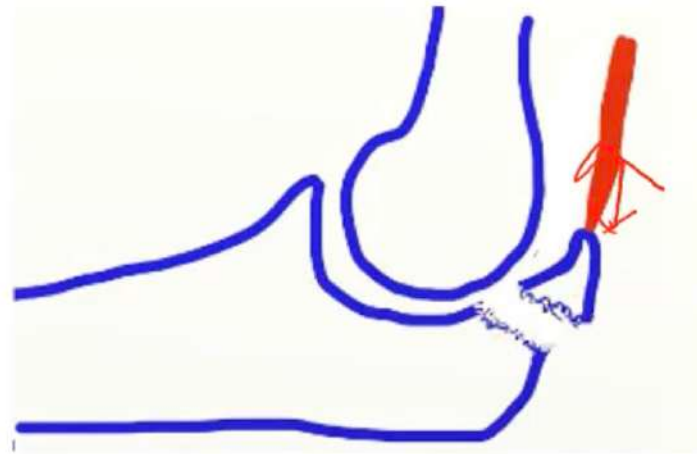


Olecranon

- Mechanism of injury-



Direct blow



Indirect injury- Triceps avulsion

- Simple #

(6 out
dislocation)



- Complex #-

(instability)



RC dislo.

Transolecranon
dislocation

anterior

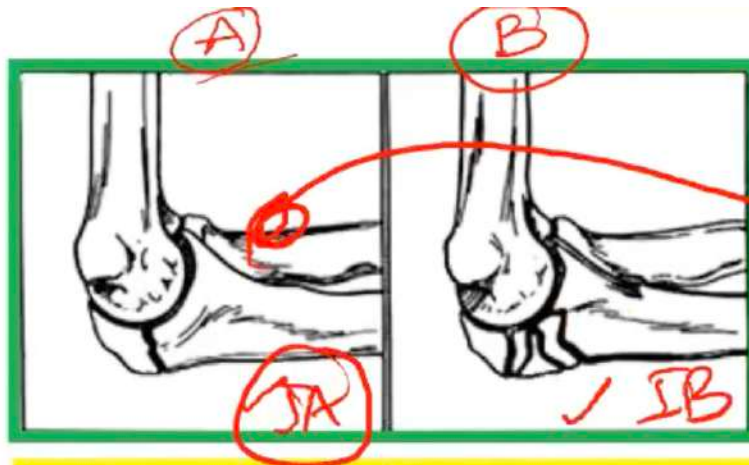


Monteggia Type II
dislocation

posterior

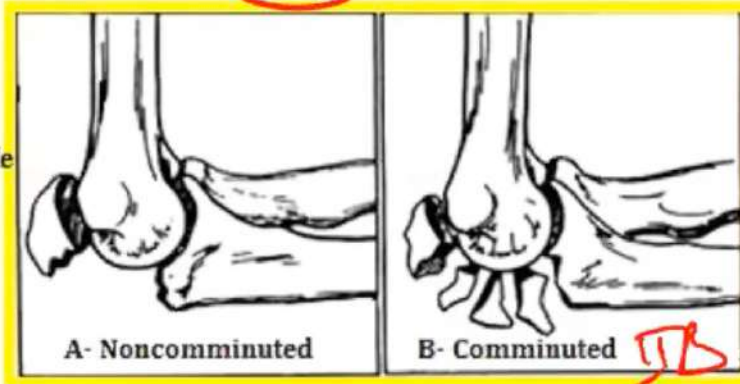
Mayo Classification

Type I
undisplaced



Non operative

Type II
displaced-stable



TBW

Type III
unstable

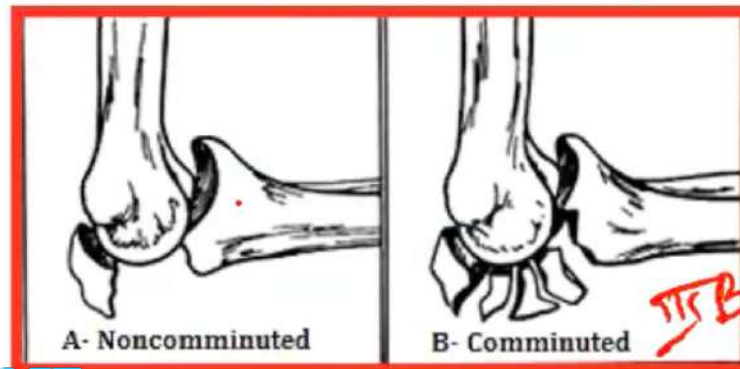
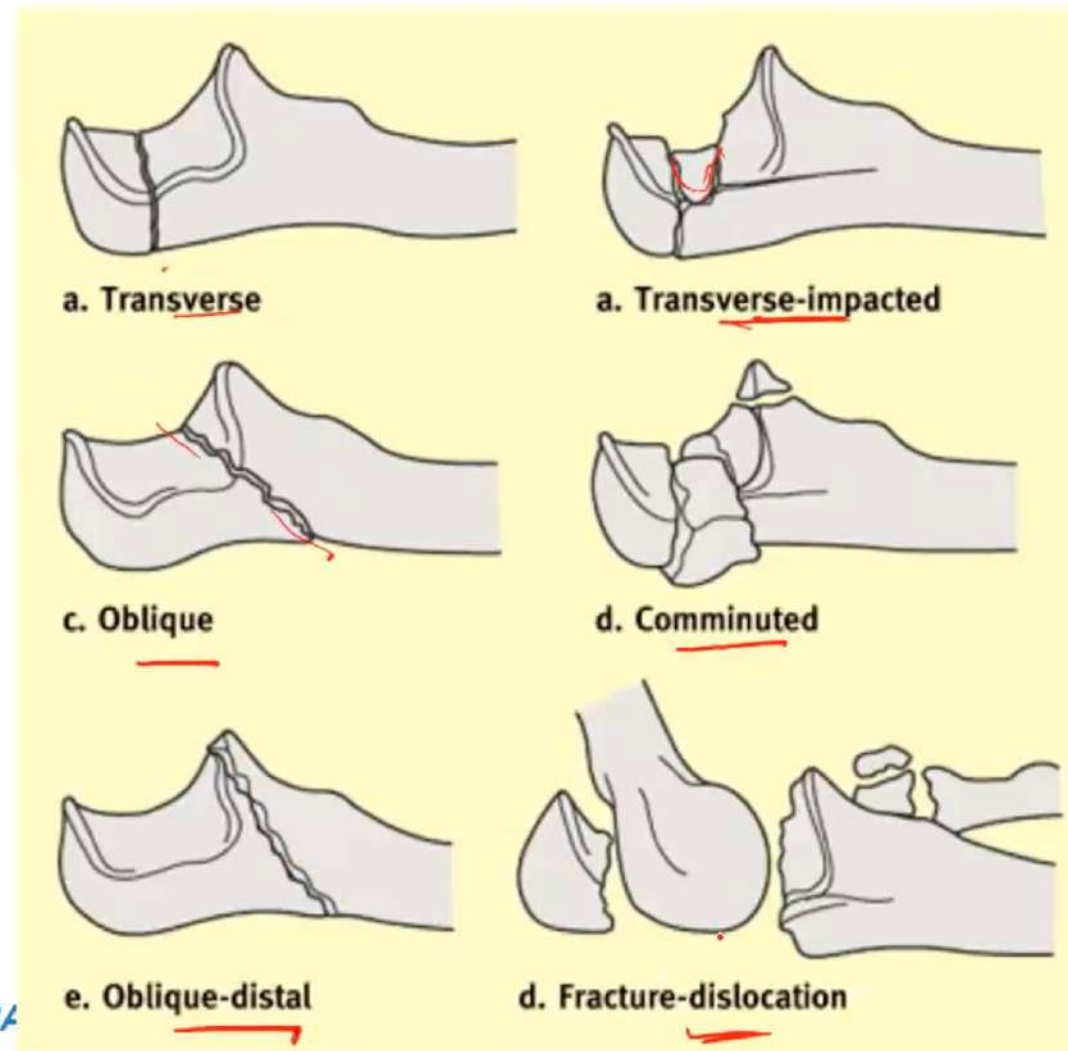


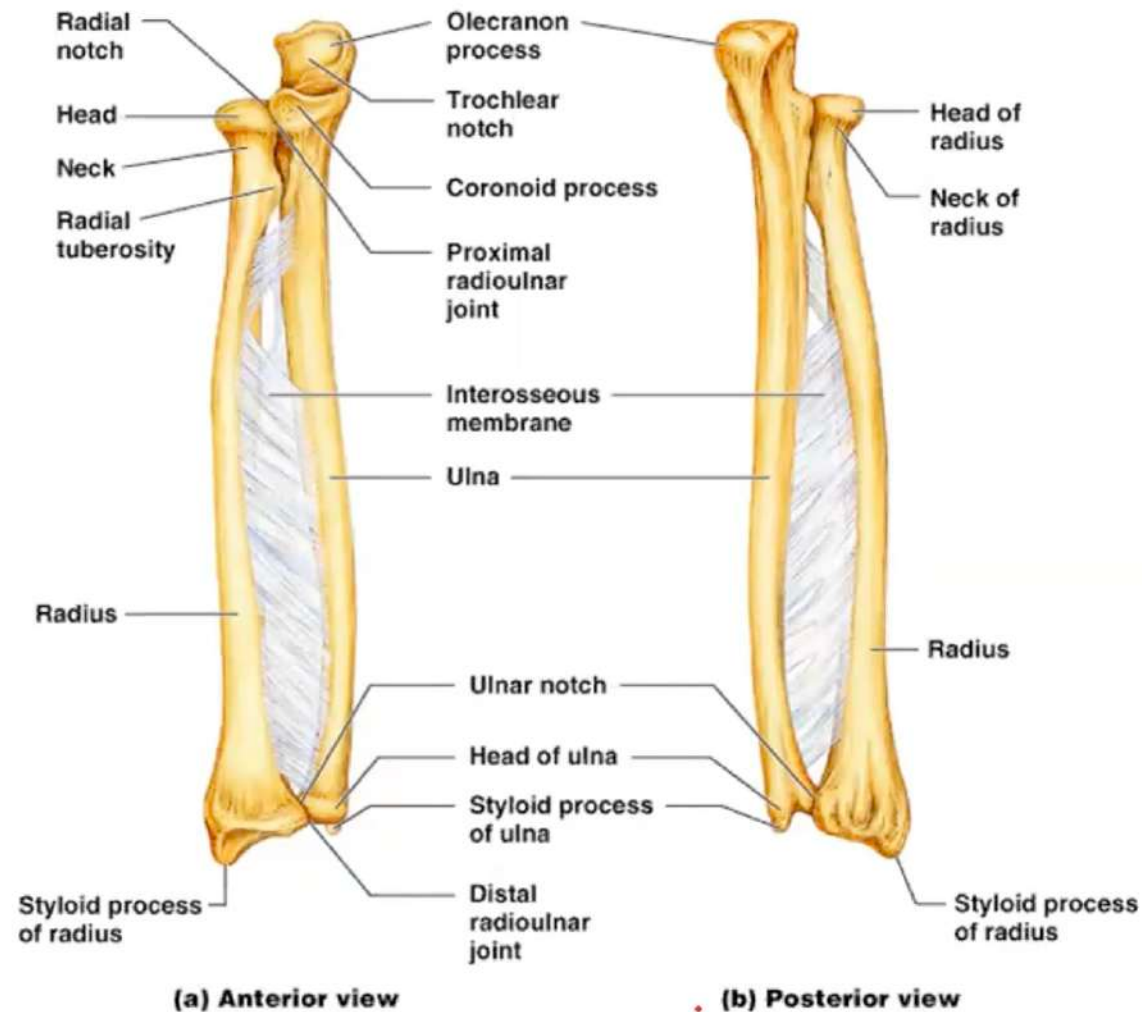
Plate – In comminuted and/or unstable #

Schatzker classification



FOREARM FRACTURES: DR ANURA

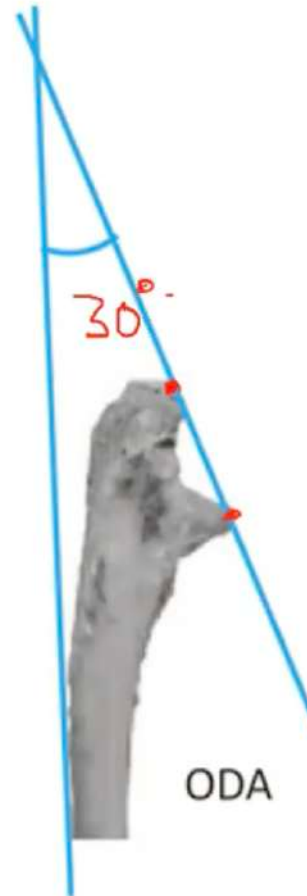
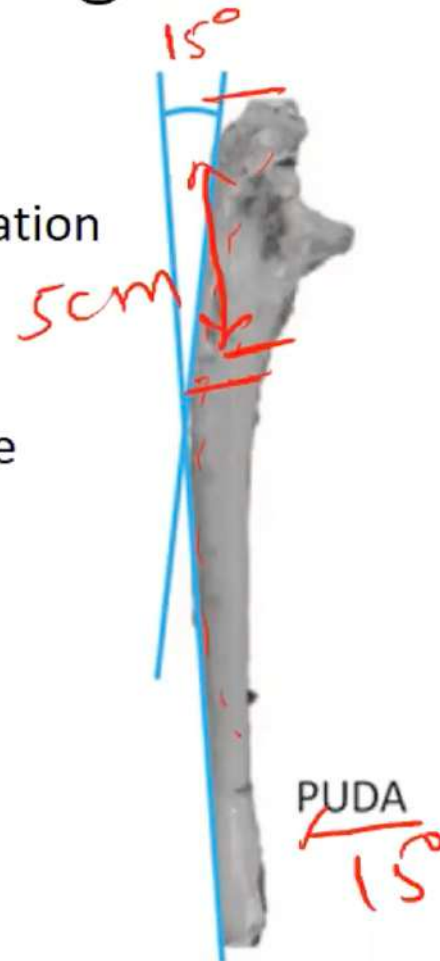
Anatomy



FOREARM FRACTURES: DR ANURAG TIWARI

Few important angles-

- ① • Proximal ulna dorsal angulation (PUDA)
- ② • Olecranon Diaphyseal angle (ODA)
- ③ • Varus angulation (VA)



Treatment

- Non operative- Undisplaced
Ability to extend elbow (Intact extensor mechanism)
- Operative- Absolute indications-
 - ✓ Elbow instability
 - ✓ Articular incongruity
 - ✓ Open #

Operative Options

- ① • TBW
- ② • Intramedullary screw fixation
with or without TBW
- ③ • Plate
- ④ • Intramedullary interlock nail
- ⑤ • Fragment excision and triceps advancement

TBW ✓

- Best for simple Transverse #

IIA.

- Contraindications-

- ✓ Comminuted #

- ✓ # distal sigmoid notch

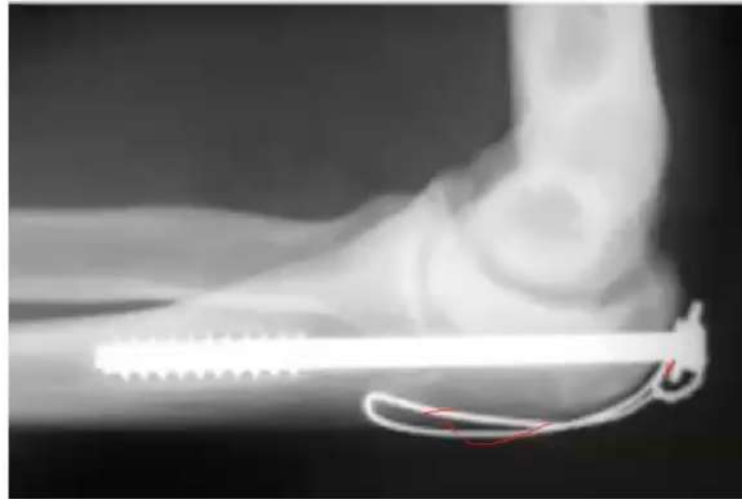


- K wires directed towards anteromedial direction
- Must engage anteromedial cortex of ulna

- Disadvantage- Hardware prominence-
Bury the k wire beneath triceps.

Intramedullary screw fixation

6.5 mm screw with washer,
can be augmented with TBW



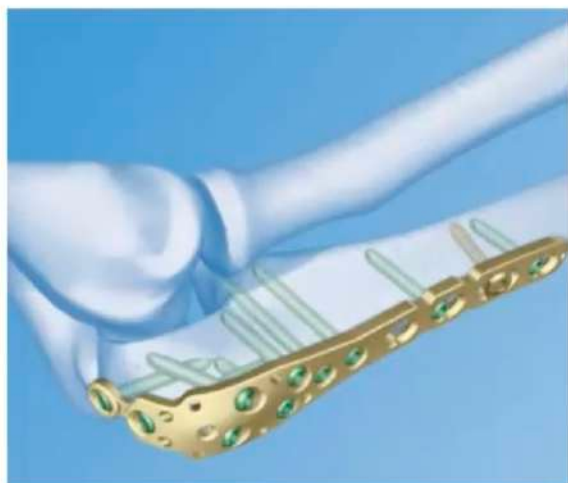
- Starting point- In AP plane – centre of olecranon tip.
In ML plane – just lateral to centre

Hardware buried beneath triceps tendon

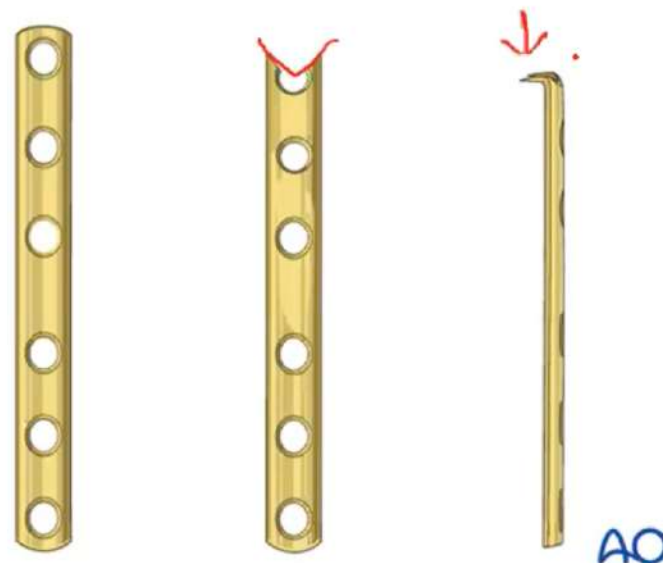


FOREARM FRACTURES: DR ANURAG TIWARI

Plate



Precontoured Olecranon locking plate



1/3rd tubular plate

Plate

- Indications-
- Unstable #
- Comminuted #
- # associated with Elbow dislocation
- Diaphyseal extension of #
- Home run screw
- Don't use angle screw

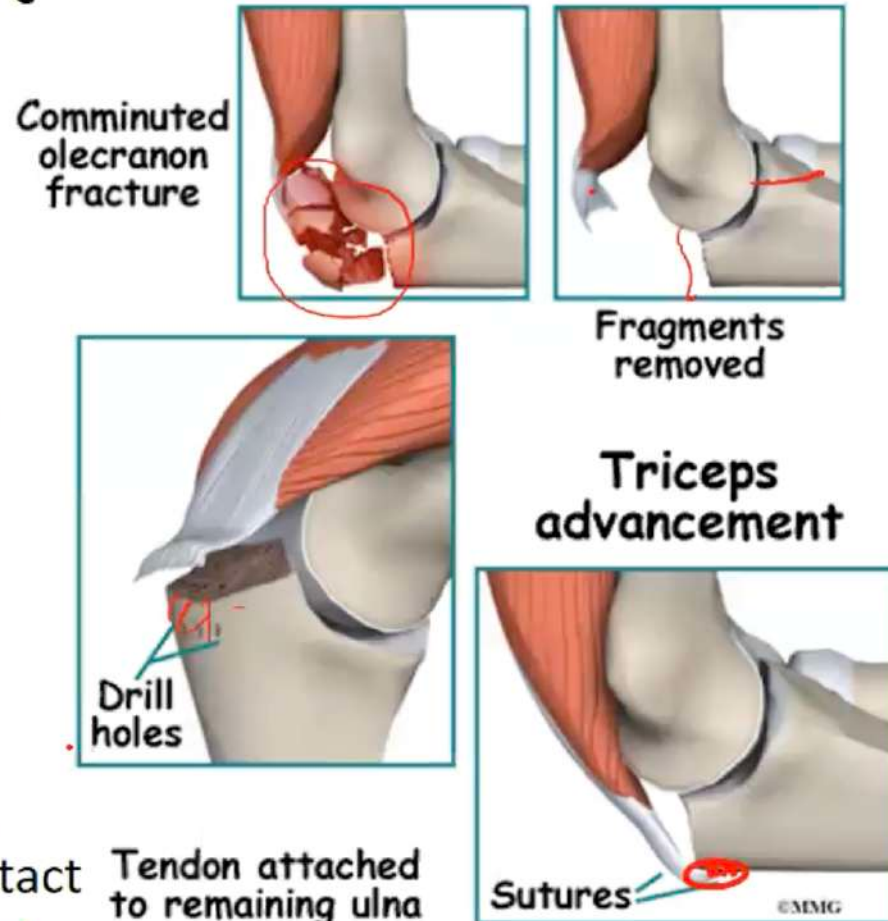


Triceps advancement

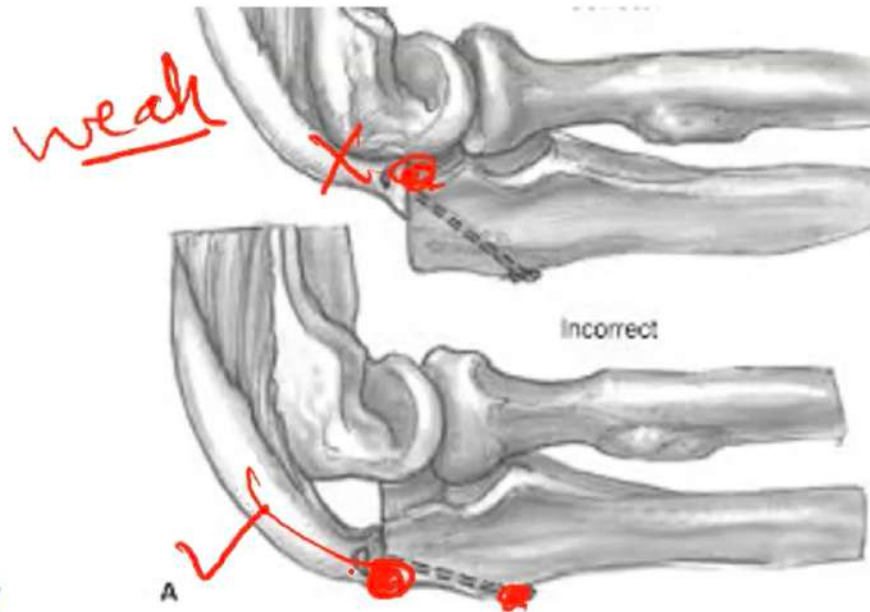
Salvage procedure

Indications

- Elderly low demand patients
- Severe osteoporotic/ comminuted #
- Non reconstructible #
- Failed internal fixation
- Fragment excised should be < 75 %
- Prerequisite - Coronoid should be intact



- Attach triceps as posterior as possible rather than anterior position
- Avoid dorsal placement of prominent knot

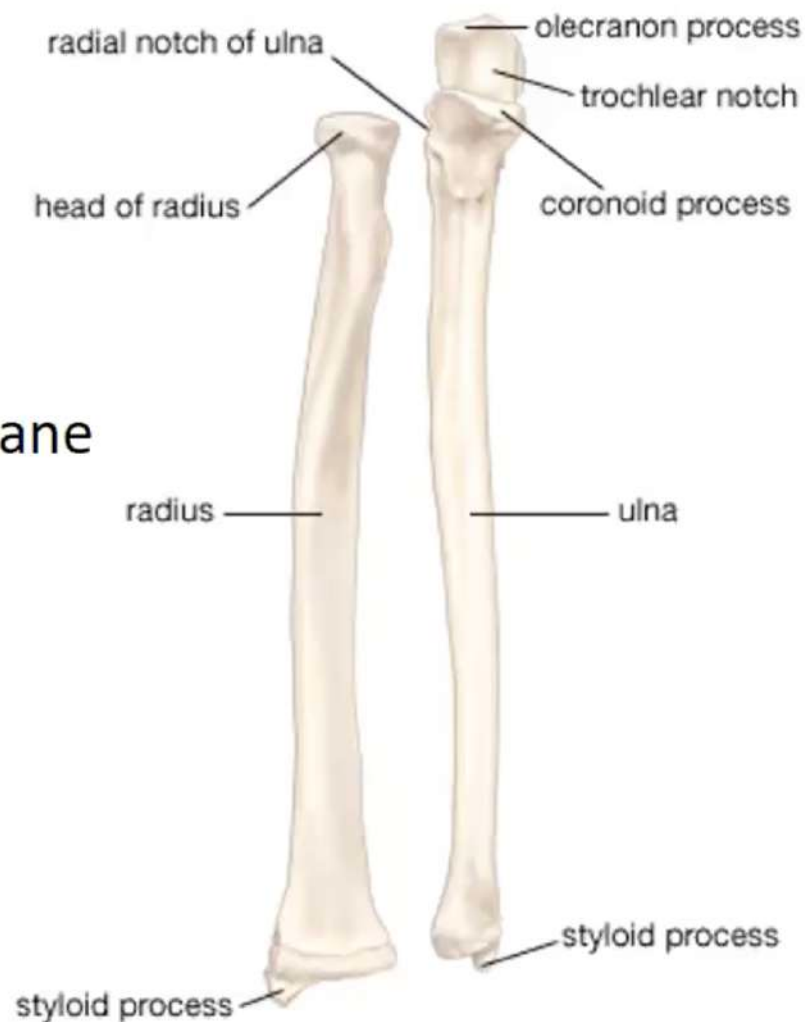


Complications

-  Prominent hardware- Bury k wire inside triceps
In plate, corner screw should not be used.
- Non union
- Malunion
- Heterotopic ossification
- Stiffness
- Failure of fixation

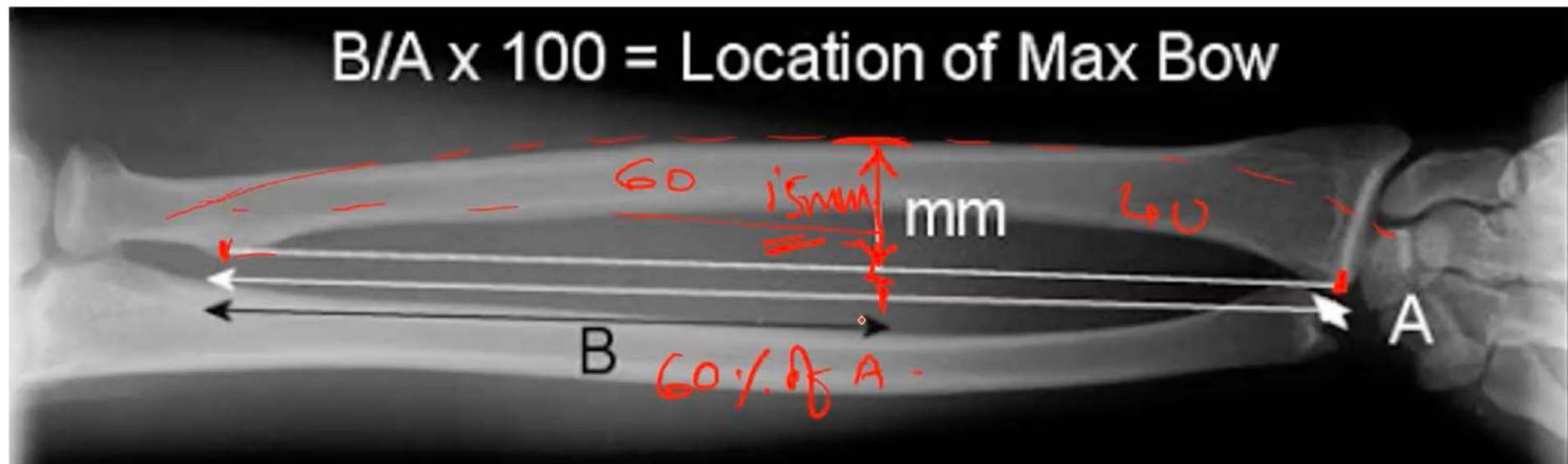
Forearm anatomy

- ① Lateral radial bow
- ② Axis of forearm rotation
- ③ Direction of interosseous membrane

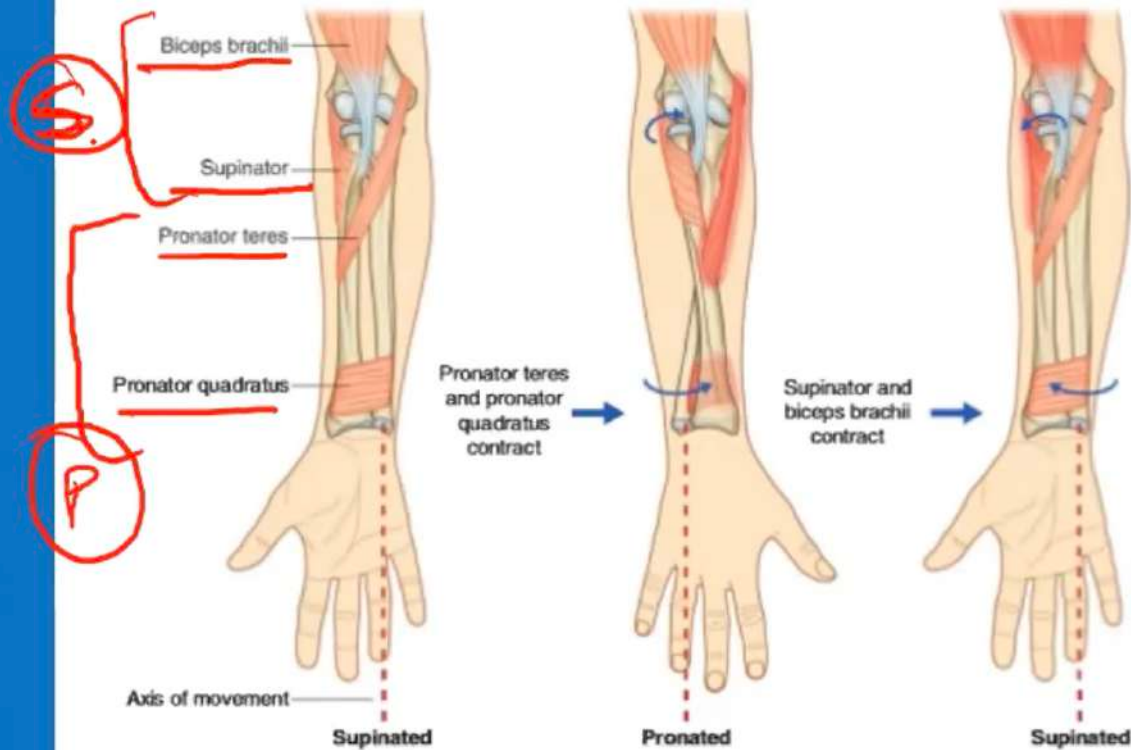
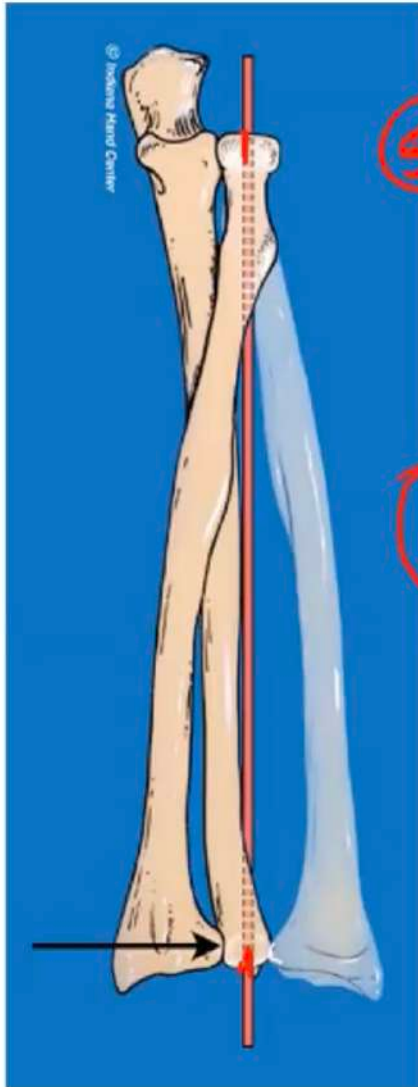


FOREARM FRACTURES: DR ANURAG TIWARI

Lateral Radial Bow



- Maximum bow is at 60 % of A distance from biceps tuberosity
- Normal value around 15 mm



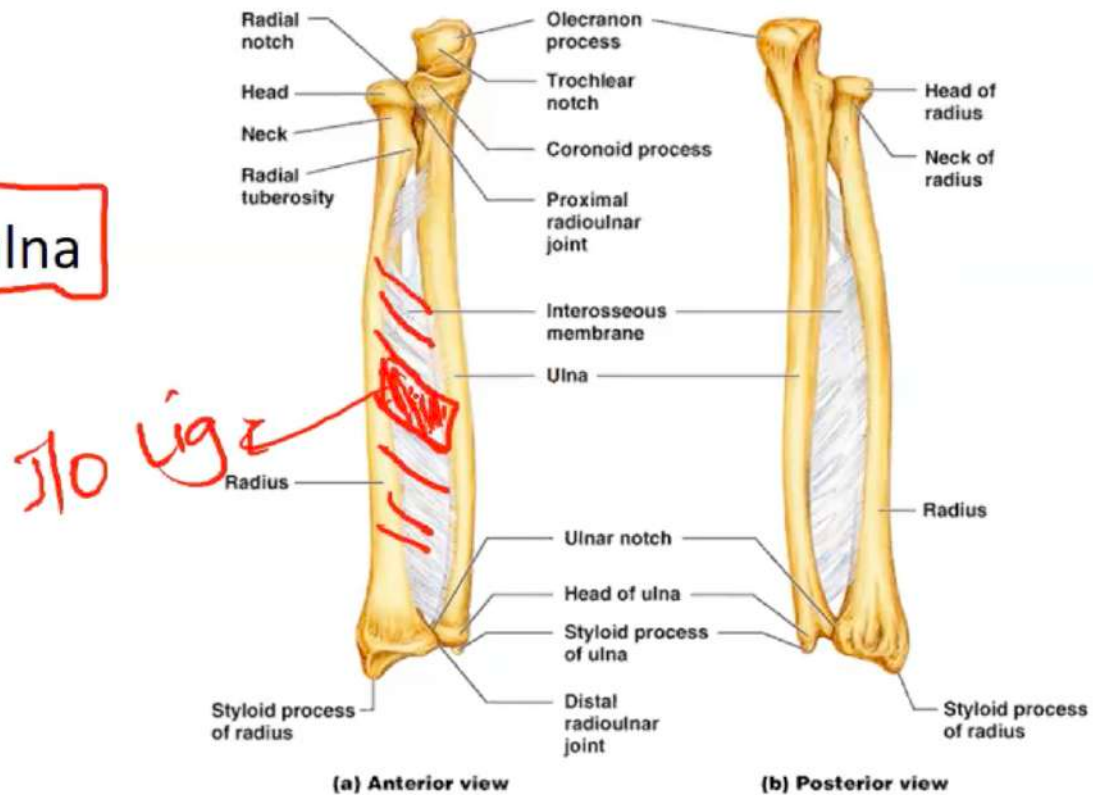
• Axis of rotation-

Radial head to fovea of ulna

Ulna is static, Radius rotates around ulna

Interosseous membrane

- What is the direction of fibres of Interosseous membrane
- A. Proximal ulna to Distal radius
- B. Transverse
- C. Longitudinal
- D. Proximal radius to Distal ulna



TFCC

- TFCC – components-

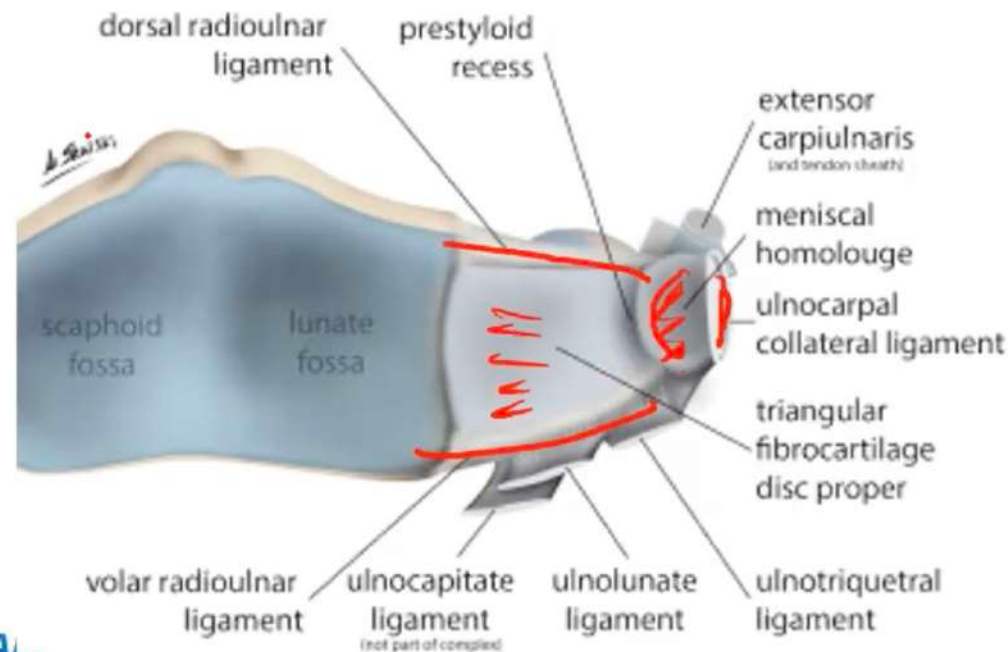
Radioulnar ligament- Volar and Dorsal

Ulnar collateral ligament

Articular disc

Meniscal homologue

ECU sheath



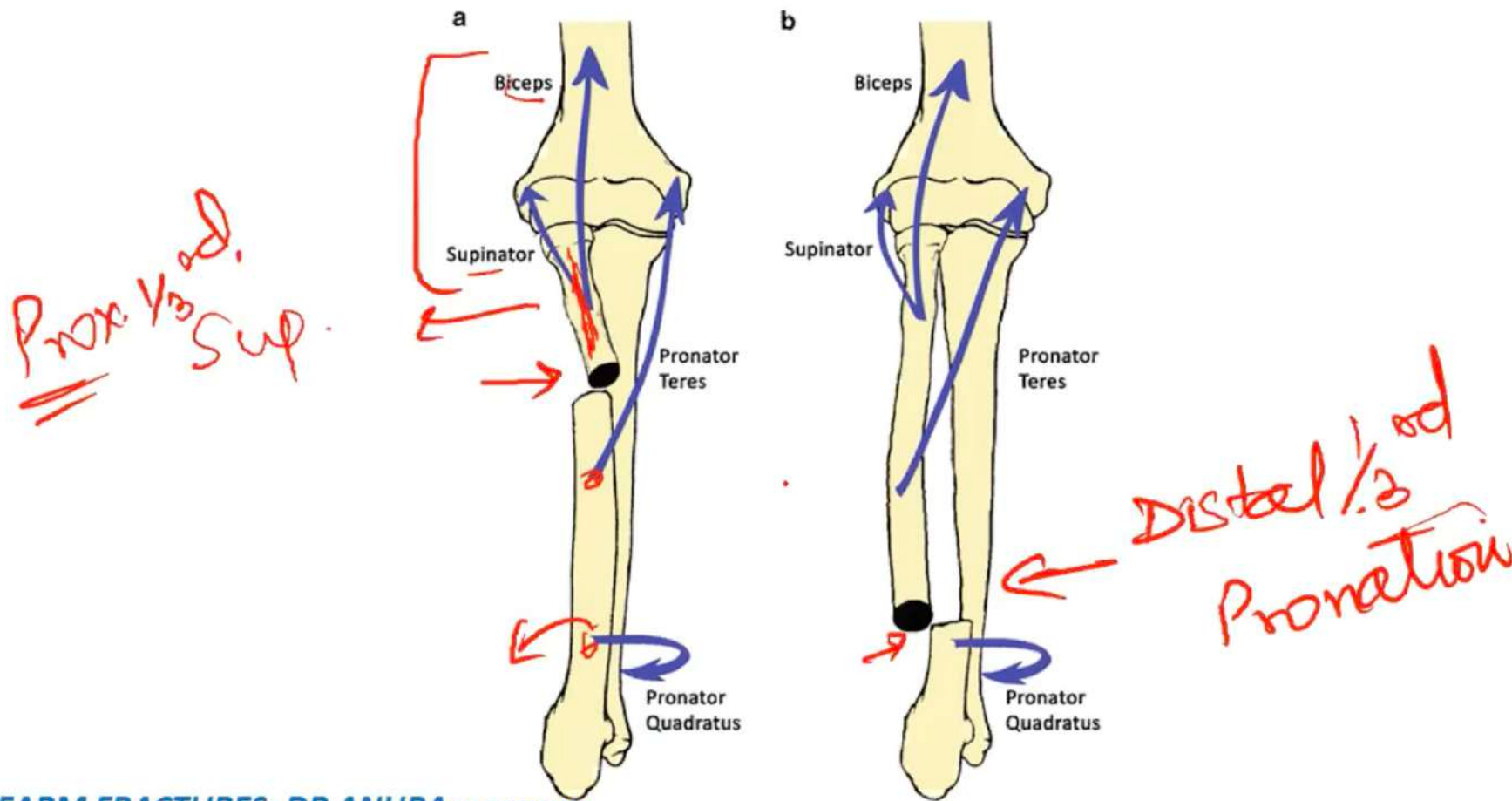
Forearm bone shaft

- Main function of forearm – To position the hand in space
- Mechanism of injury-
 - Direct- Blunt trauma or gunshot injury
eg Nightstick #
 - Indirect- Bending - # both bone at same level
Rotational injury- different level, Spiral #



FOREARM FRACTURES: DR ANURAG TIWARI

Displacements in forearm



FOREARM FRACTURES: DR ANURAG TIWARI

Clinical presentation

- ...Pain, swelling, deformity, bruise, crepitus....
- 1. Examination of elbow and wrist is mandatory

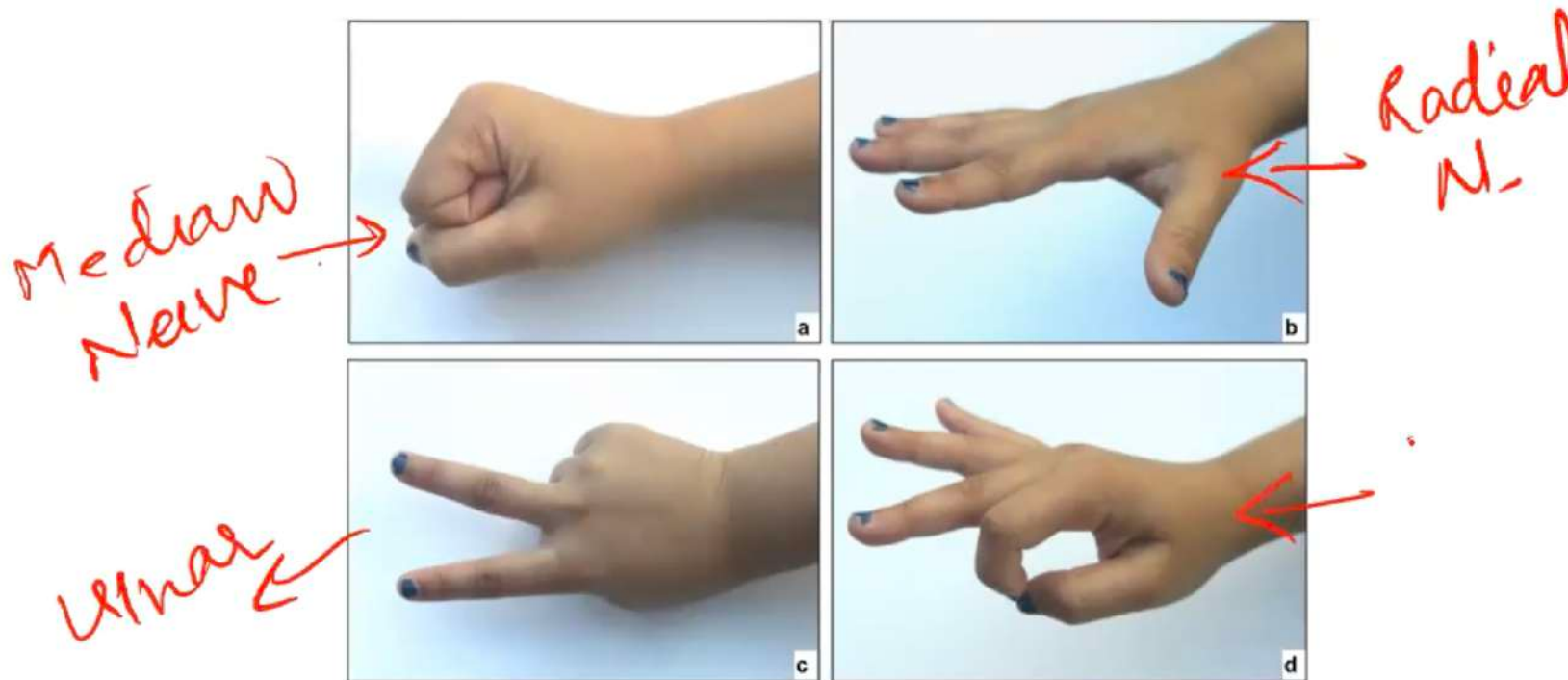
DR. UJ.



FOREARM FRACTURES: DR ANURAG TIWARI

Clinical presentation

- 2. Neurovascular examination



Fist- Paper- Scissor- OK sign

Clinical presentation

- Compartment syndrome-
- Most common site for compartment syndrome
- A. Arm
- B. Forearm ← 80% 2nd M.C.
- C. Thigh
- ✓ D. Leg ← 20% M.C.

Xray- Poll



- See the xray. What will you do?
- A. Close reduction
- B. Open reduction
- ☒ C. Get Xray of wrist before deciding treatment
- D. Percutaneous k wire fixation

Entire forearm

↳ Essex-Lopresti variant

FOREARM FRACTURES: DR ANURAG TIWARI

Xray technique

- Which Xray view is this?
- A. Supinated PA view
- B. Neutral rotation PA view
- C. Pronated PA view
- D. None of the above



Xray

- True AP ✓
- True Lateral view ✓
- Entire view of forearm ✓



- Elbow- detect PRUJ injury-
- Line passing through radius shaft, should pass through centre of capitellum *McLaughlin's*

- Wrist – detect DRUJ injury
- Ulnar styloid #
- Widening of DRUJ on PA view
- Ulnar variance – if > 5 mm



FOREARM FRACTURES: DR ANURAG TIWARI

Treatment

- Treatment goals – To maintain

- ✓ Length
- ✓ Axial alignment
- ✓ Rotation

- Non operative -

- Indications- Stable undisplaced isolated distal ulna # (Nightstick #)

(< 50% displacement/ < 10 degree angulation) → 1/0 muscle intact

- Operative-

- Treat Forearm as a joint

- "Absolute stability reduction and anatomical fixation is must"

FOREARM FRACTURES: DR ANURAG TIWARI

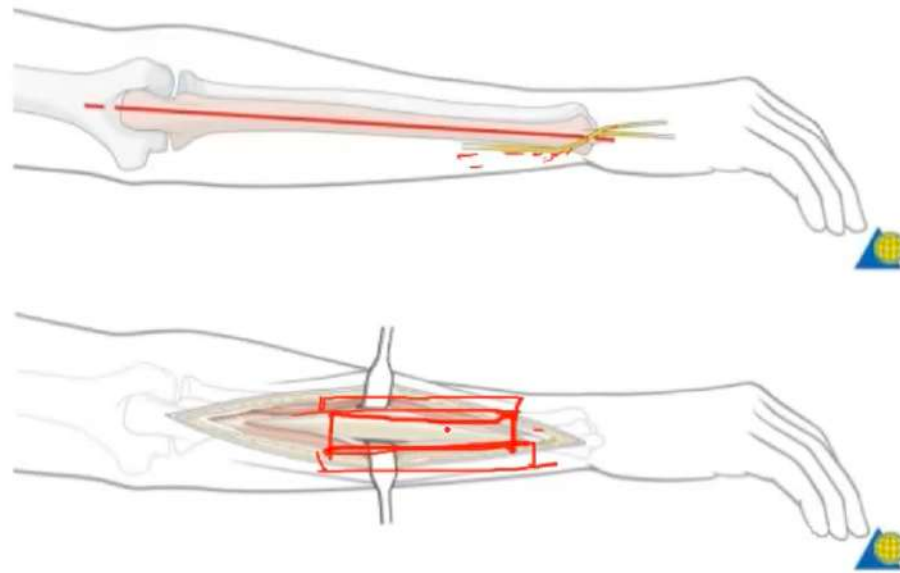
- **Approach**

- Sequence
- Implant choice-
- Number of cortices
- Lag screw-
- Prebending of plate

Ulna → Subcut

- Always use separate approach for two bones
- Single incision- More prone for Synostosis & nerve injury

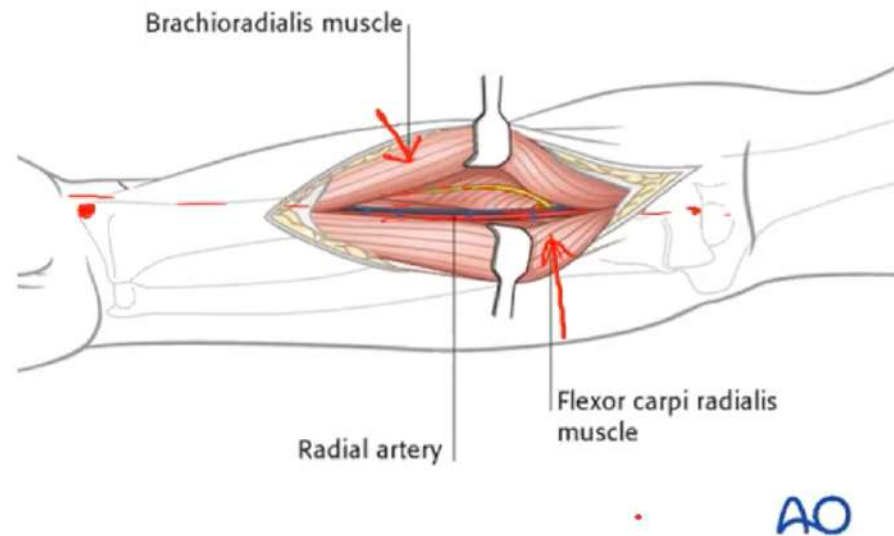
Ulna approach



- Approach – Subcutaneous
- Plane - Between FCU and ECU
- Safe- but protect ulnar nerve dorsal cutaneous branch in distal ulna #
- Plate position dorsal or volar.

FOREARM FRACTURES: DR ANURAG TIWARI

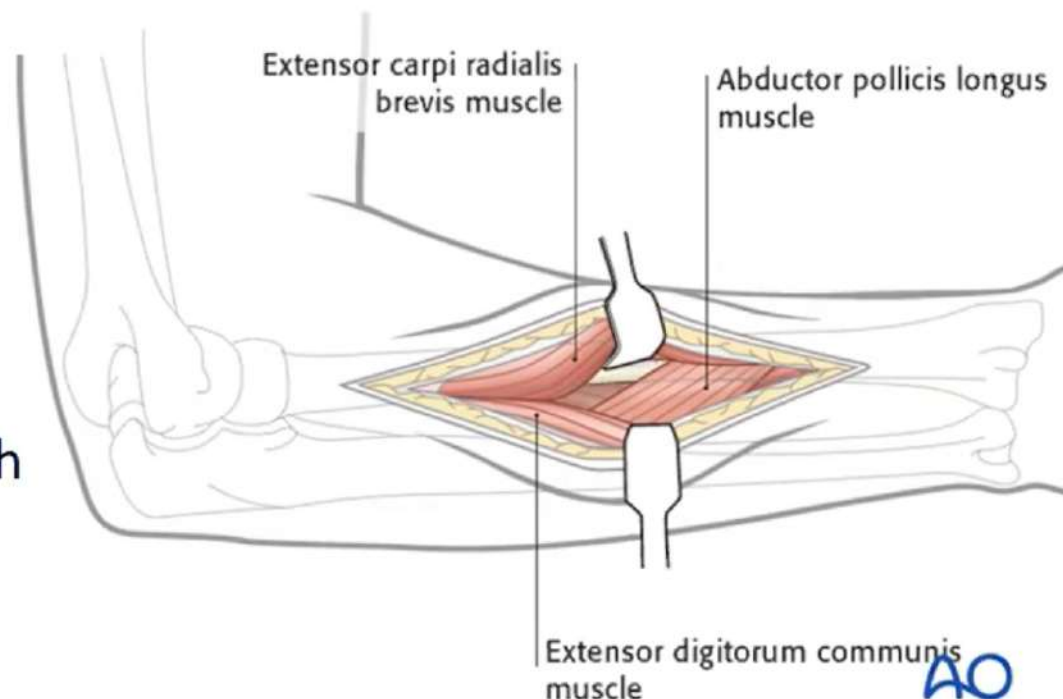
Radius



- Volar Henry approach-
- Specially for middle and distal #
- Incision-
- Plane – BR and FCR
- Protect radial artery and SRN

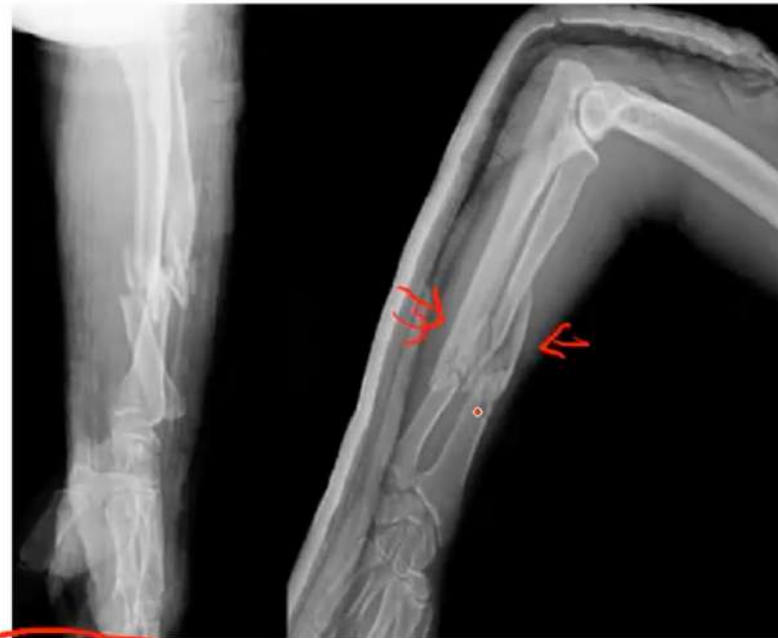
FOREARM FRACTURES: DR ANURAG TIWARI

- Dorsal Thompson approach
- Proximal third #
- Incision-
- Plane – ECRB and EDC
- Protect PIN



FOREARM FRACTURES: DR ANURAG TIWARI

- Sequence



Simple Simple Comm.-Simple Surgeon -
ulna fr. r.

FOREARM FRACTURES: DR ANURAG TIWARI

- Implant choice-

- Implant – Plate-3.5 mm DCP or LCDCP –
(Gold standard)

Nail- ✓ Square nail
✓ TENS →
✓ Interlocking nail



- Indications-
- Open #
- Segmental #
- Poor soft tissue status
- Osteoporosis
- Polytrauma

Nailing

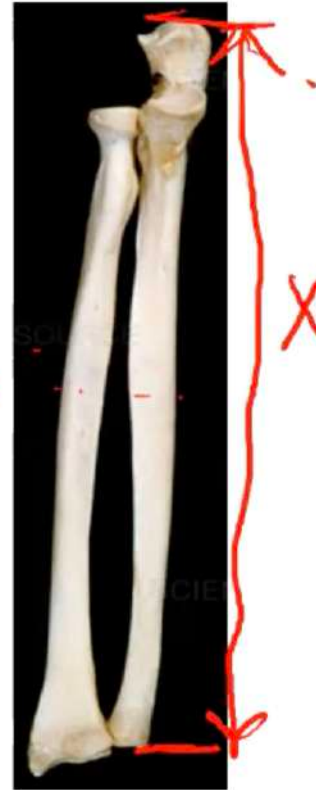
- Nail length- Olecranon to ulnar styloid (X)
- Ulnar nail length = $(X-1)$ cm
- Radial nail length = $(X-3)$ cm

$X-3$

$X-1$

- Diameter of nail=
- 1 cm less than the diameter at isthmus

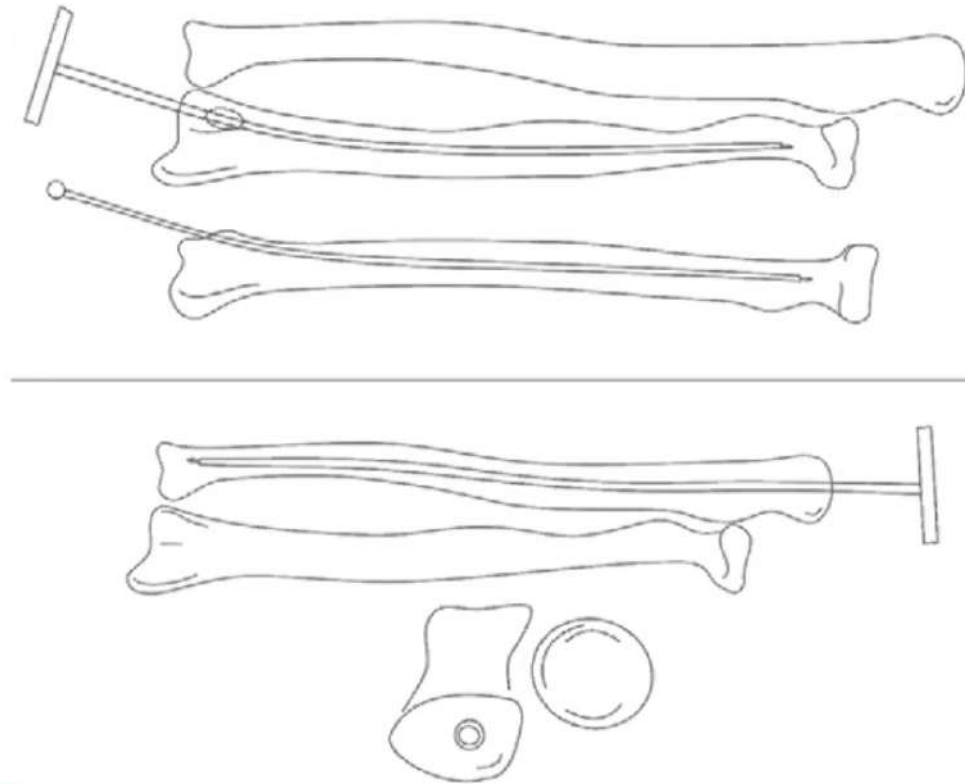
- Nail simple # first



FOREARM FRACTURES: DR ANURAG TIWARI

- Radius Entry point- Dorsal radius just lateral to Lister's tubercle
- Ulna entry point- Tip of olecranon process

EPL



FOREARM FRACTURES: DR ANI

Hybrid fixation

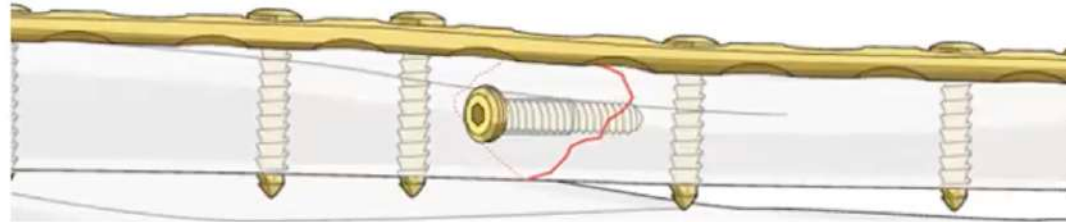


FOREARM FRACTURES: DR ANURAG TIWARI

- Approach
- Sequence
- Implant choice-
- **Number of cortices**
- Lag screw-
- Prebending of plate

6 cortices fixation on each fragment



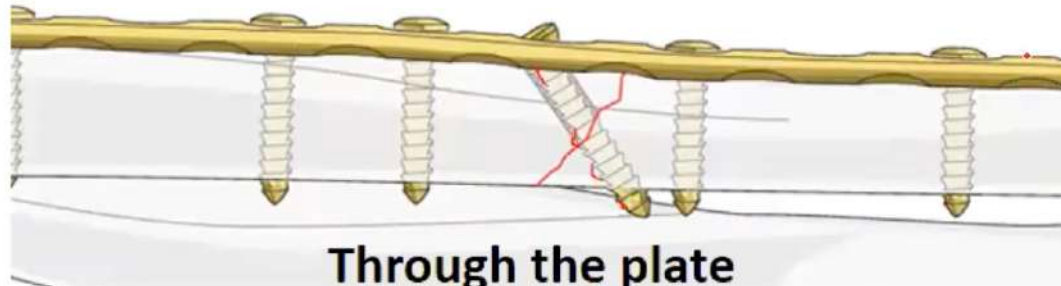


- Lag screw-

outside plate (3.5mm)
Lag screw first then plate (in neutralization)

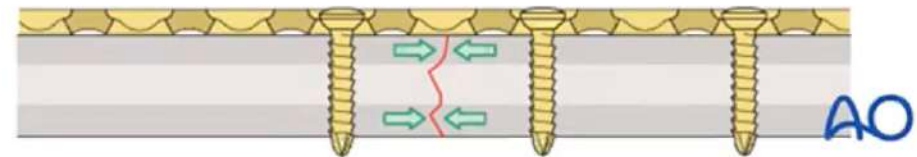
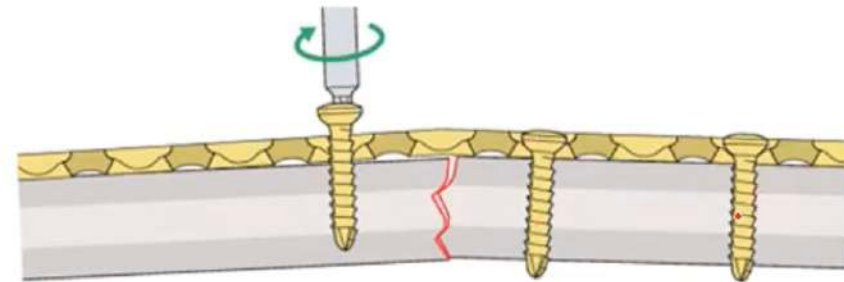
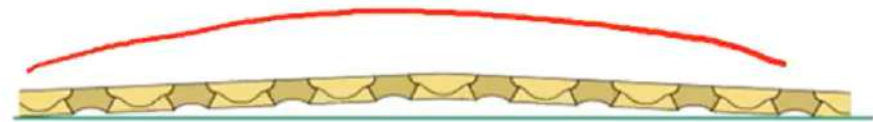
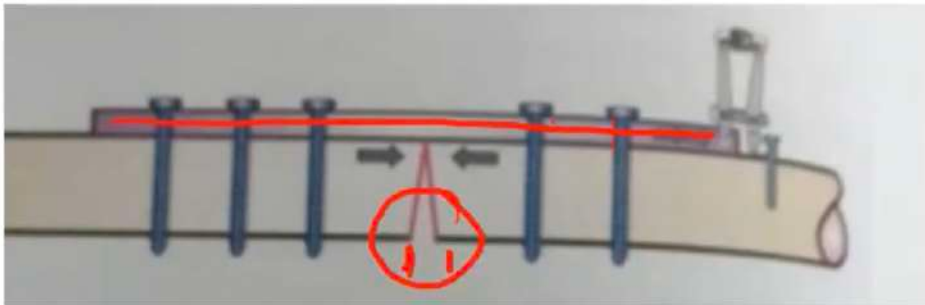
Dynamic X

- Used in case of oblique #
- Screw should be perpendicular to # site



Through the plate
Use smaller size screw (2.7mm)
First screw then plate

- Approach
- Sequence
- Implant choice-
- Number of cortices
- Lag screw-
- **Prebending of plate**



FOREARM FRACTURES: DR ANURAG TIWARI

How to check malrotation intraop

Radius-

- Bicipital tuberosity and radial styloid are at an angle of 160-180 degree on PA view

Ulna –

- Coronoid and ulnar styloid are at angle of 180 degree

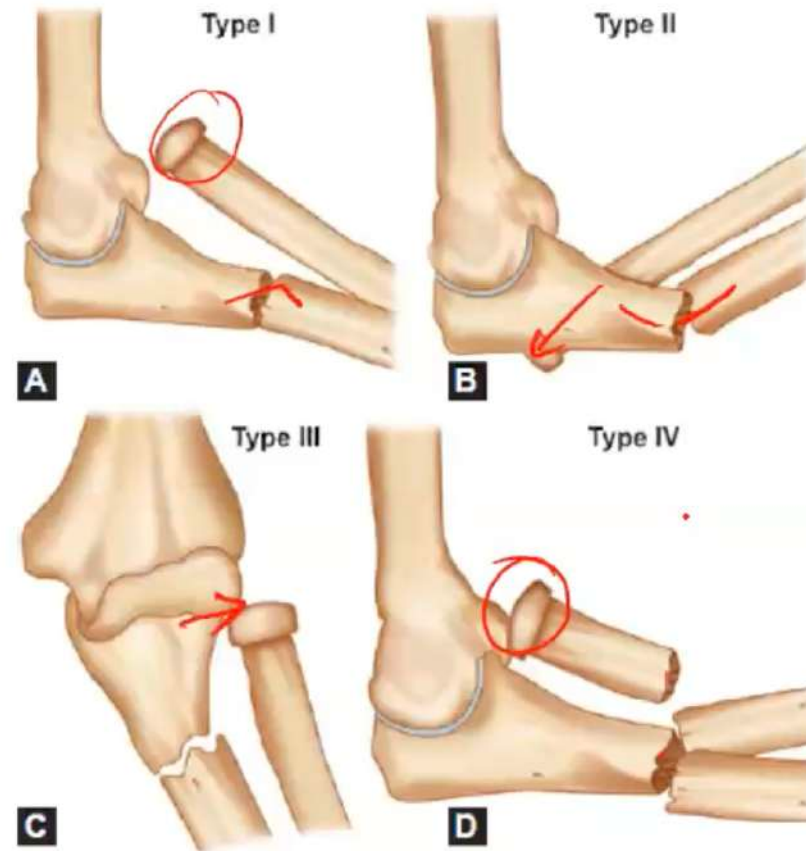


FOREARM FRACTURES: DR ANURAG TIWARI

Monteggia

R-CX

- Proximal Ulna # + Proximal Radioulnar injury
- Bado classification
- Apex direction is direction of radial head



FOREARM FRACTURES: DR ANURAG TIWARI

- Most common type of Monteggia in Adults

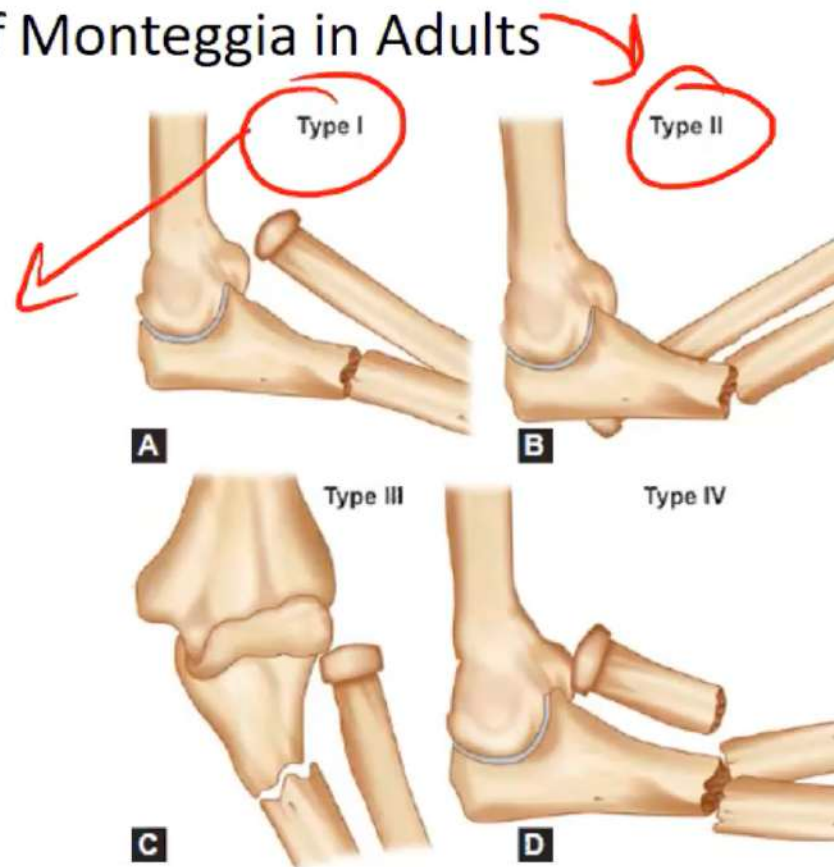
- A. Bado Type I

- B. Type II

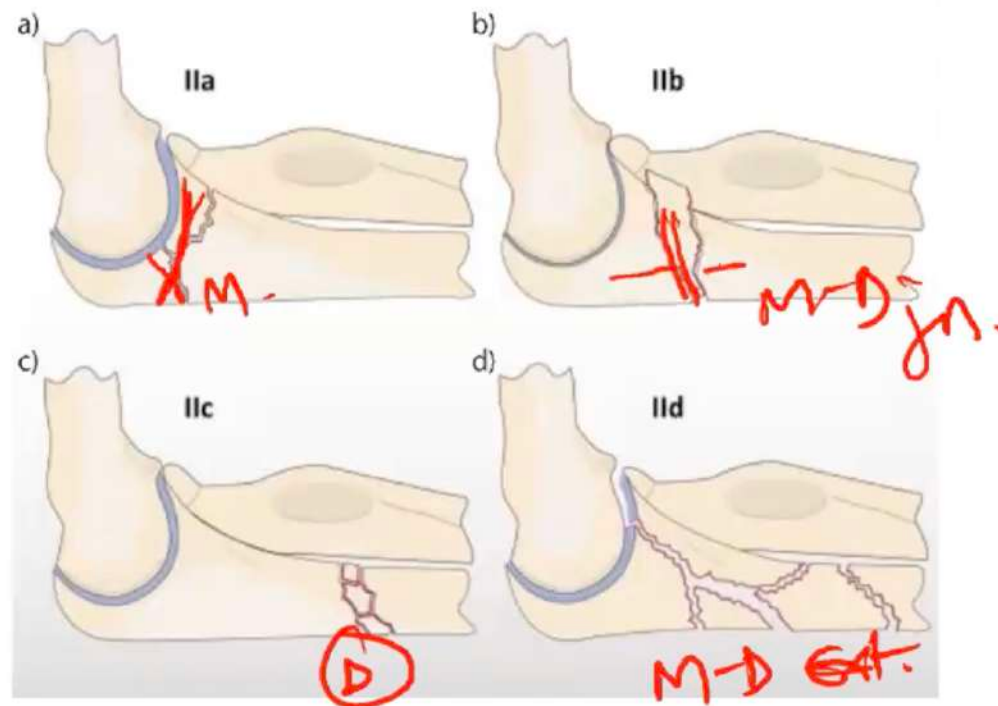
- C. Type III

- D. Type IV

Chi



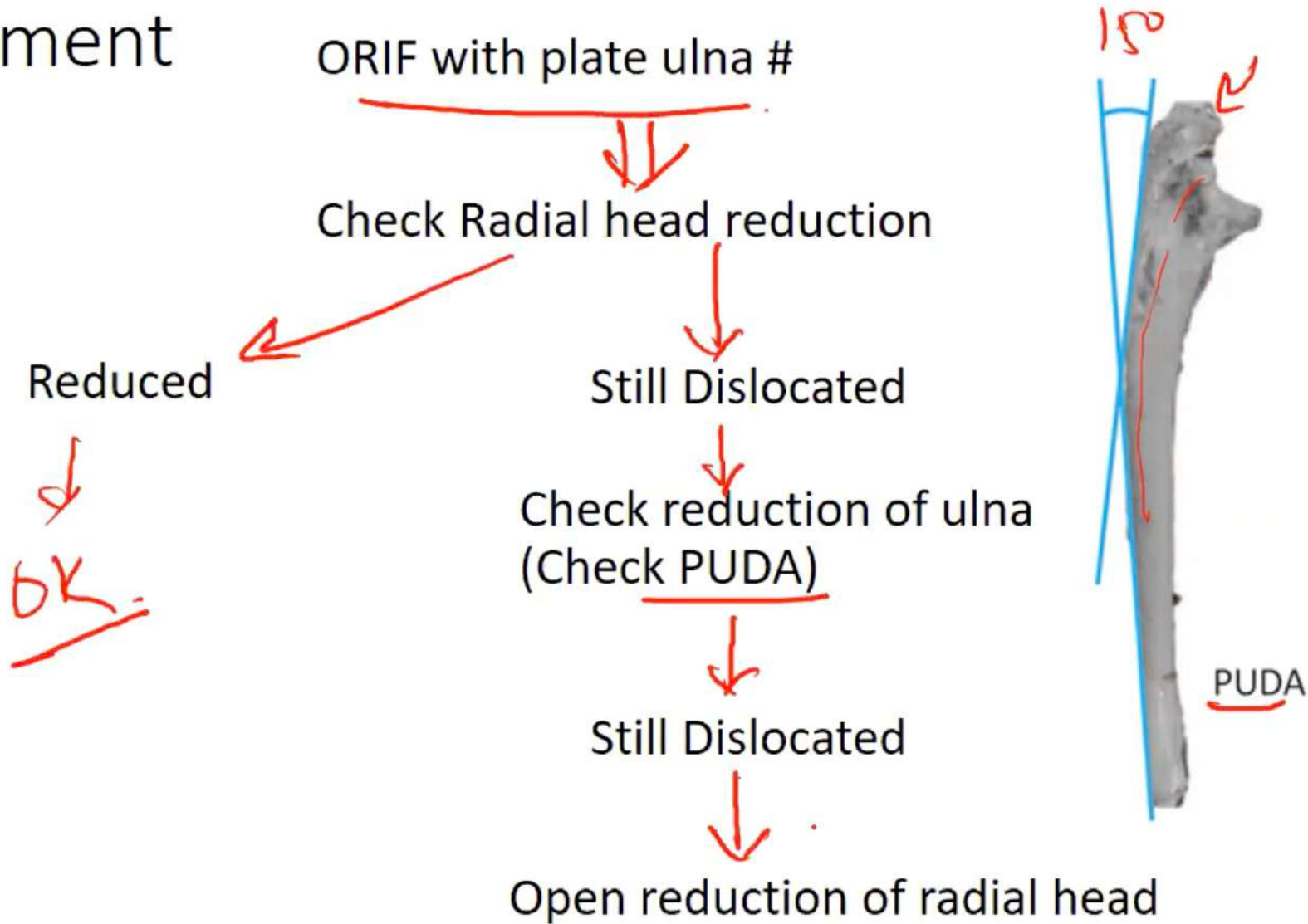
Jupiter classification of Bado Type II



Monteggia equivalents

- Pulled elbow
- # ulna shaft with # radius head / neck
- # ulna shaft + Olecranon + anterior dislocation of radius head

Treatment



FOREARM FRACTURES: DR ANURAG TIWARI

Galeazzi

- # of necessity
- Piedmont #
- Reverse Monteggia
- Distal radius shaft # + DRUJ injury
- DRUJ is suspected on Xray –
- # ulnar styloid
- Widening of DRUJ on AP view
- Ulna head dislocation on lateral view
- Ulnar variance $> 5\text{mm}$



FOREARM FRACTURES: DR ANURAG TIWARI

Classification



Type 1- Apex volar angulation of radius # with
volar dislocation of ulna



Type 2- Apex Dorsal angulation of radius # with
dorsal dislocation of ulna

Classification- Rettig and Raskin –



- Type I - # radius within 7.5 cm from distal articular surface

✓ More DRUJ instability



Type II- > 7.5 cm away from articular surface

Treatment

ORIF of Radius # (Plate)

Check DRUJ reduction and stability

Reduced and Stable

Fine

Reduced but Unstable

DRUJ Pinning

Still dislocated

OR of DRUJ

Suspect ECU or EDM interposition

Dorsal galeazzi – immobilize in supination ✓
Volar – In pronation ✓



FOREARM FRACTURES: DR ANURAG TIWARI

Complications of Forearm



Non union



Malunion



Synostosis



Risk factors, Head injury

both bone same level

Severe Comminution

Single incision



Bone graft at interosseous border

FOREARM FRACTURES: DR ANURAG TIWARI



(C) www.targetortho.com

Pediatric Forearm

- Plastic deformation

- Greenstick #

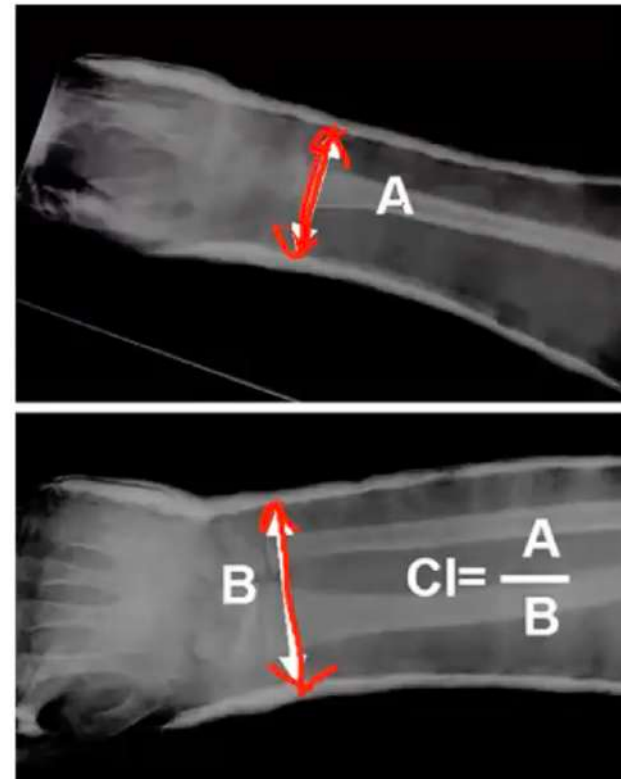


FOREARM FRACTURES: DR ANURAG TIWARI

Cast index

- Sagittal cast width / coronal cast width
- Cast width In lateral view/ AP view
- Normal value = 0.7

interosseous moulding



Close reduction “Acceptability criteria”

- 20 degree angulation distal third #

10yr

- 15 degree mid shaft

- 10 degree proximal third #

Entry point for nailing

- Protecting the physis.
- Radius - Just proximal to physis
- Ulna – Just distal to olecranon apophysis