Pediatric Elbow Trauma

PAOS 2021

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Pediatric Orthopedics

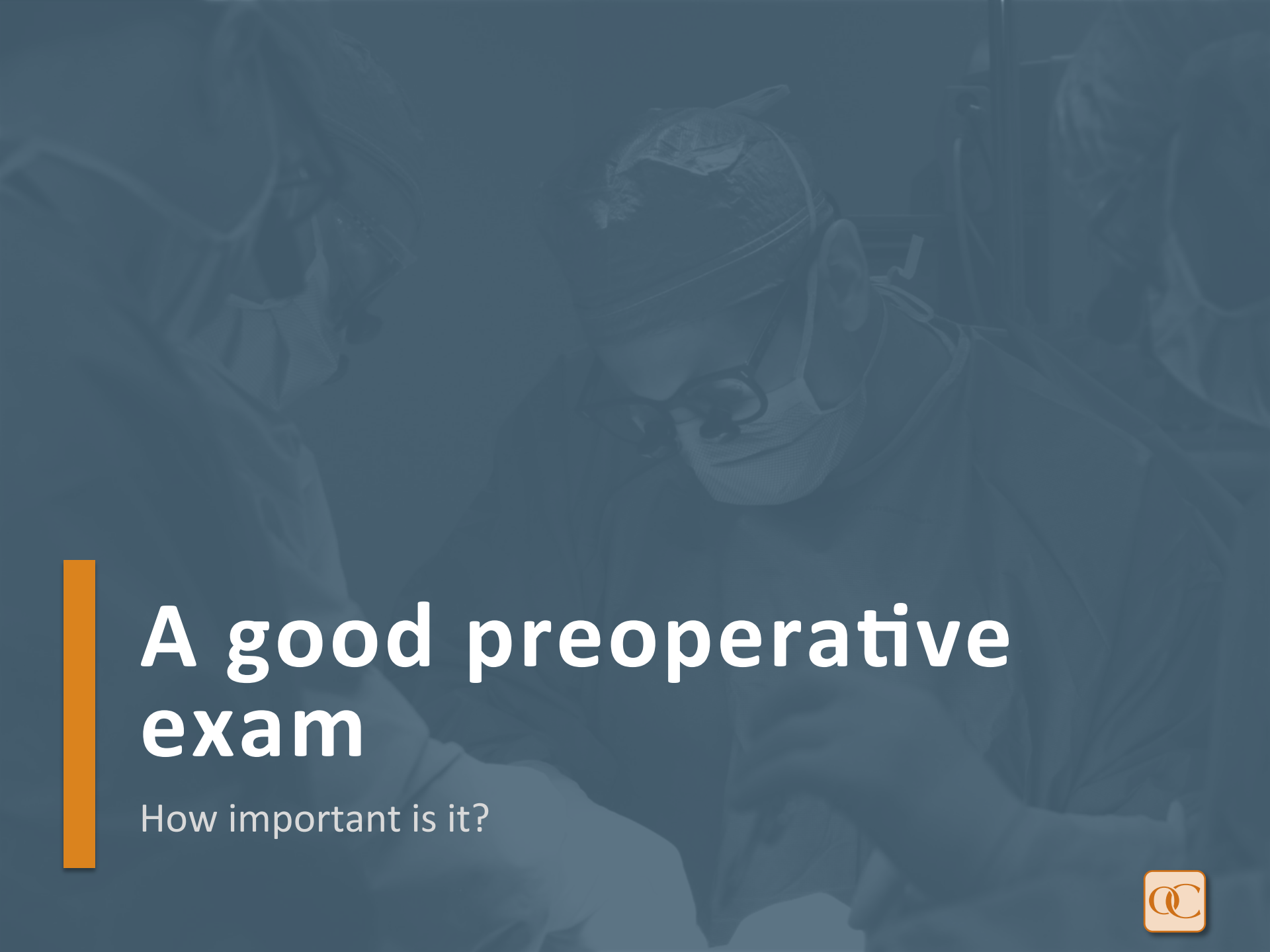
No relevant disclosures

Elbow Fractures

- 86% of elbow fractures are in distal humerus
  - 80% supracondylar
  - 17% lateral condyle
  - 12% medial epicondyle

Pediatric Elbow Fractures

- Supracondylar humerus fractures
- Lateral humeral condyle fractures
- Medial epicondyle fractures
- Radial neck fractures
- Olecranon fractures
- Monteggia fractures
- Nursemaid’s elbow



A good preoperative exam

How important is it?

Patient Evaluation in ED

- Distal perfusion: pulses/doppler signal?
- Skin – soft tissues: brachialis sign, open?
- Neurological function
- NPO status
- Other injuries?

Neurologic Exam

- Extend fingers/thumb (Radial N)
- Make O with thumb and index finger (Median N)
- Spread fingers (Ulnar N)

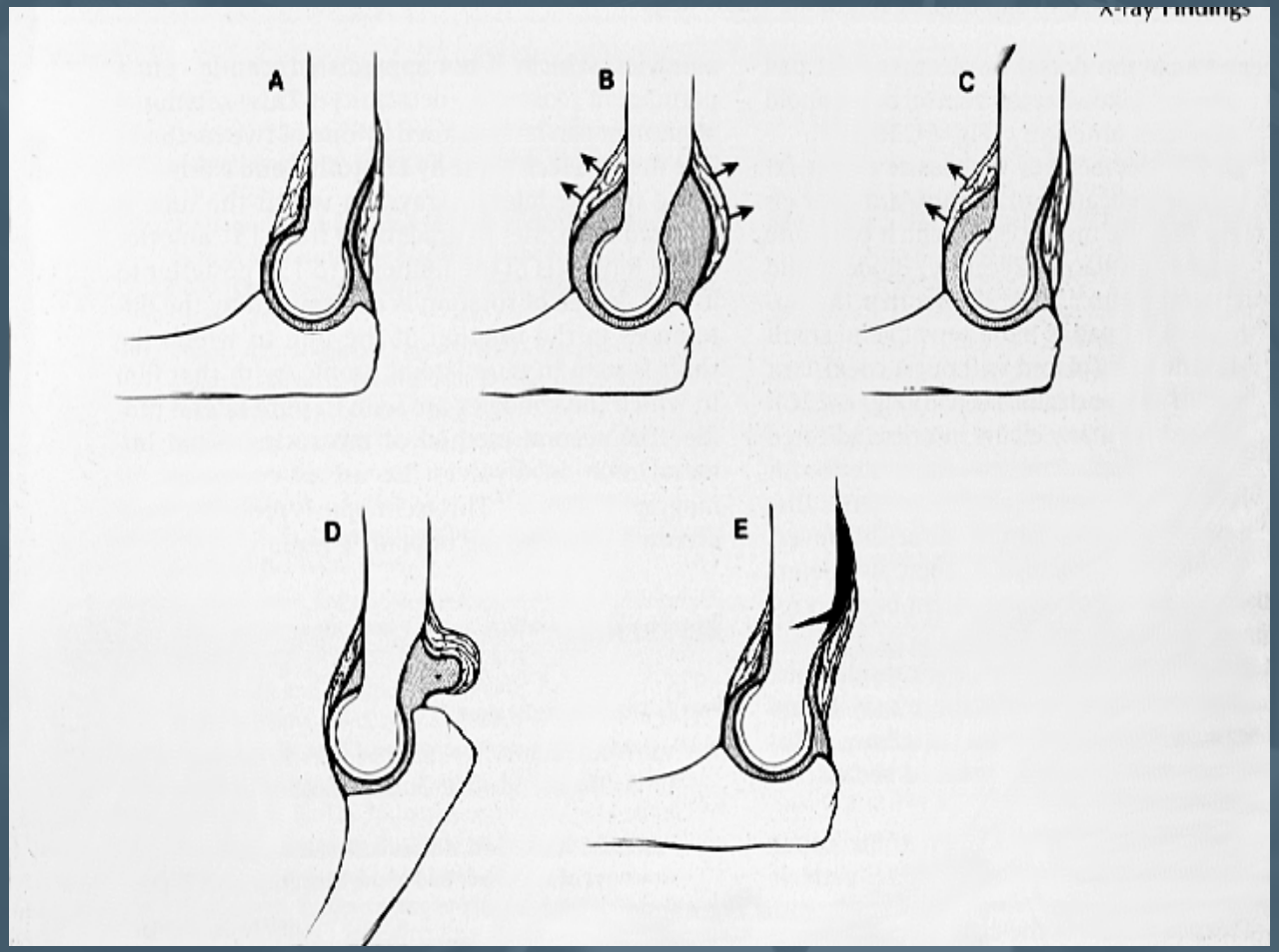
Anterior Interosseous Nerve Deficit

OK **NOT OK**

Radiographic Assessment

Fat Pad Sign

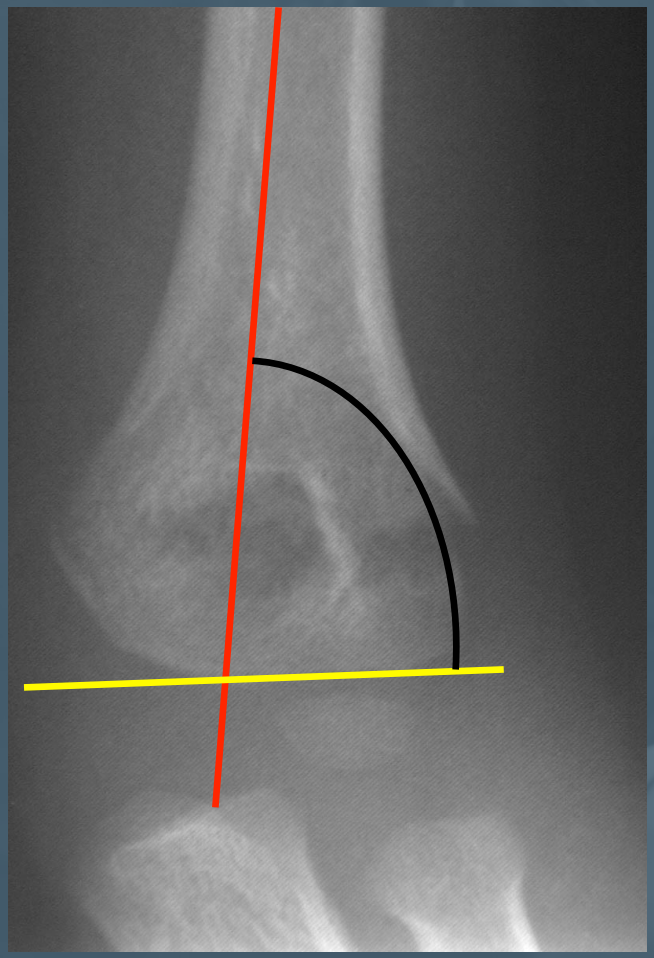
- 50% will have a fracture



Fat Pad Sign

- Usually cast children with + fat pad sign for 3 wks

Elbow Fractures in Children: Radiograph Anatomy/Landmarks



- Baumann's angle: a line paralell to the axis of the humerus and a line through the physis of the capitellum
- Wide range of normal and can vary with rotation of arm (64-81)
- In this case, the medial impaction and varus position increases Baumann's angle
- Note that some refer to the complement as Baumann's angle

Elbow Fractures in Children: Radiograph Anatomy/ Landmarks

- Anterior Humeral Line - should pass through middle of capitellum. If it does not then posterior displacement/ angulation

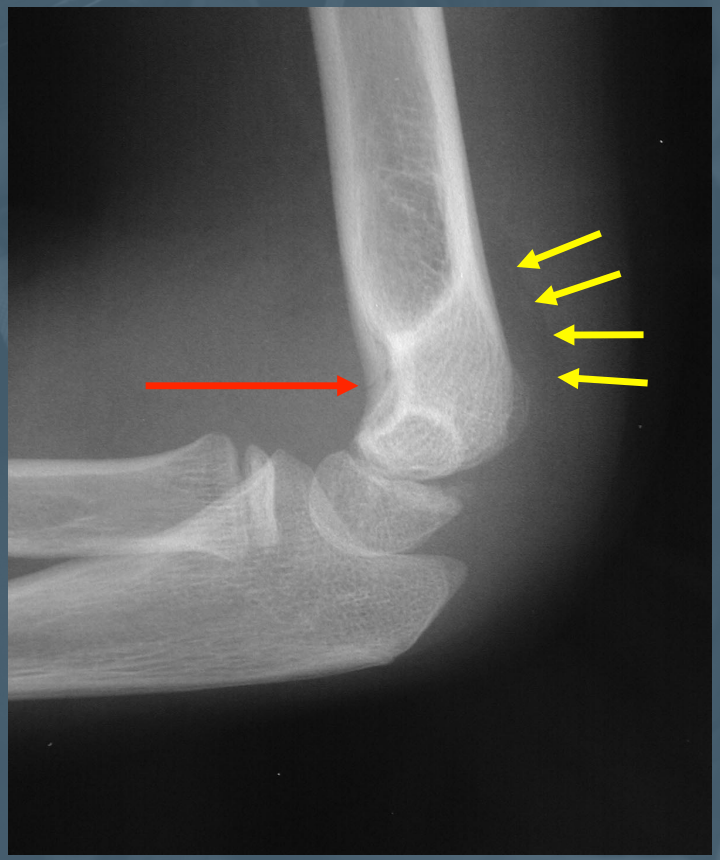
Elbow Fractures in Children: Radiograph Anatomy/Landmarks

- Distal humerus angulated anteriorly about 30 degrees.
- Implications for pinning

Type I : non-displaced

- Note the non-displaced fracture anteriorly
- (Red Arrow)

- Note the posterior fat pad
- (Yellow Arrows)



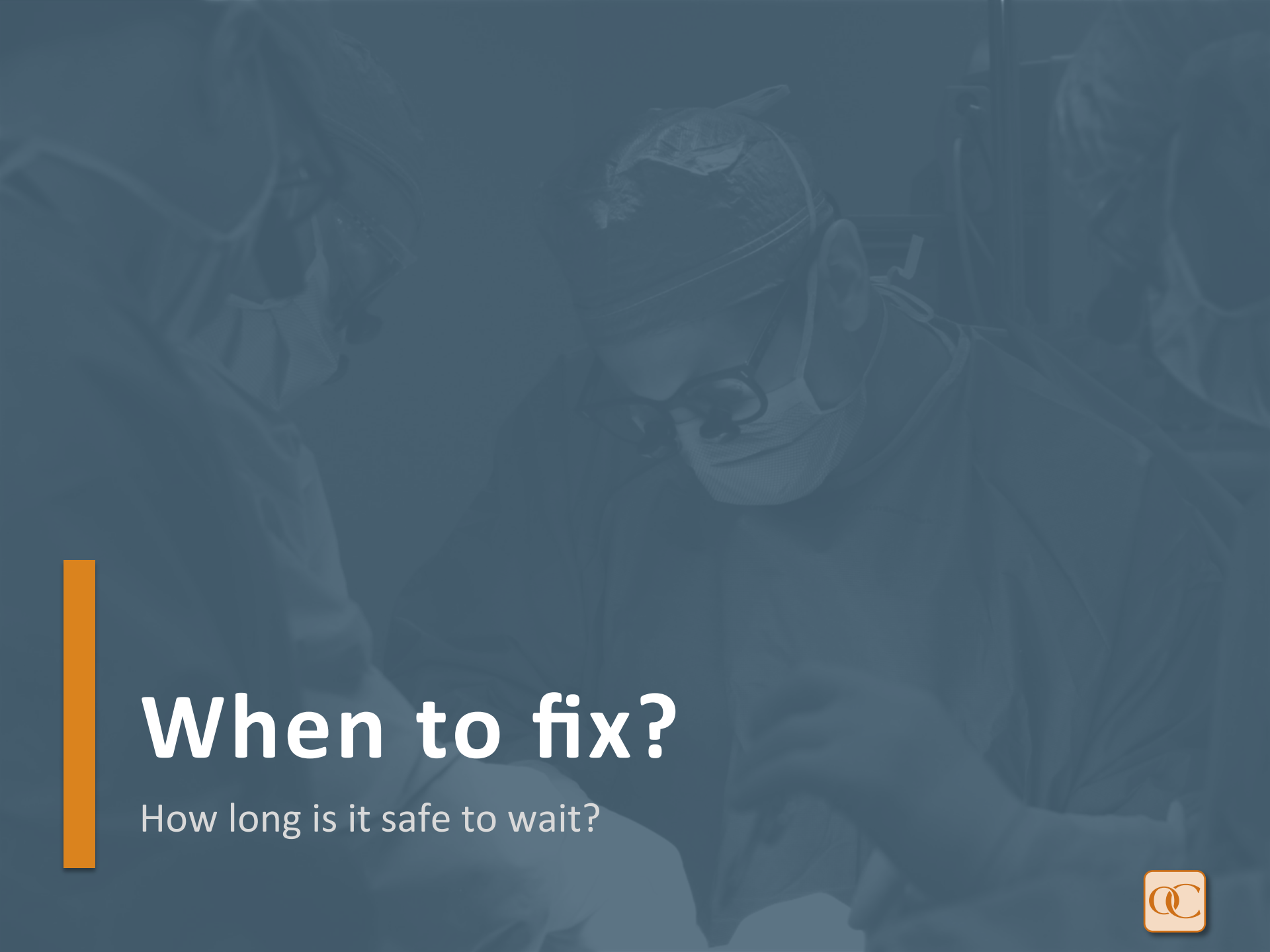
Type II : Angulated with intact posterior cortex

Type III : Complete displacement, with no contact between fragments

Type IV: Completely unstable

Treatment

- Type I: cast
- Types II and III (and IV)
  - Closed Reduction and Pinning
  - Cast / Pins 3 weeks



When to fix?

How long is it safe to wait?

When to fix?

- Type II can be sent home from the ED and fixed electively in the next few days
- Type III needs to be fixed within 24 hours preferably
- Which ones need to get fixed emergently?

6 year old, AIN out, good pulses and sensation

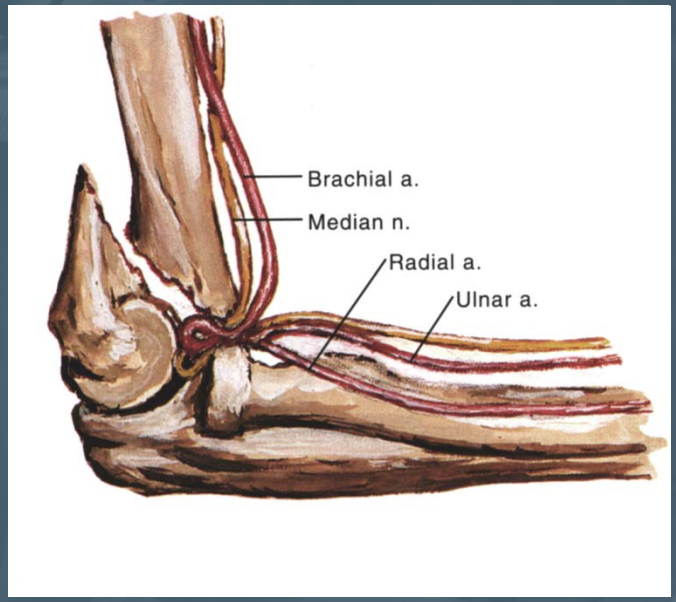
Brachialis sign

CRPP next am, stable exam postop

Supracondylar Fractures

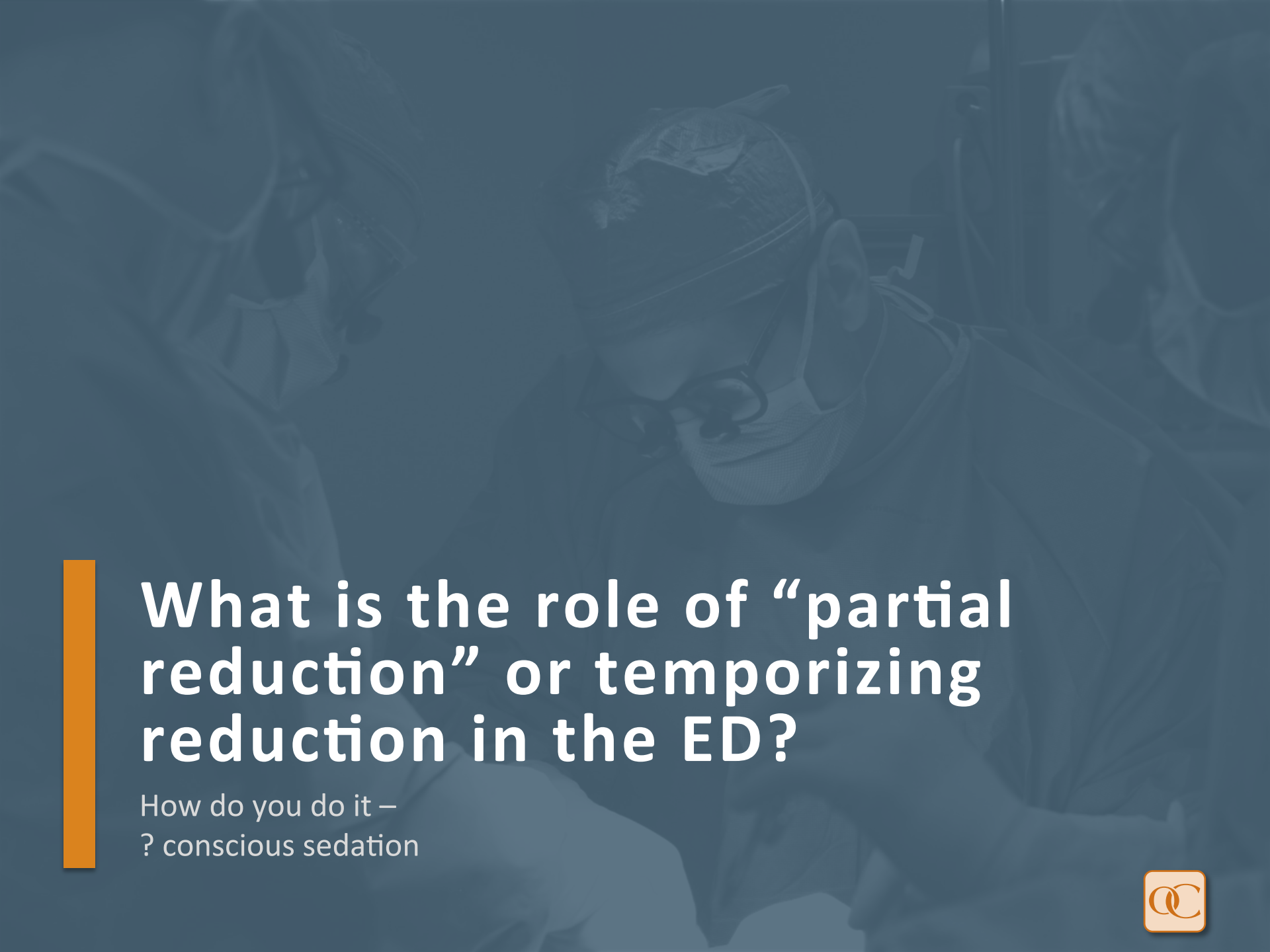
Catastrophes

- Neurovascular injury
- Large open
- Compartment syndrome



Emergent

- Open
- Poorly perfused hand



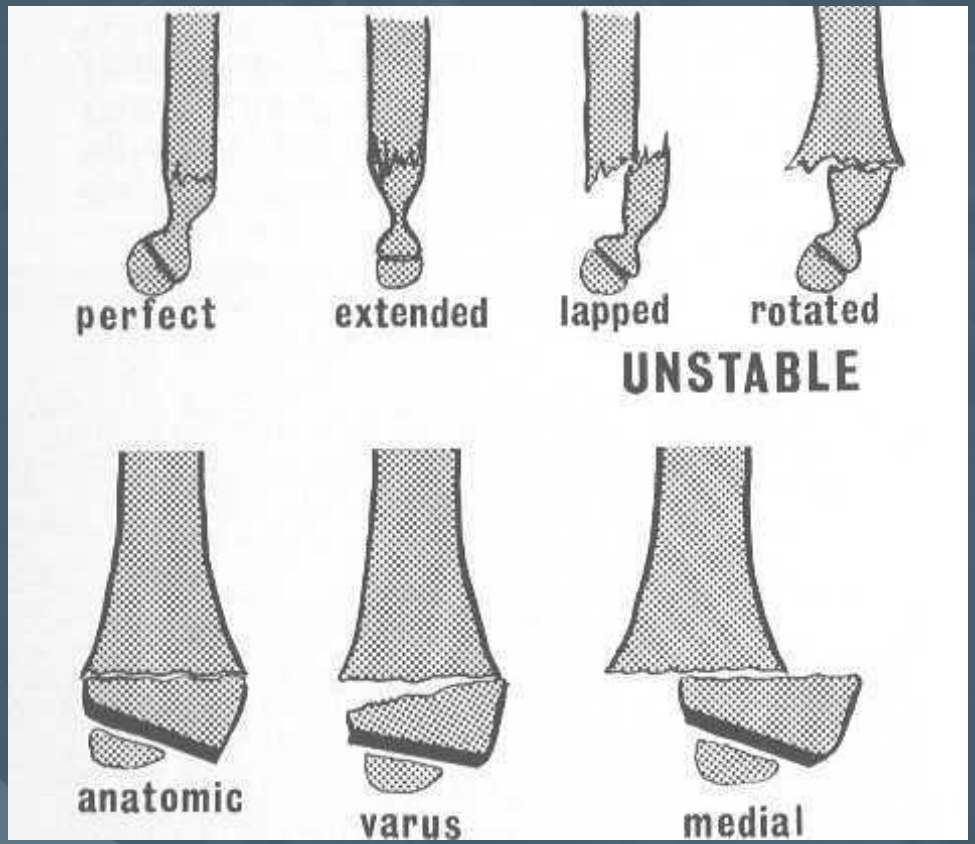
What is the role of “partial reduction” or temporizing reduction in the ED?

How do you do it –
? conscious sedation

What is an acceptable closed reduction?

Adequate reduction?

- No varus/valgus
- anterior hum line
- minimal rotation
- translation OK



From M. Rang, Children's Fractures

Acceptable Reduction?

- <10 degree difference in Baumann's angle
- <15 degrees decrease in carrying angle

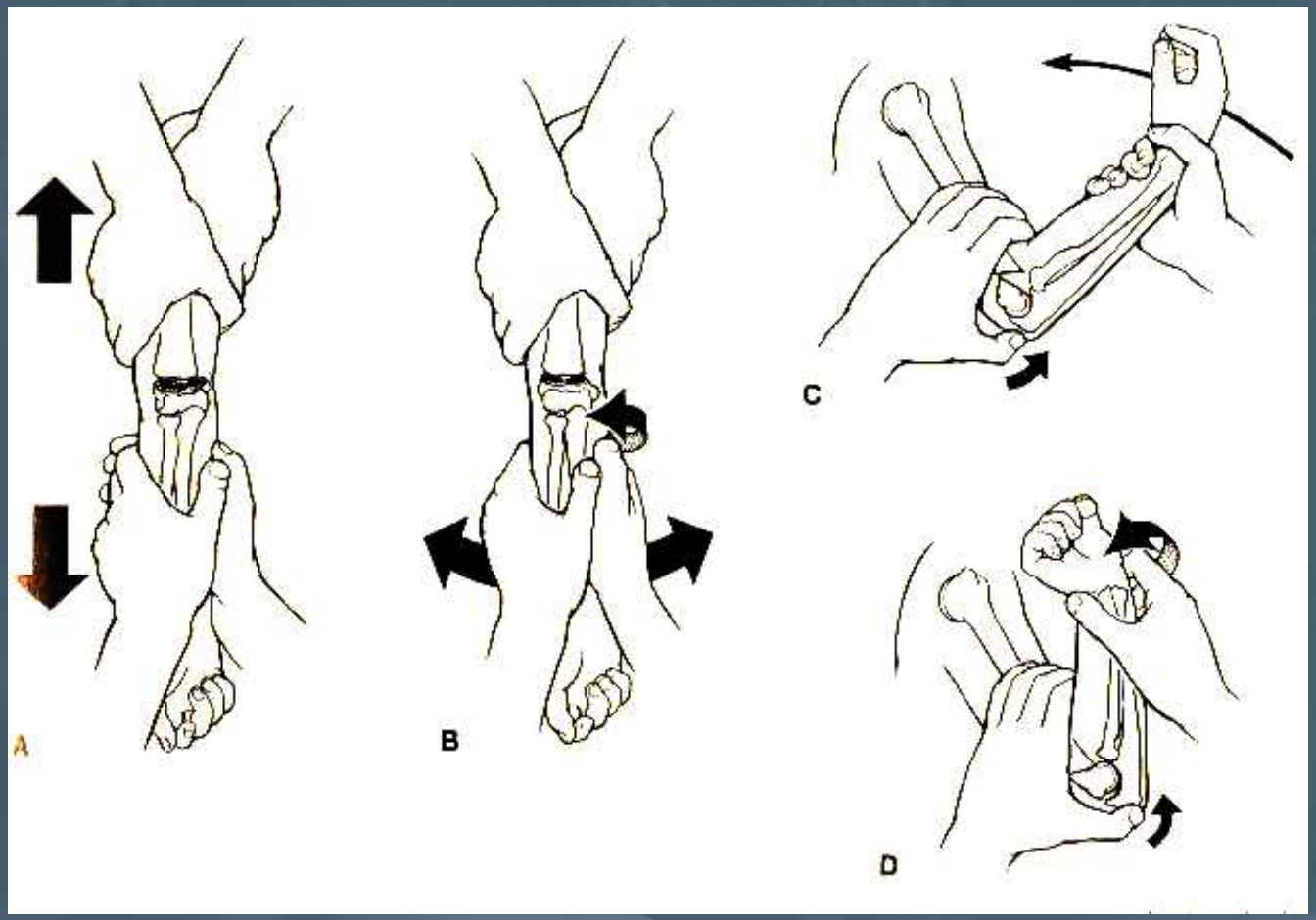
CRPP

- Examine other elbow first
- carrying angle, ROM
- supine, sheet around axilla
- plexiglass arm board

Closed Reduction: One Technique_

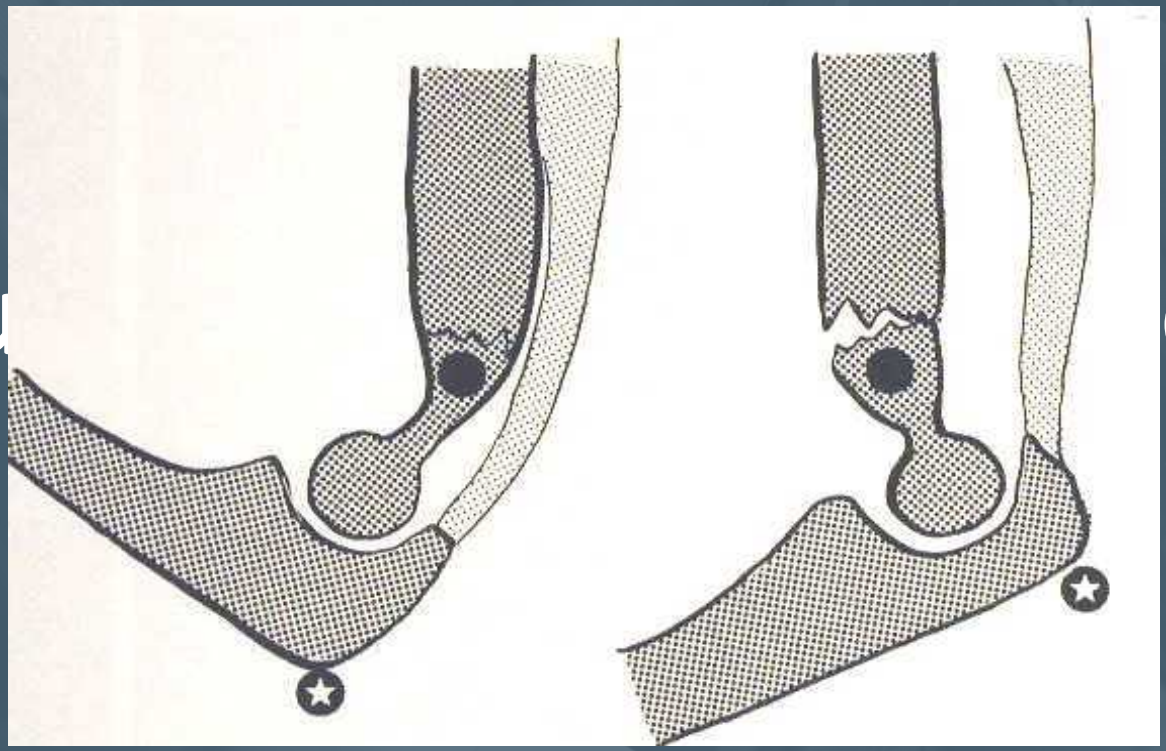
- Longitudinal traction
- Correct medial-lateral displacement, rotation
- Push olecranon forward
- Flex elbow & pronate forearm

Reduction



From Mercer Rang's Children's Fractures

Pu or



Are there tricks/tips for closed reduction method?

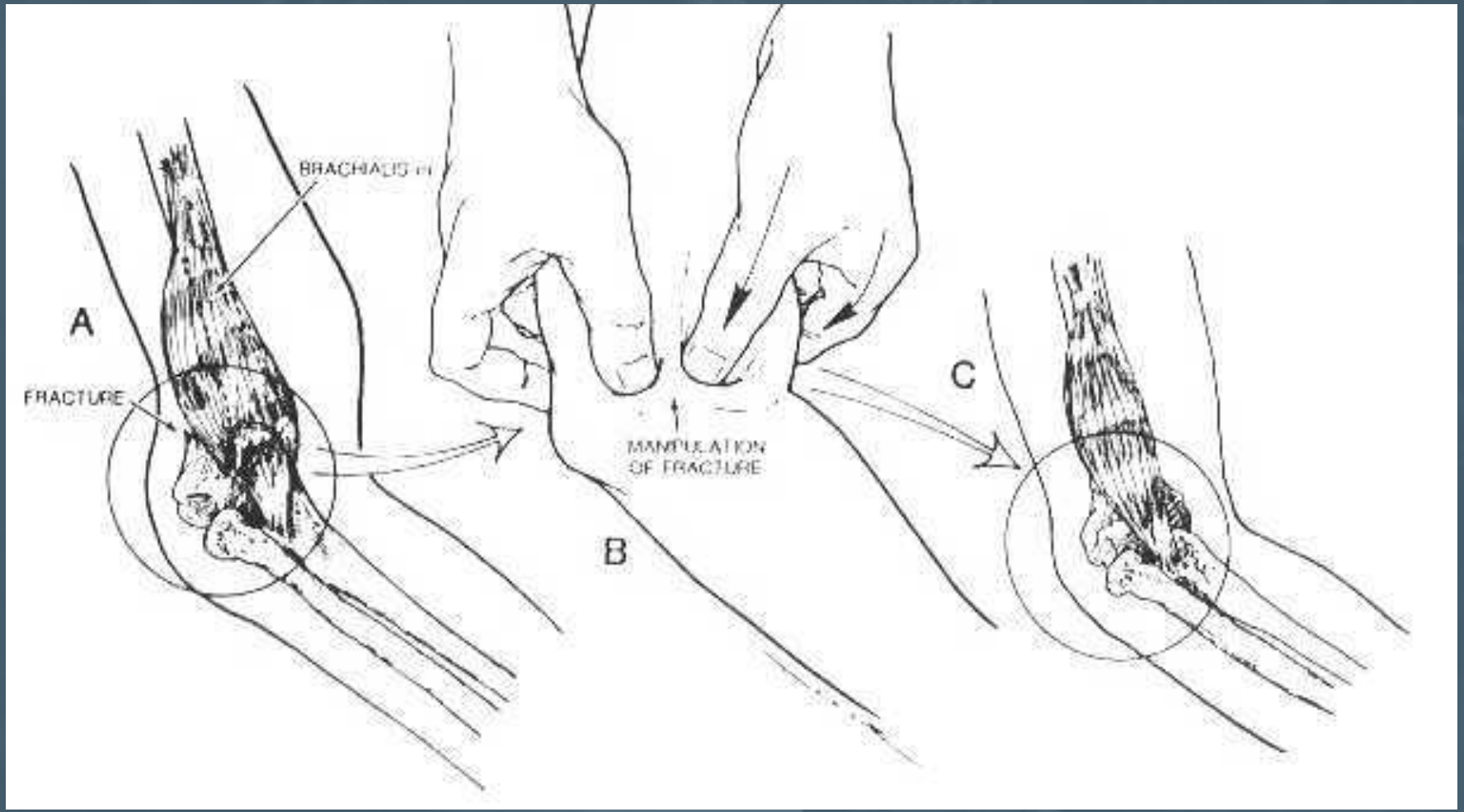
Severely Displaced

- Skin dimple
- Hyperextension/rotation
- "milk" brachialis first
- Don't flex elbow until olecranon pushed anterior to epicondyles

Brachialis Interposition-signs

- Local ecchymosis
- Anterior skin dimple
- Palpable subcutaneous proximal fracture fragment

“Milking Maneuver”



From Archibeck et al. JPO 1997

Milking Maneuver

From Archibeck et al. JPO 1997

Medial Pin

- 8-17% incidence UN instability
- Extend elbow to 50 degrees after 2 lateral pins
- Thumb over UN ?
- Percutaneous or mini-open pin placement

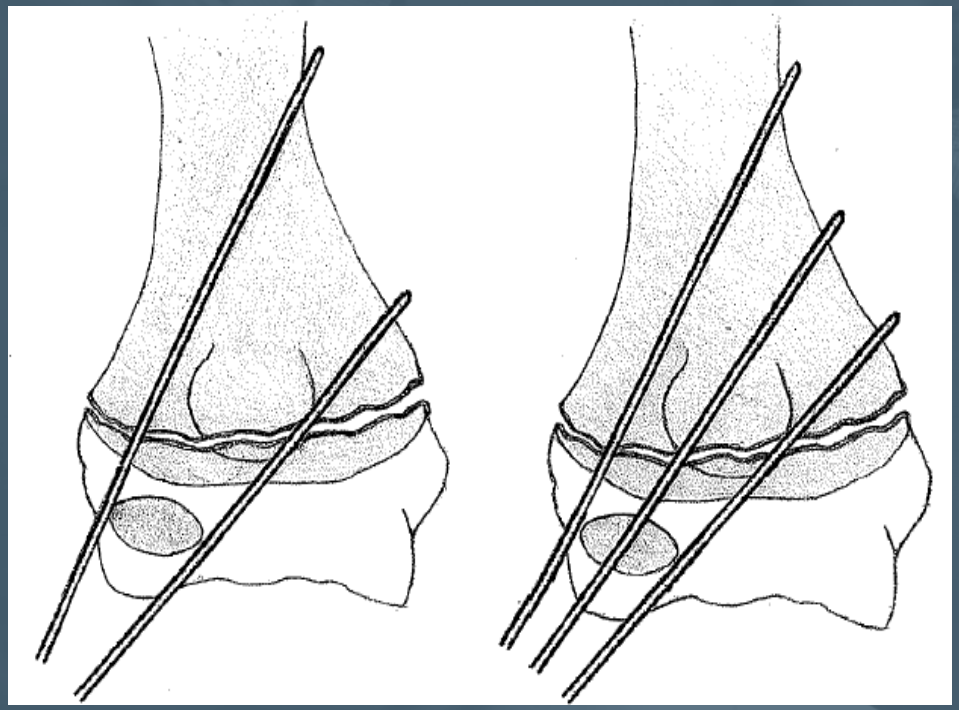
Ulnar Nerve Instability
Zaltz et al JPO 1996

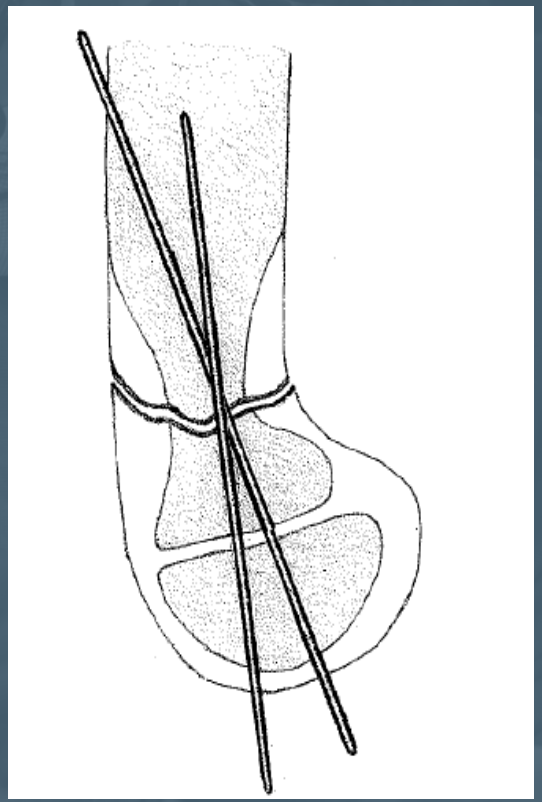
- 0-5 yrs old - 17%
- 6-10 yrs old - 8%
- 11-18 yrs old - 6%
- Usually bilateral

Are two lateral pins enough?

- Skaggs et al JBJS 2001 - yes. No difference 2 lateral versus lateral and medial pins
- less chance of UN injury

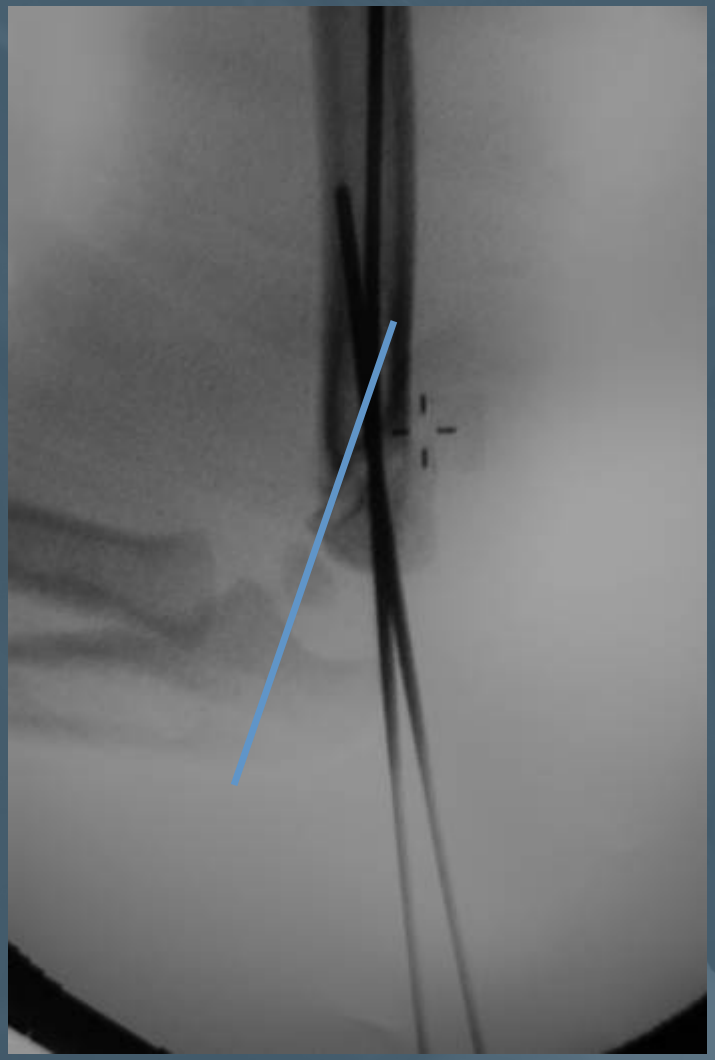
Third lateral pin added for unstable fractures

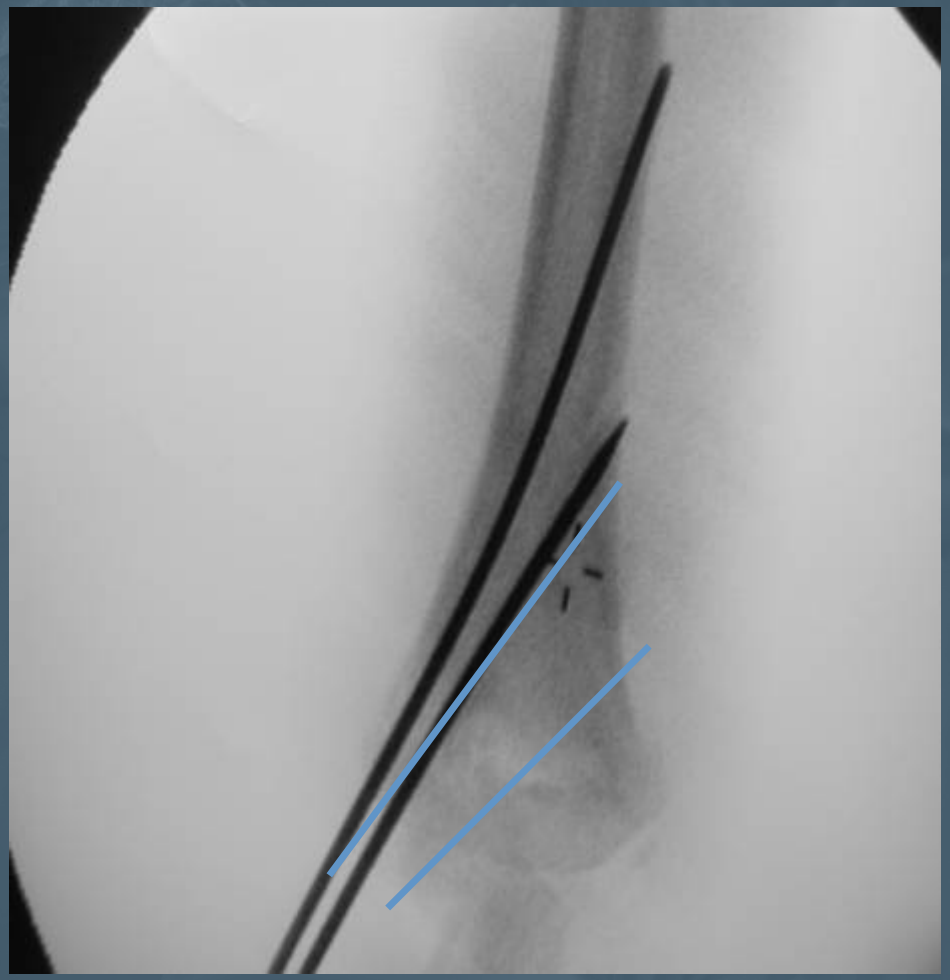




From Skaggs et al. JBJS, 2004

6 yo fall off of jungle gym





Very unstable fracture / soft tissue hinges disrupted

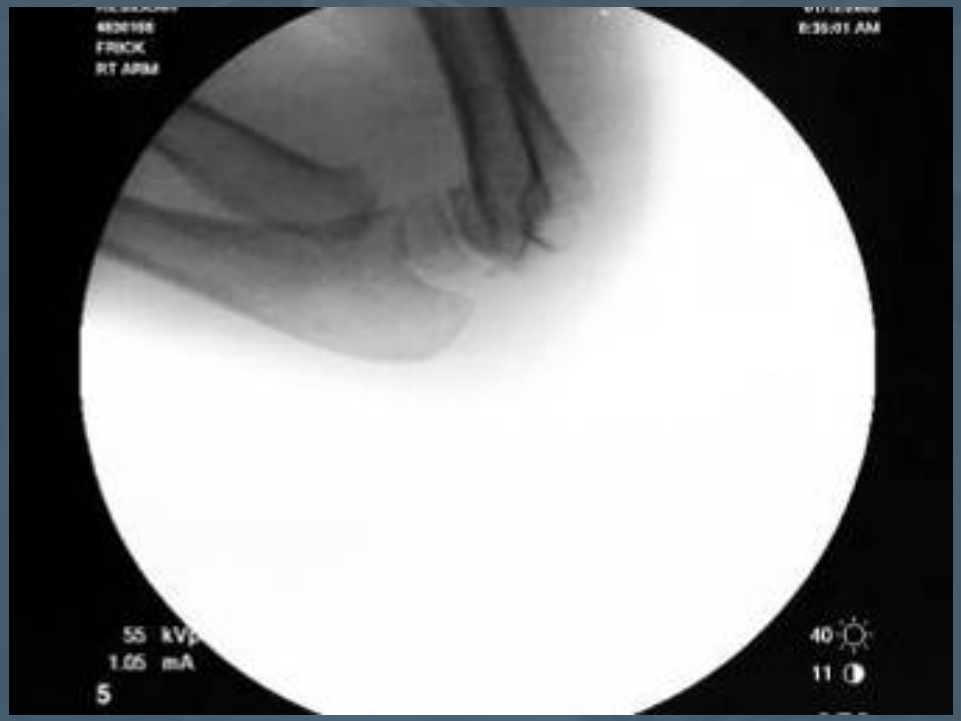
Injury films- extension type III, impaled through brachialis


FRICK
RT ARM
53 kVp
0.89 mA
1
OEC


FRICK
RT ARM
53 kVp
0.89 mA
2
OEC

After milking maneuver, longitudinal traction

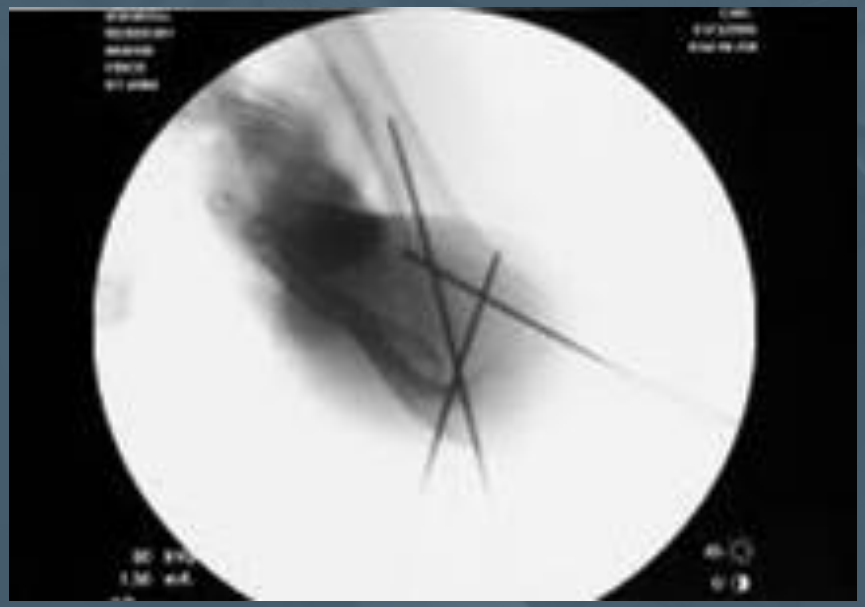
After flexion reduction maneuver



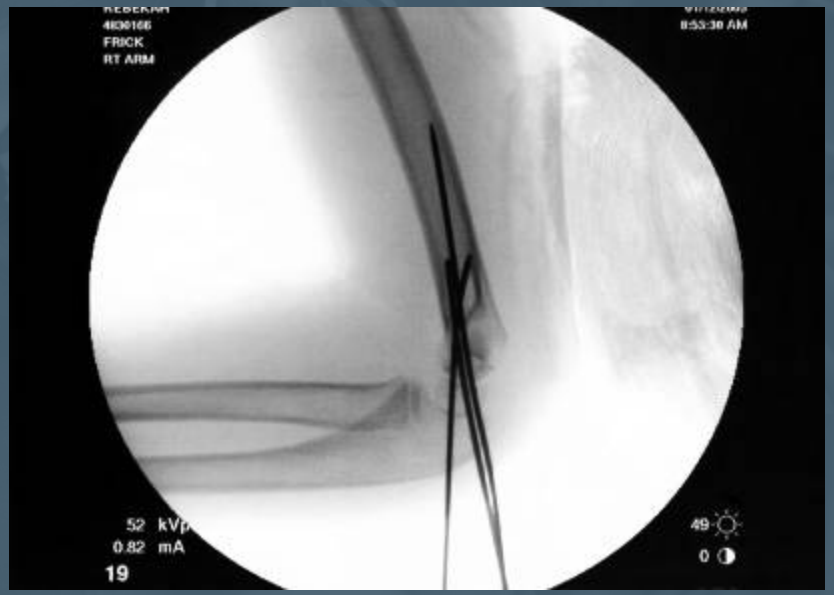
The completely unstable SC humerus fracture

- Goes from extension type to flexion type
- After reduction maneuver the distal fragment is anterior to the proximal fragment
- How to handle?

Pinning at 90 deg flexion



Final C-arm views

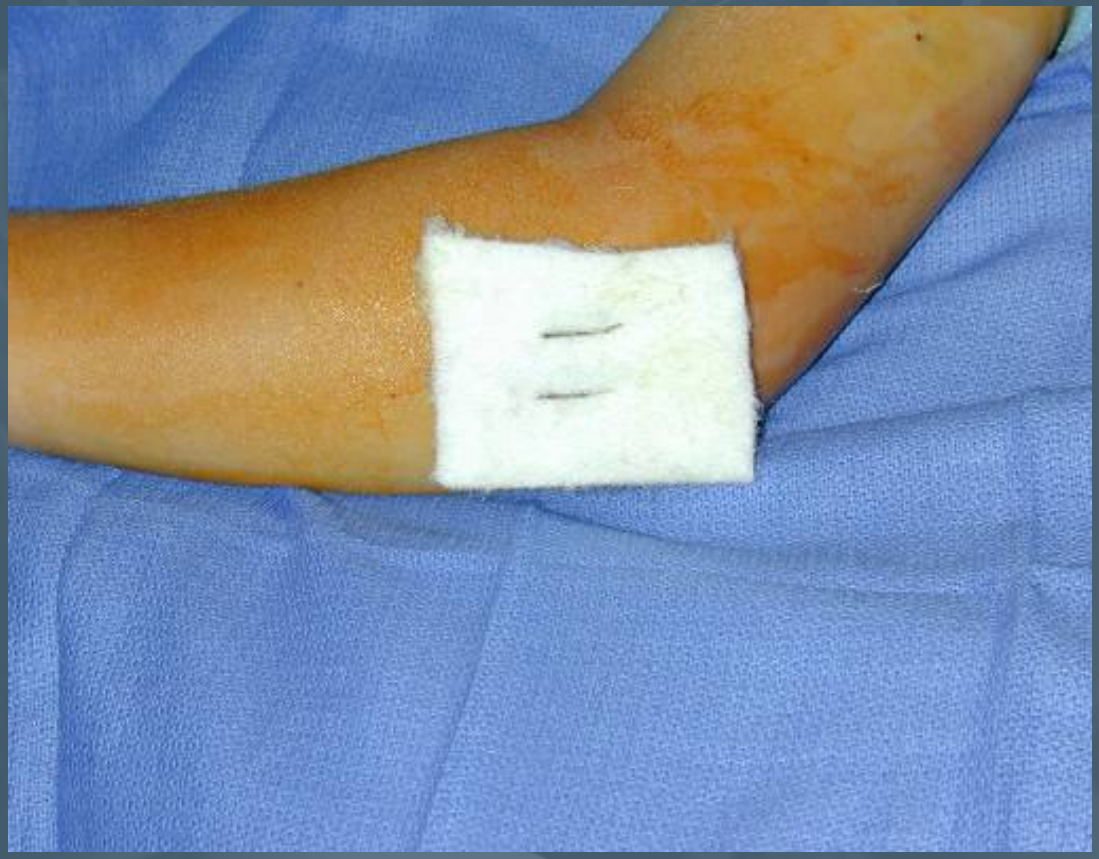


Postoperative care

- How do you take care of pins postoperatively?

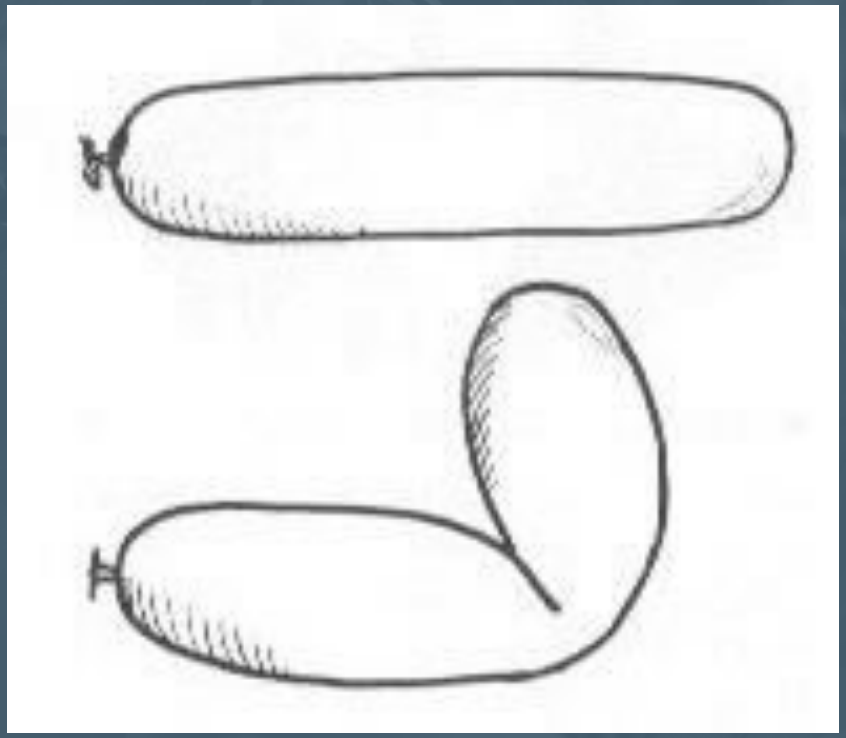
Avoiding Complications: Pin Tract Infections

Avoiding Complications: Pin Tract Infections



How do you immobilize the upper extremity after CRPP?

- Splint
- Cast
- Material?
- Position of elbow?



From John Charnley,

The Closed Treatment of Fractures

CHLA
Pin care – Padding- Cast technique

Post-pinning Management

- Pins out of the skin, bend 90 deg and cut long
- Sterile felt and cast padding
- Flex until antecubital skin touches, then extend 10 deg
- Fiberglass LAC , split & spread
- Monitor overnight

Cubitus Varus - causes

- Failure to recognize varus
- Malreduction- primarily coronal plane, also extension / IR
- Loss of fixation
- Avascular necrosis
- Overgrowth

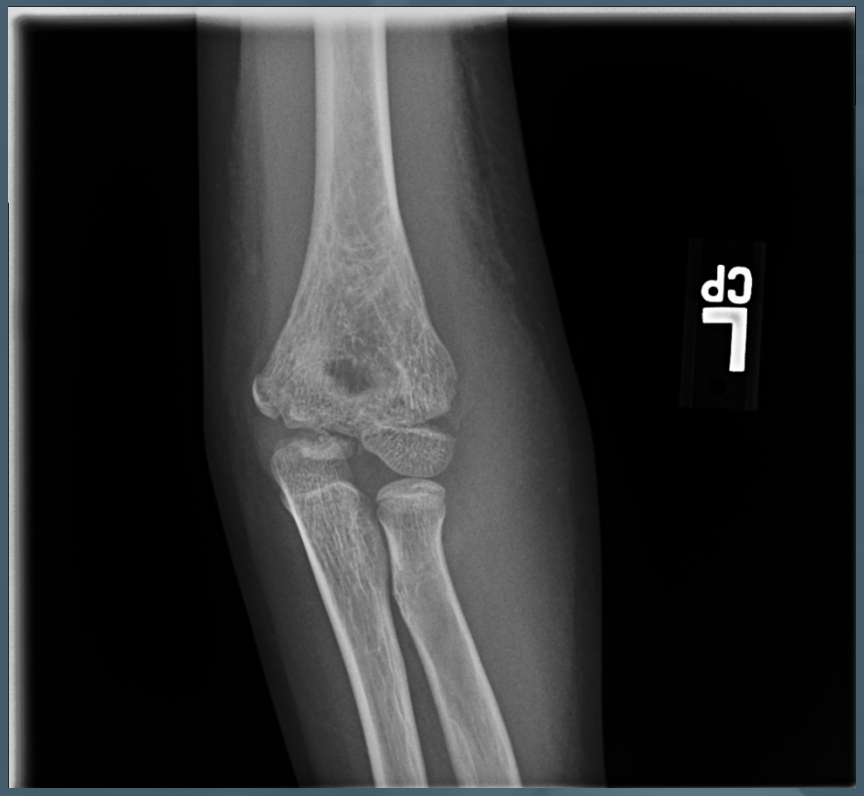
Pre and Post Osteotomy

Pre and Post Osteotomy

Ipsilateral SCH and Distal Radius fractures

- Increased risk for?

What type supracondylar is this?



Trick Question!

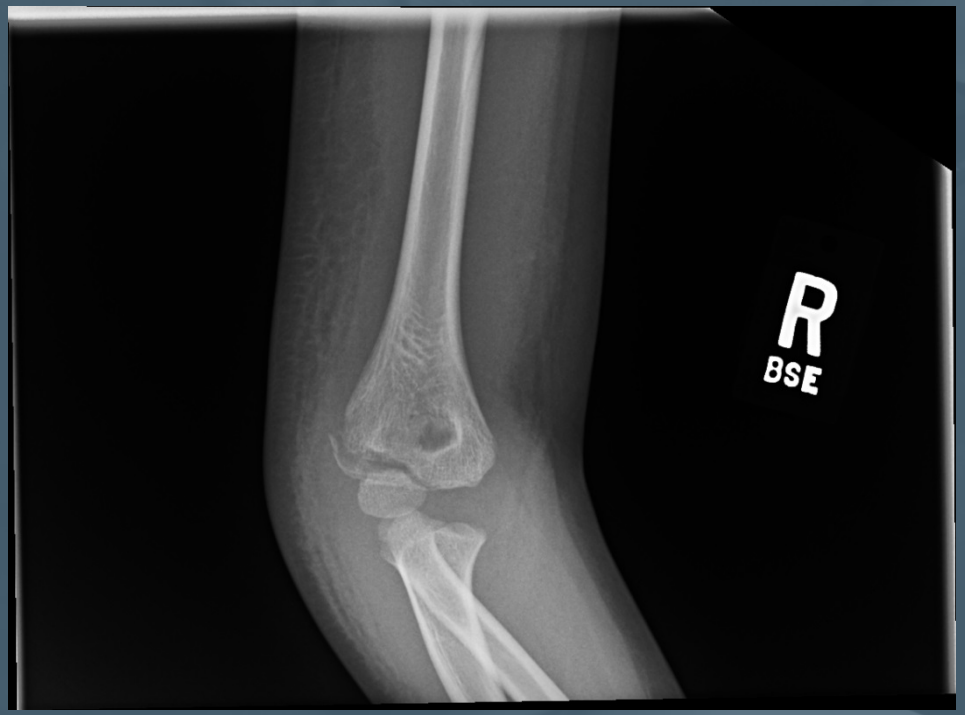
Lateral Condyle Fractures

- Diagnosis
- Often subtle

Lateral Condyle

- Less than 2 mm or only visible on one image then try non-op
- 2-4mm then closed reduction with perc pin or screw fixation and arthrogram
- Greater than 4mm typically needs open reduction

Lateral Condyle



Lateral Condyle

Medial Epicondyle Fractures

- Often associated with Elbow dislocation

Medial Epicondyle Fracture

- Think dislocation
- Literature supports conservative treatment
- Reduction and fixation in overhead athlete


R
YY


R
YY


R
BSE


R
BSE

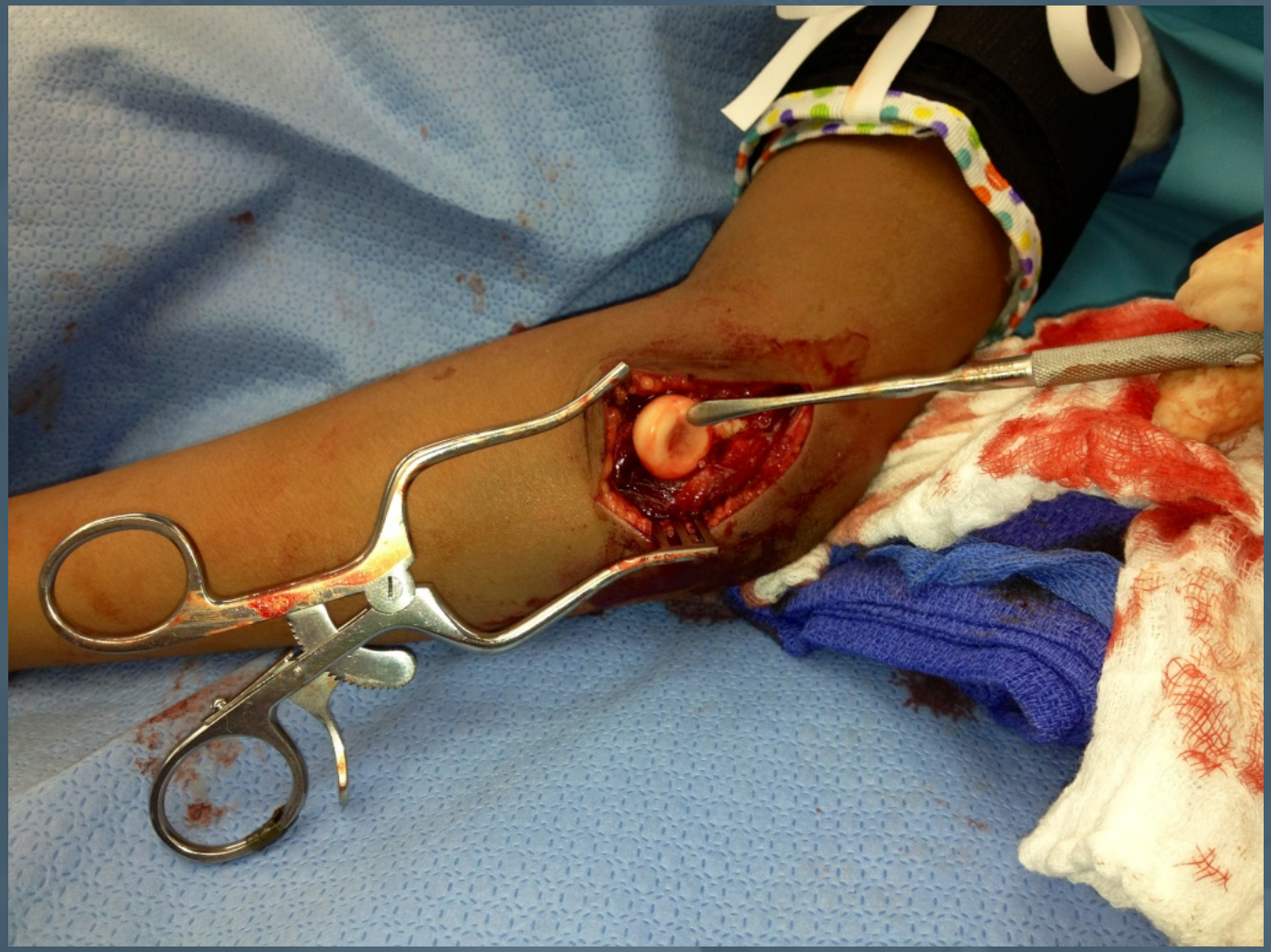
Olecranon

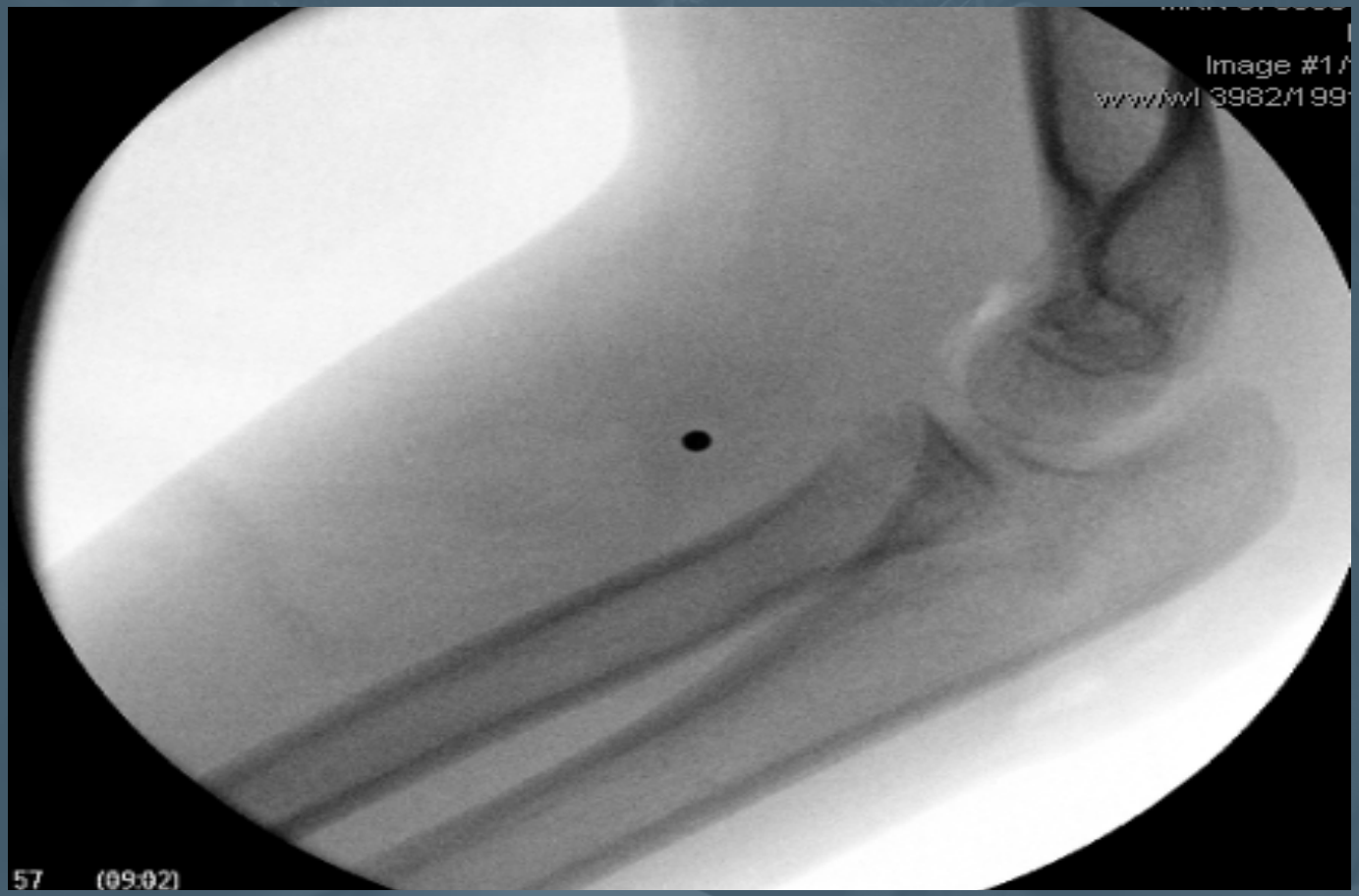
Bilateral Olecranon Fractures

- This should raise a red flag in your head
- Maybe associated with blue sclera
- Osteogenesis Imperfecta!

Tension Band

Radial Neck

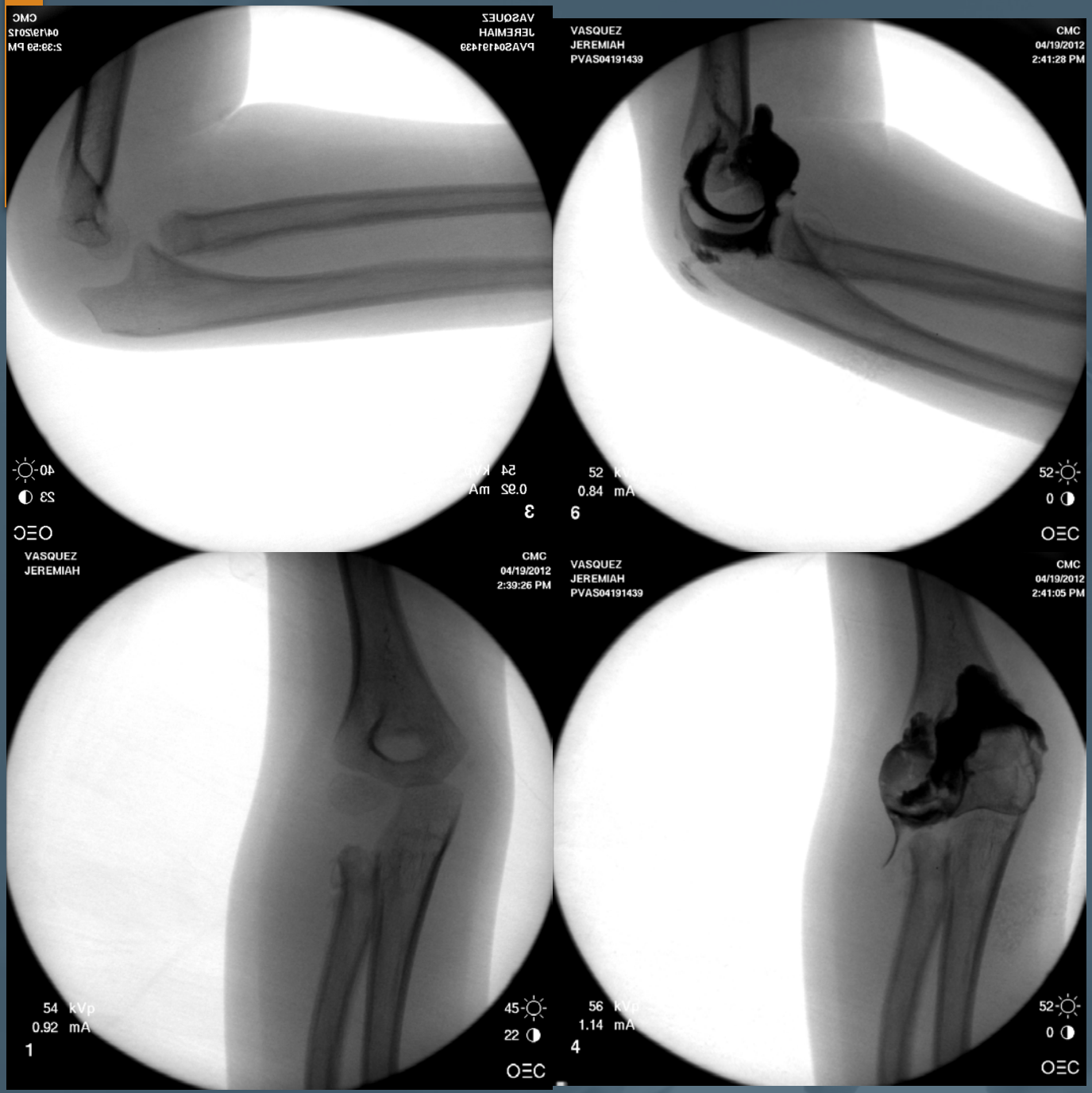



57 (09:02)

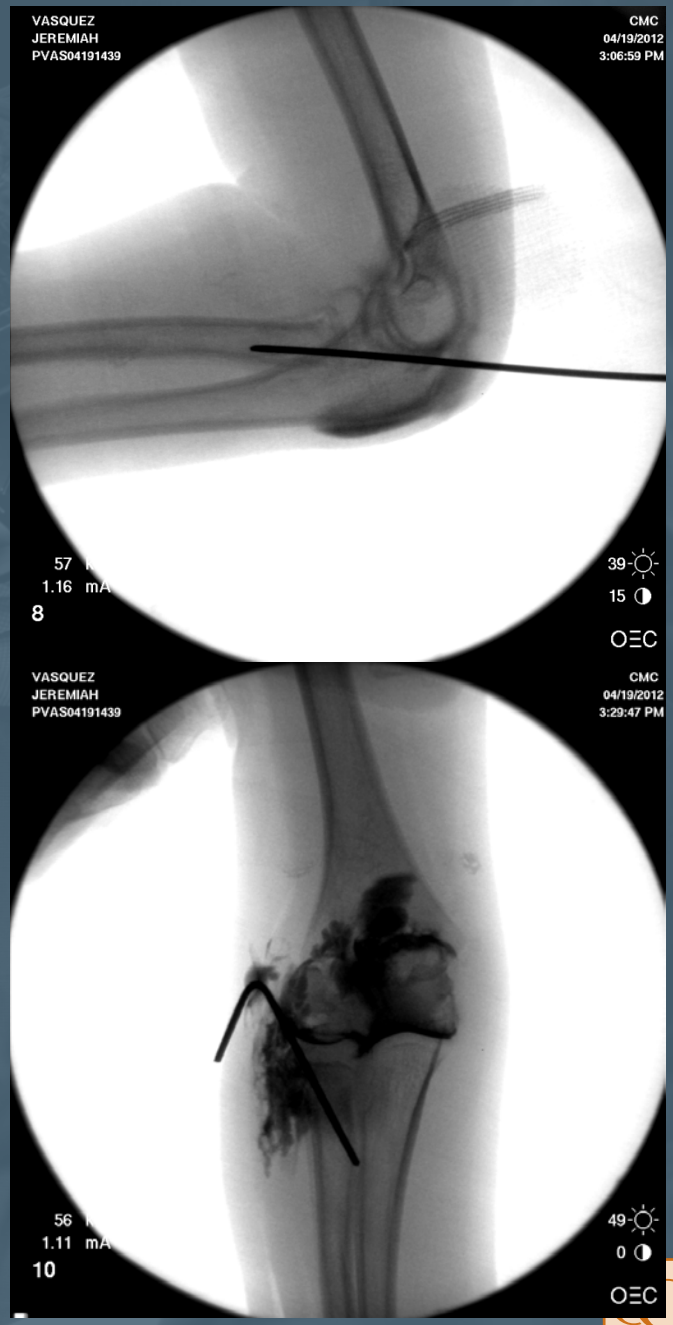
- 5 yo M
- Fall onto outstretched arm 3/29

- 4/17 …. Almost 3 weeks post injury
- Exam shows almost full flex/ex
- Severely limited supination
- Prompts MRI and referral

MRI

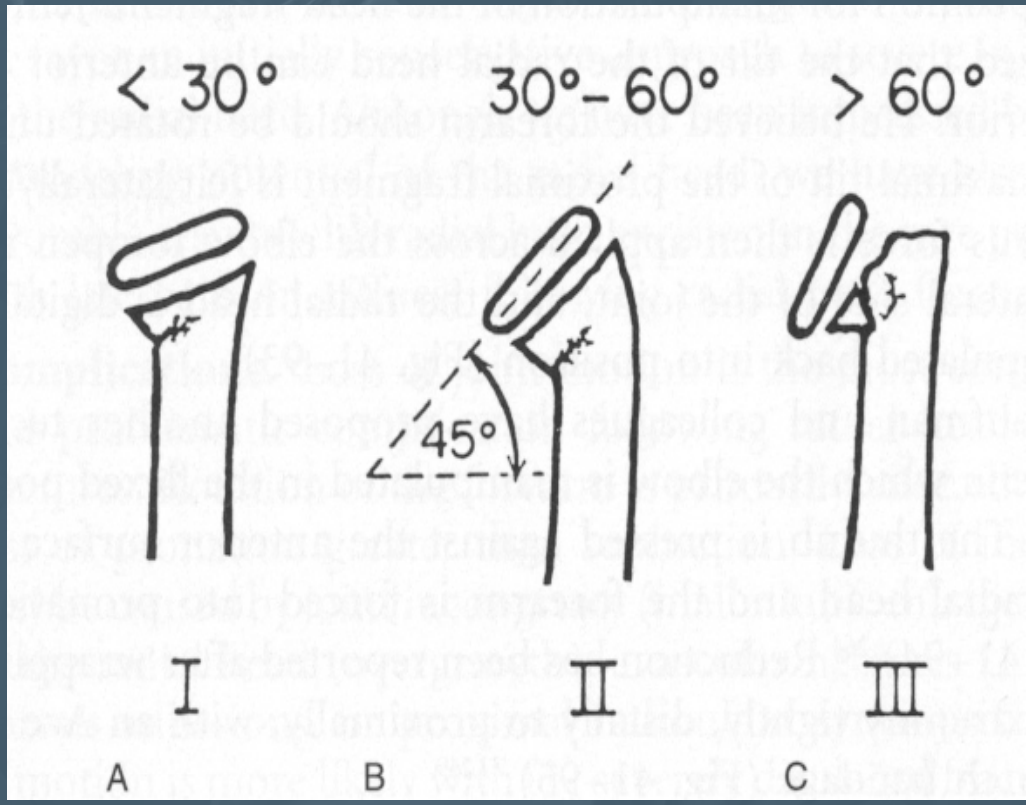

VASQUEZ
JEREMIAH
PVAS04191439
CMC
04/19/2012
2:41:28 PM
52 kVp
0.84 mA
6
52
0
OEC
VASQUEZ
JEREMIAH
CMC
04/19/2012
2:39:26 PM
54 kVp
0.92 mA
1
45
22
OEC
VASQUEZ
JEREMIAH
PVAS04191439
CMC
04/19/2012
2:41:05 PM
56 kVp
1.14 mA
4
52
0
OEC

- Open reduction
- K-Wire across fracture



Radial Head&Neck Fx's

- Observe I
- > 30° consider closed reduction
  - Accept 45° after attempt at CR



BC

BC

- Joystick

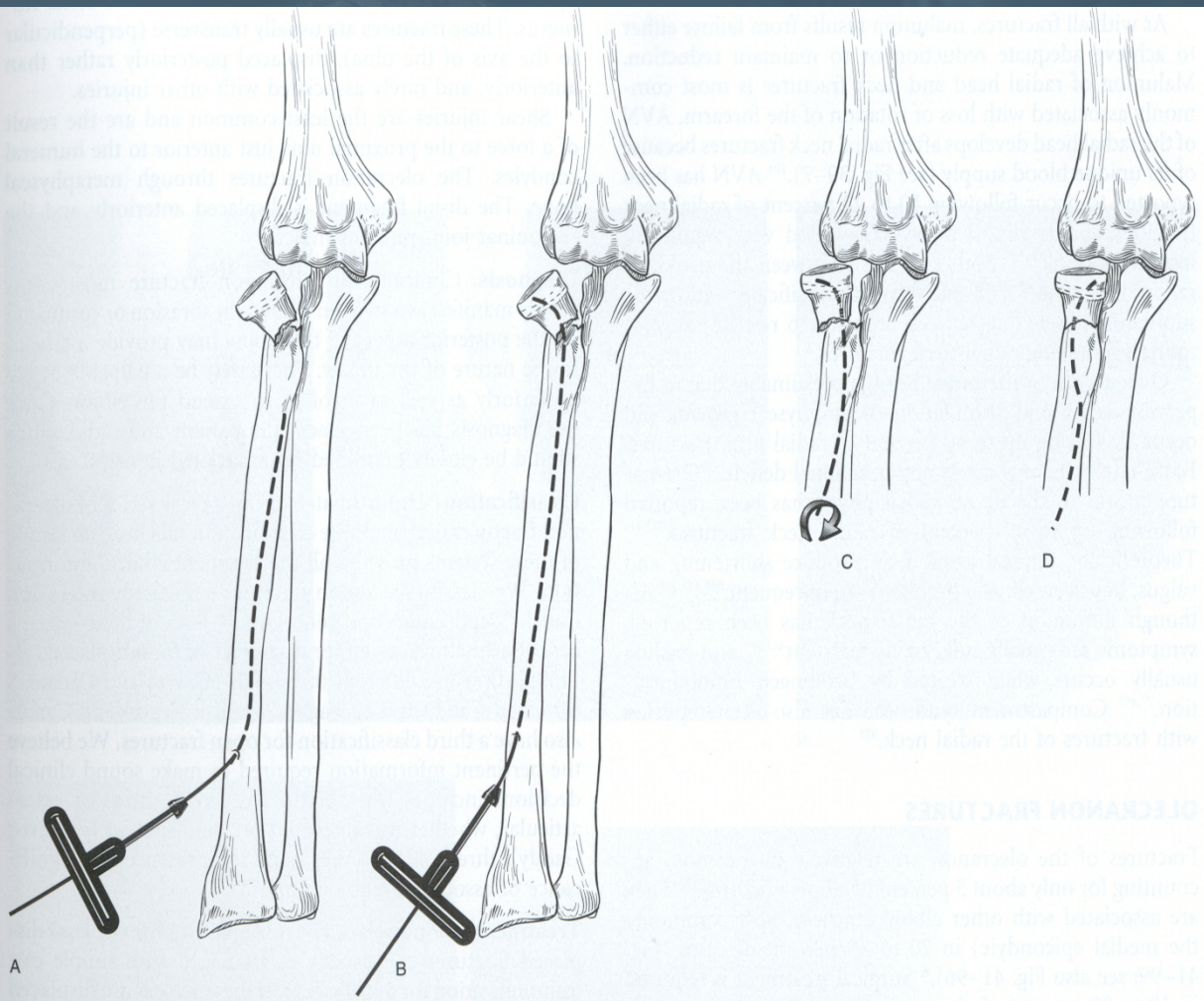


FIGURE 41–97 Métaizeau technique for intramedullary reduction of a radial neck fracture. **A,** A flexible intramedullary wire is introduced through a starting hole proximal to the distal radial physis. **B,** Under image intensification the wire is advanced into the proximal radial fragment. **C** and **D,** The wire is rotated to reduce the proximal fragment.

Forearm Fractures

Monteggia Fx

Monteggia Fractures

- Dislocated Radial Head
- Ulna fracture
- Remember to examine elbow & wrist of forearm fx's

Monteggia Fracture

- High index of suspicion
- “Isolated” radial head dislocation – usually has plastic deformation of ulna

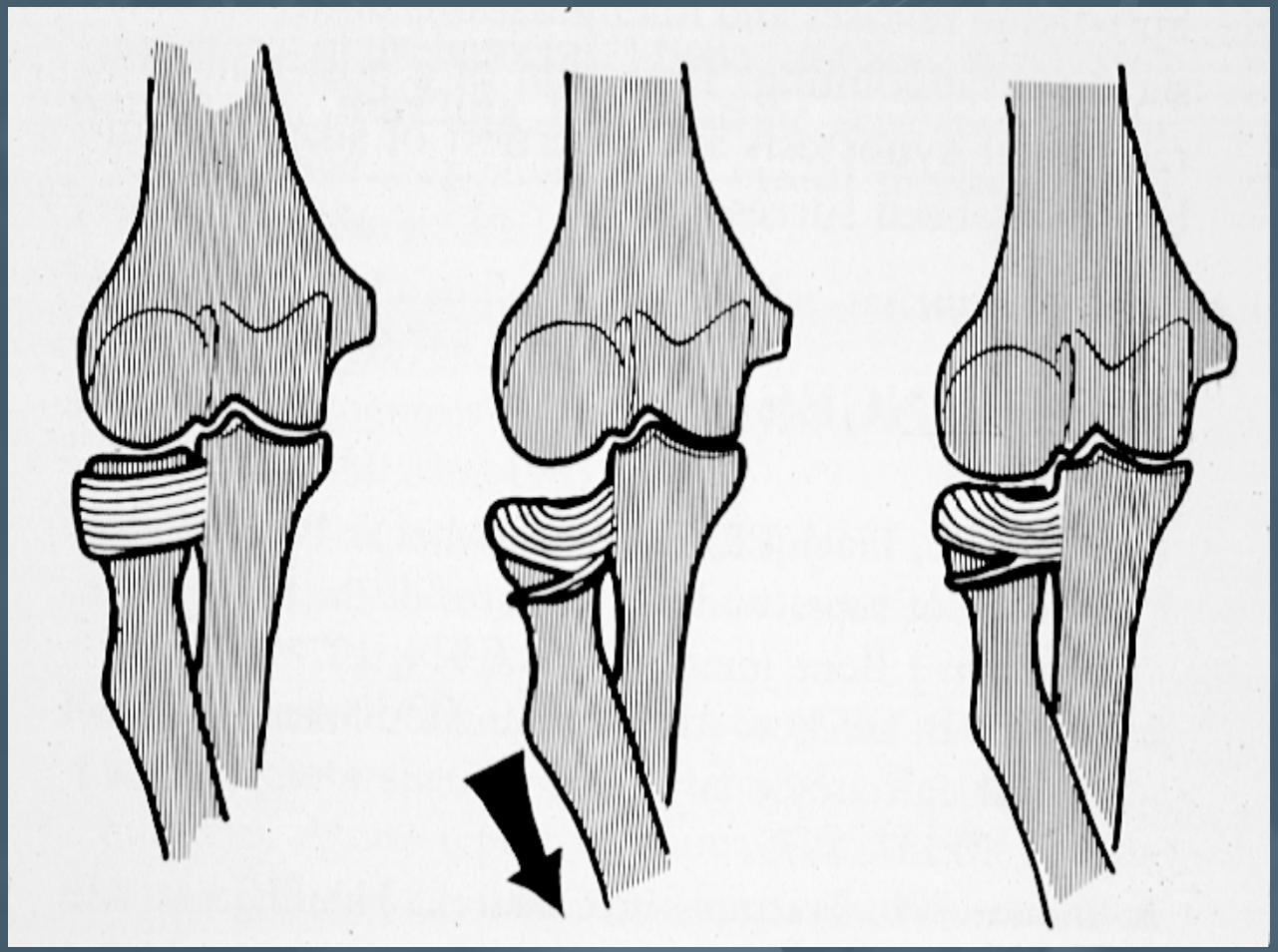
Nursemaid's elbow

- Caused by pulling in a child's arm but can be a gentle twist

- Usually 1 - 4 year old children

Nursemaid Elbow

Nursemaid Elbow



Nursemaid's elbow

- Subluxation of radial head (normal radiographs)

- Reduce by supinating forearm and flexing elbow

Closing remarks

- Be wary of the pediatric elbow
- Un-ossified structures can try to trick you
- Let mechanism, swelling, and pain increase your level of concern as needed
- Use the contralateral elbow for exam (and even radiographs) to help you if needed!

Thank You