Pediatric Upper Extremity Trauma: Pearls, Pitfalls and the Physis

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Disclosures

- I have none.

Pre-test

1. What are the two most important components of evaluating the pediatric trauma patient?

   a) Physical exam and patient weight
   b) X-ray and MRI
   c) Physical exam and X-ray
   d) Physical exam and history

Pre-test

2. What are the two most important considerations in reading the pediatric elbow X-ray?

   a) Anterior Humeral Line and Bowman's Angle
   b) Anterior Humeral Line and Radiocapitellar Line
   c) Anterior Humeral Line and Krengel Angle
   d) Anterior Humeral Line and Radial-Olecranon Line

Pre-test

3. Are all pediatric fractures seen on initial X-ray?

   a) No
   b) Yes
   c) Maybe, depends on if swelling is present
   d) Depends on the cooperation of the child

Pediatric UE Trauma: By The Numbers

Pediatric Fractures:

- 55% upper extremity
- 32% wrist and hand

Step 1: History

Trauma is:

- **Specific**
- **Witnessed**
- **Definitive timeline**

Step 2: Examine Your Patient

I. Be the vulture

- Start as far away from the pain as possible and circle in.
  - Ex: Examine asymptomatic side

II. Rely on your history and exam!

- Just because an x-ray is negative doesn't mean you dismiss a fracture
- '+' X-rays confirm. '-' X-rays do not deny!

III. When all else fails:

- Examine your patient

IV. Always consider infection

The Upper Extremity Exam: Hand and Wrist

I. Inspection
- *Rotation*
- Angulation
- *Cascade*

II. Palpation
- *Snuff box (bilateral)*

III. ROM
- *Cascade in ext.*

IV. Neurovascular
- *Nickle and Quarter*

The Upper Extremity Exam: Elbow

V. Inspection

- *Swelling*
  (proximal forearm vs. humerus)

VI. Palpation

- *Locate the point of maximal tenderness*
  (Lateral condyle vs. Supracondylar?)

VII. ROM

- *Pain with Extension*
  (Supracondylar fracture?)

- *Pain over radial head with supination and pronation*
  (Radial head/neck fracture?)

The Upper Extremity Exam: Keep going up

VIII. Don’t forget the shoulder!

IX. …Or the Clavicle!

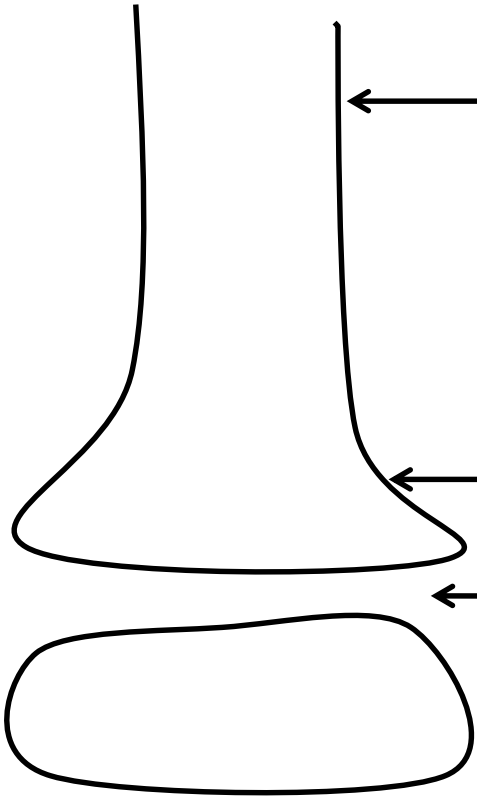
X. …Or the neck!

Step 2: X-ray Your Patient

Describing the X-ray: (Like a Vulture)

I. Age and sex of your patient.
II. Open or Closed
III. Side: Left, Right, Bilateral
IV. Location on bone:
    I. Proximal, Distal, etc.
    II. Metaphysis, Diaphysis, etc.
V. Bone
VI. Displaced?
VII. Angulation?

Fracture Basics: Parts of Bones



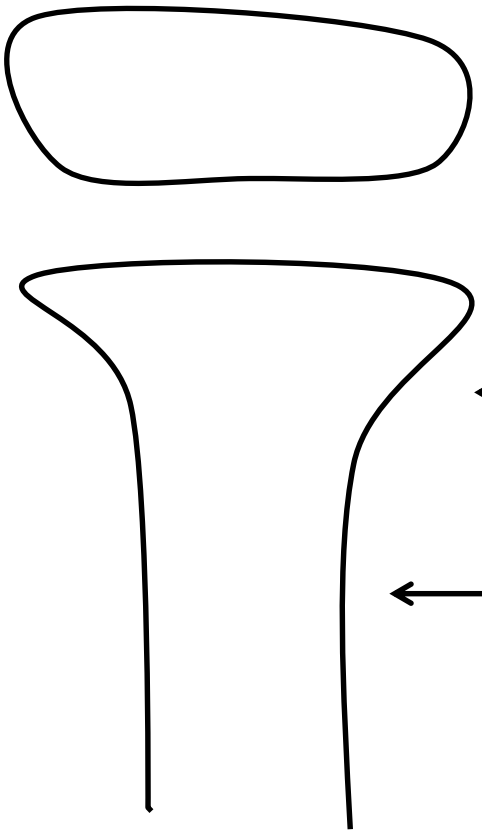
Diaphysis (the skinny part)

Metaphysis (the flared part)

Physis (the Growth Plate)

Epiphysis (the ice cream on the cone)

Fracture Basics: Parts of Bones



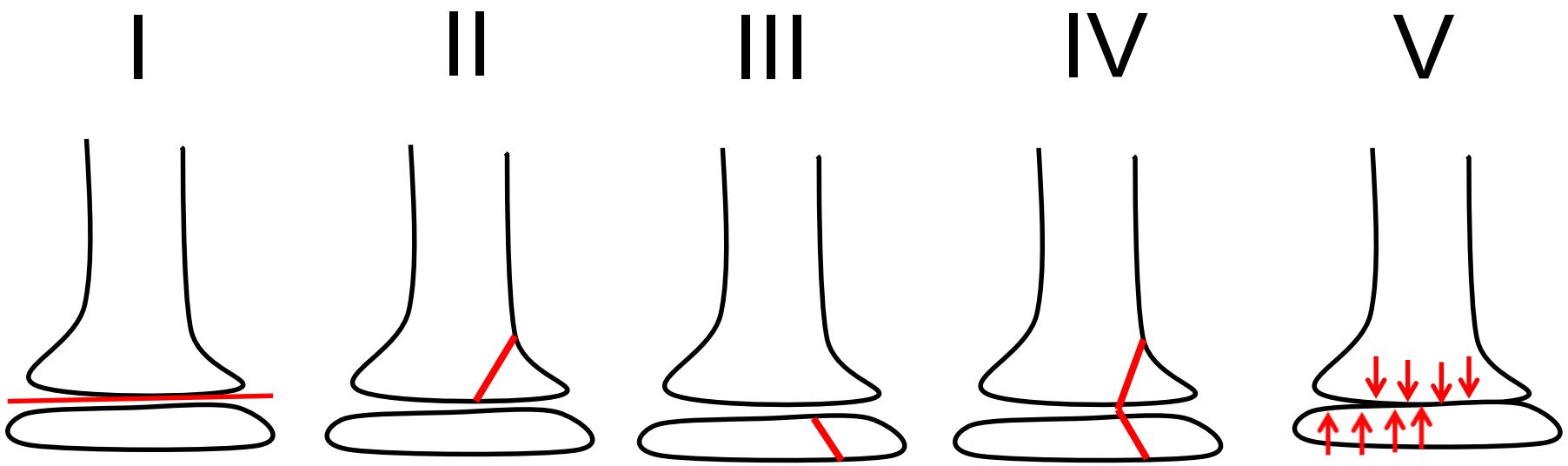
Epiphysis

Physis

Metaphysis

Diaphysis

Fracture Basics: The Salter Harris Classification



Straight (across) **A**bove **L**ower **T**hrough **ER**

I II III IV

Fracture Basics: Pediatric Fracture Pattern Pearls

I. Immature bone can bow and/or compress

= fracture patterns not seen in adults

II. Ligaments and Tendons are stronger than growing bone

=10 yo and younger tend to break (***rarely sprain***)

III. Periosteum is thicker, stronger and more biologically active

= Usually remains intact after fracture

Case

HPI: 16 yo male hit over middle finger while playing basketball. “It bent back.” Difficulty moving PIP.

O: Pain and swelling over PIP
No rotation
Can fully extend but difficulty with flexion

The “Jammed Finger”/volar plate injury

Etiology:

- Hyperextension
- Small avulsion of base of middle phalanx

Physical Exam:

- Pain Volar aspect of PIP

Radiology:

- AP, Lat, Oblique

Treatment:

- Splint in slight flexion x 1 week
- Buddy tape x 3 weeks
- *Refer if joint not congruent or large fragment*

Case

HPI: 10 yo girl hit over small finger in basketball practice. Immediate pain and deformity.

O: Angulation at small finger MCP. Cascade demonstrates small finger pointing away from scaphoid.

No pain in remaining fingers, hand, wrist or forearm.


ACC

Extra Octave Fracture

Etiology:

- Axial Load

Physical Exam:

- Pain over MCP
- Angulation?
- ***Rotation?***

Radiology:

- AP, Lat, Oblique
- SH II

Treatment:

- Reduction if necessary
- ***Ulnar gutter splint/cast***

Case

HPI: 14 yo boy with 2 months of wrist pain after a back flip while practicing Parkour. Can not weight bear on UE without pain. Reports pain with extension of the wrist.

O: Pain over “anatomic snuff box” and with extension/flexion of wrist.

No pain at elbow or shoulder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Carpal Navicular (Scaphoid) Fracture

Etiology:

- FOOSH
- ***Can be delayed presentation***

Physical Exam:

- Pain – anatomic “snuff box”
- ***Palpate BILATERALLY***

Radiology:

- AP, Lat, Scaphoid views

Treatment:

- 5-6 weeks of casting if acute and nondisplaced.
- X-ray at 5-6 weeks, recast x 4-5 weeks (total = 9 weeks)
- Non-union = surgery

Case

HPI: 14yo boy fell from tree.

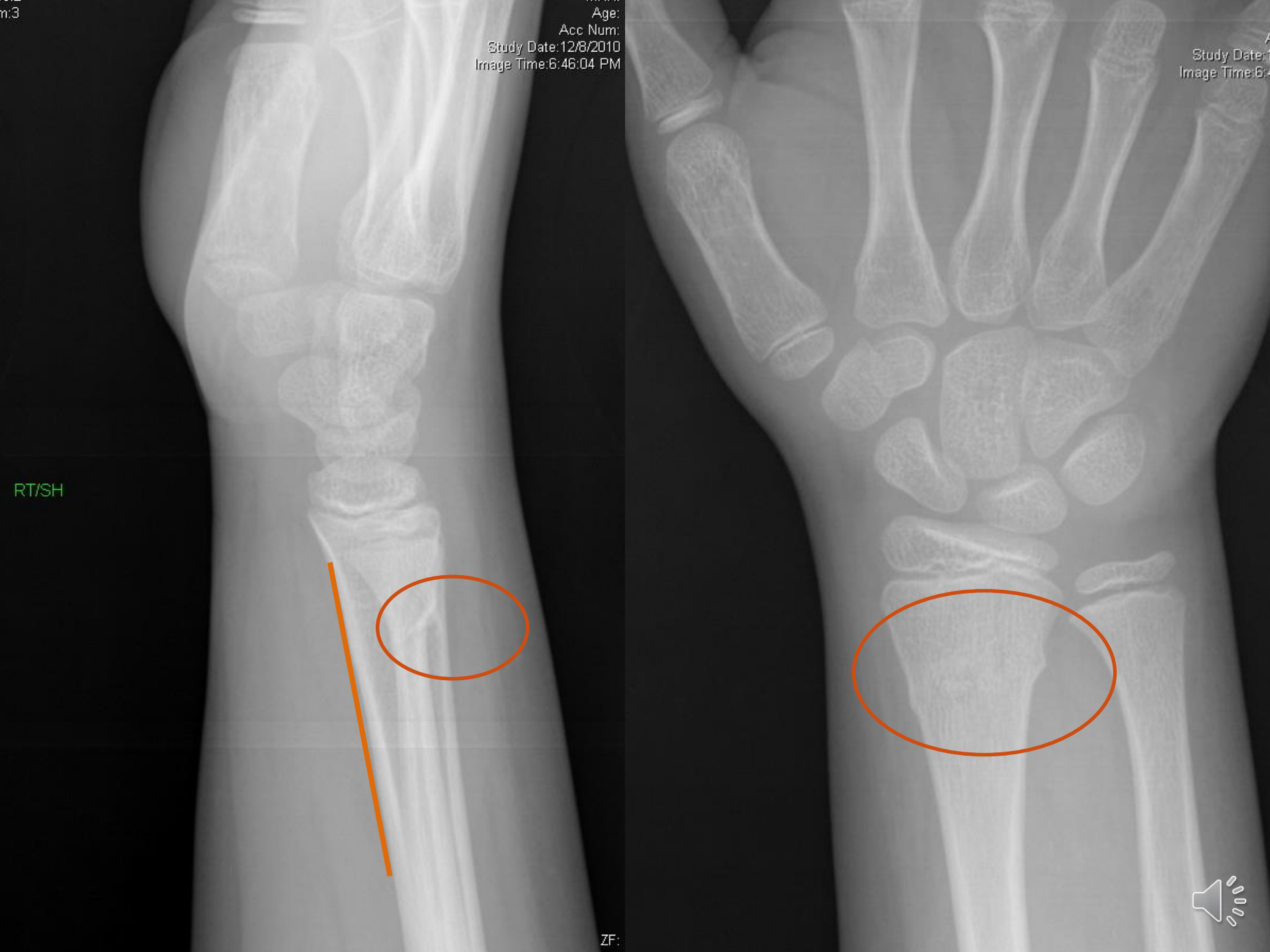
O: Pain through anatomic “snuff box”

Xray: “Negative”

Case

HPI: 9 yo girl fell from monkey bars this morning now with wrist pain.

O: Minimal swelling at wrist and painful over distal radius.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Distal Radius Fracture: Torus/Buckle

Etiology:

- FOOSH
- ***Bone fails in compression***

Radiology:

- PA and Lat
- ***NO angulation or disruption in cortex opposite compression****

Treatment:

- 3-4 weeks in splint[4]/cast

Torus Definition:

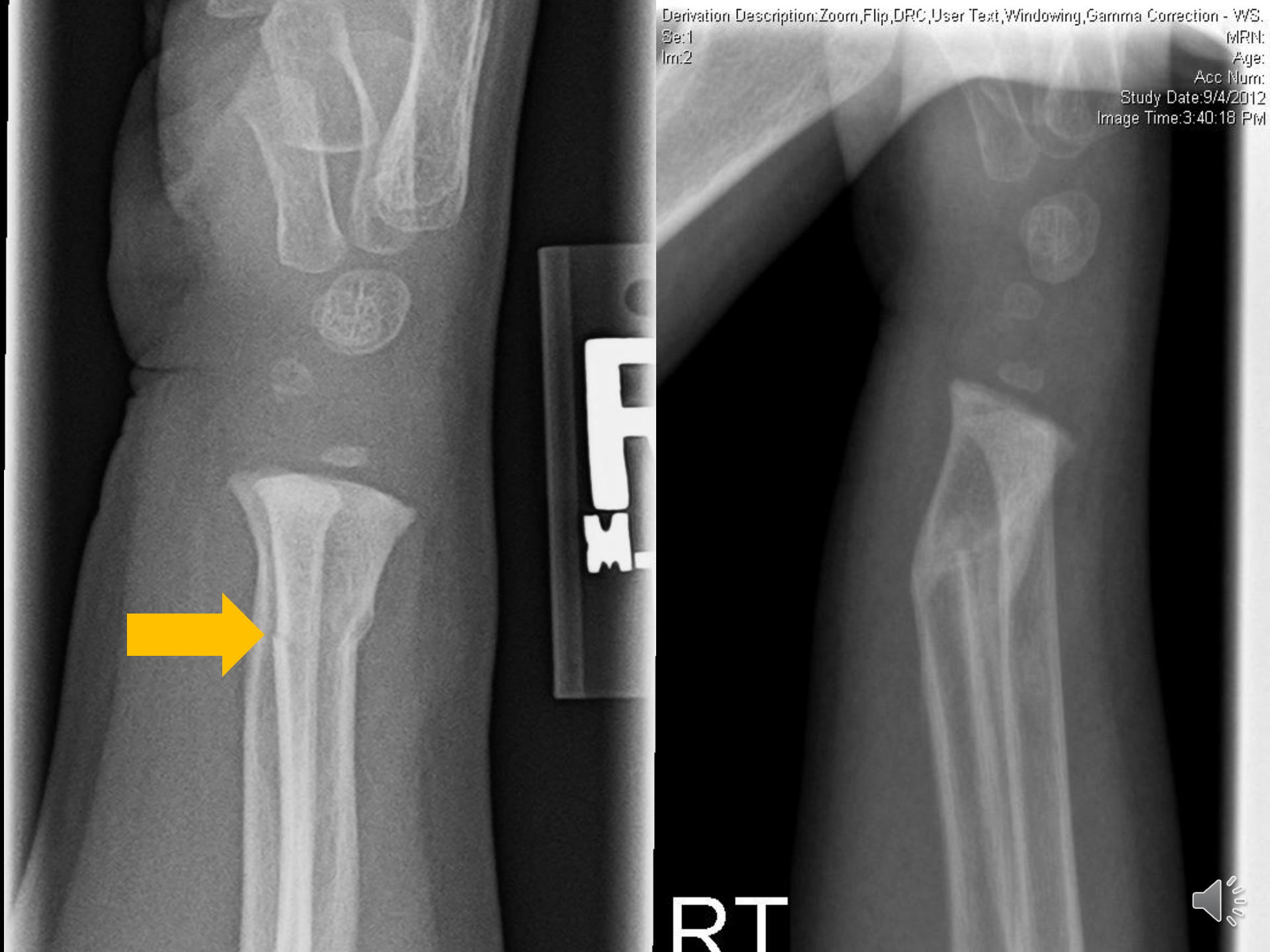
- anatomy- a projection or expansion
- architectural- convex moulding/base of a classic column.

Pearl/Pitfall : Angulation = Unstable

Case

HPI: 4 yo girl treated at an outside facility for a distal radius torus fracture 4 weeks ago in a velcro splint. Parents concerned about deformity.

O: No pain but notable apex volar angulation.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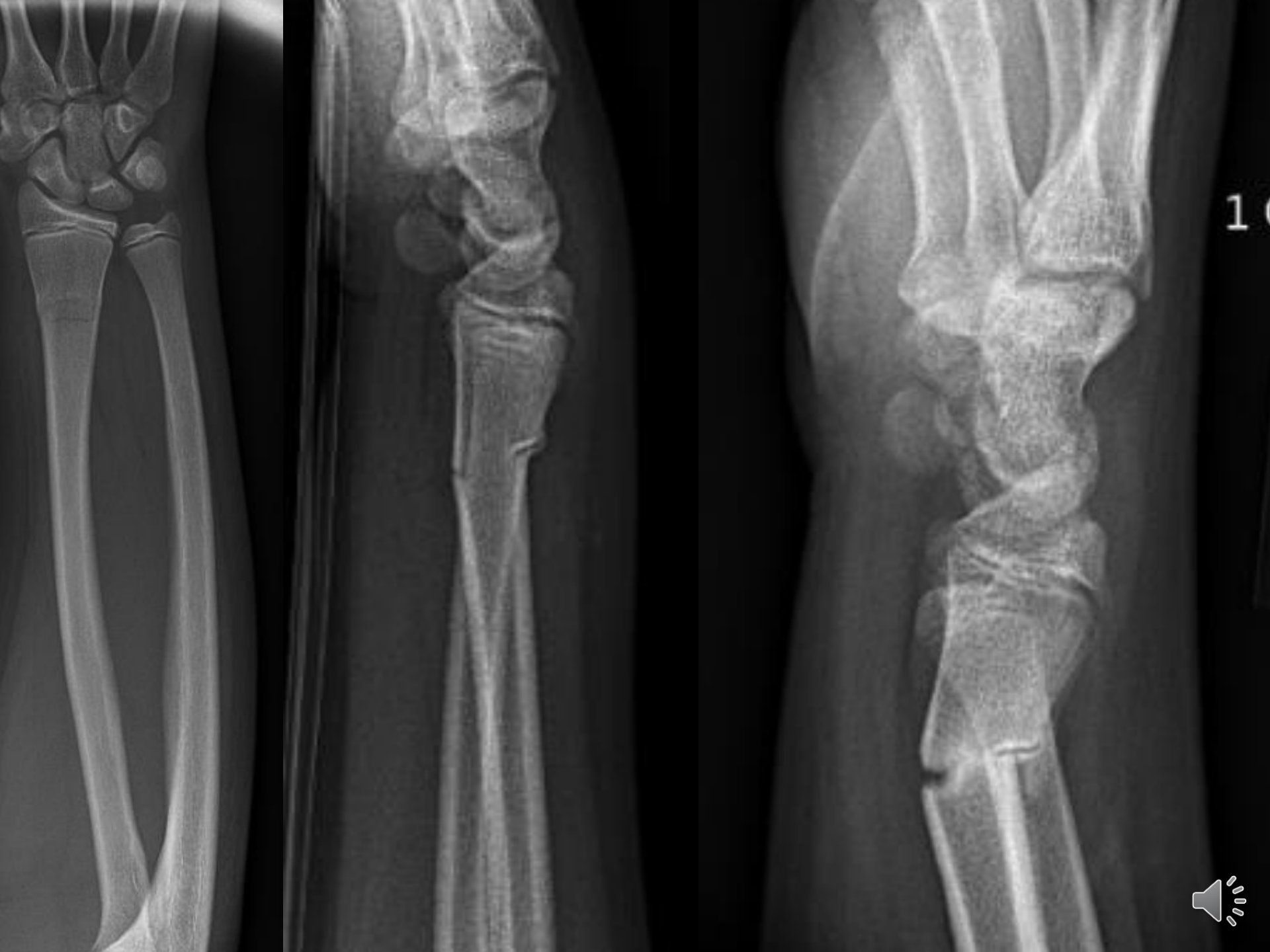
Case b

HPI: 15 yo male, fall from skate board earlier today. Diagnosed with a torus fracture. Mom wants a second opinion.

O: Pain to palpation over distal radius and ulna. No clinical deformity.

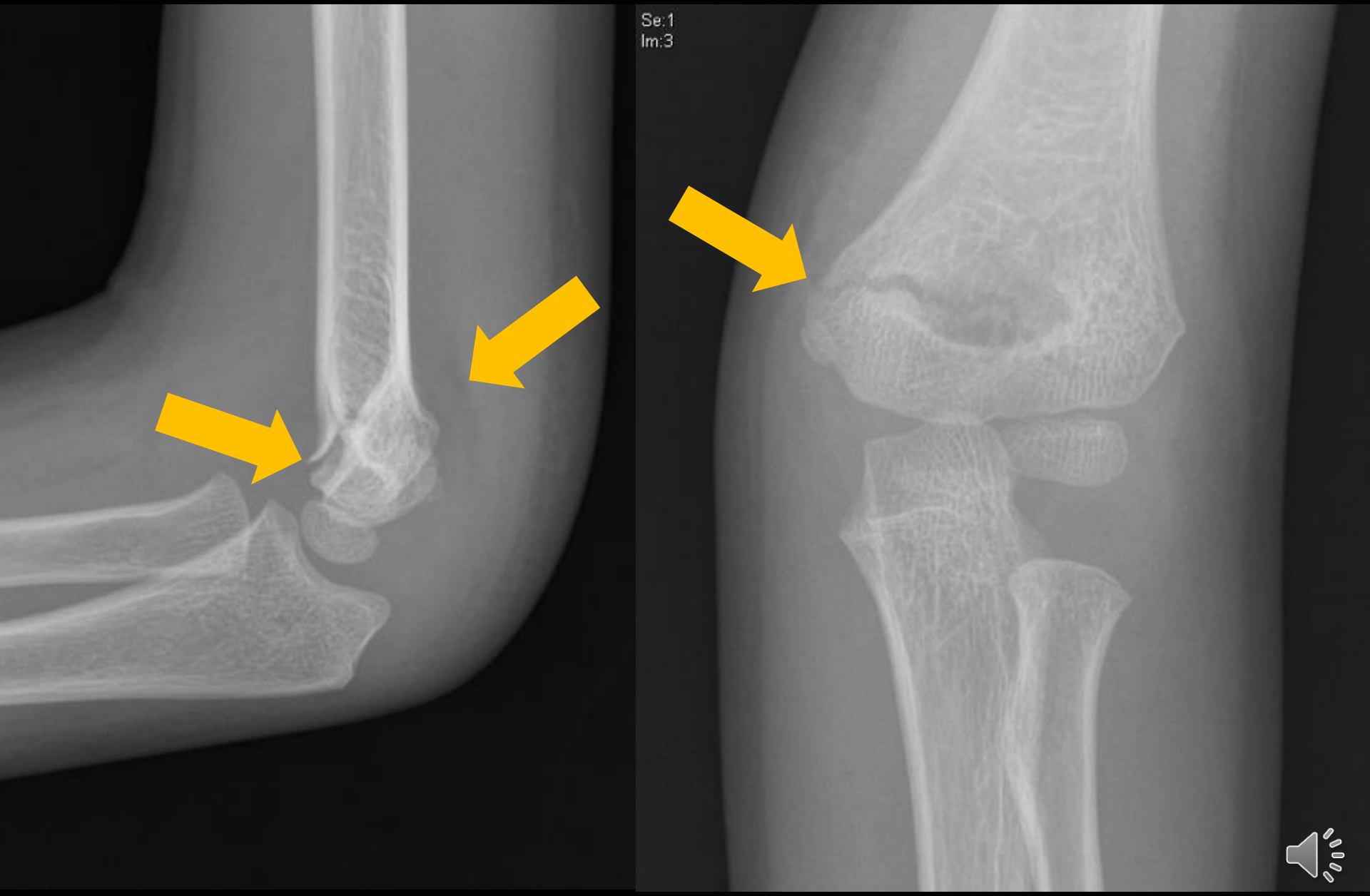
SO: What is your opinion?



Case

HPI: 6yo boy, painful/swollen elbow after fall from monkey bars at recess.

O: Swollen R elbow
Pain through antecubital fossa/distal humerus
Significant pain with extension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Supracondylar Fracture

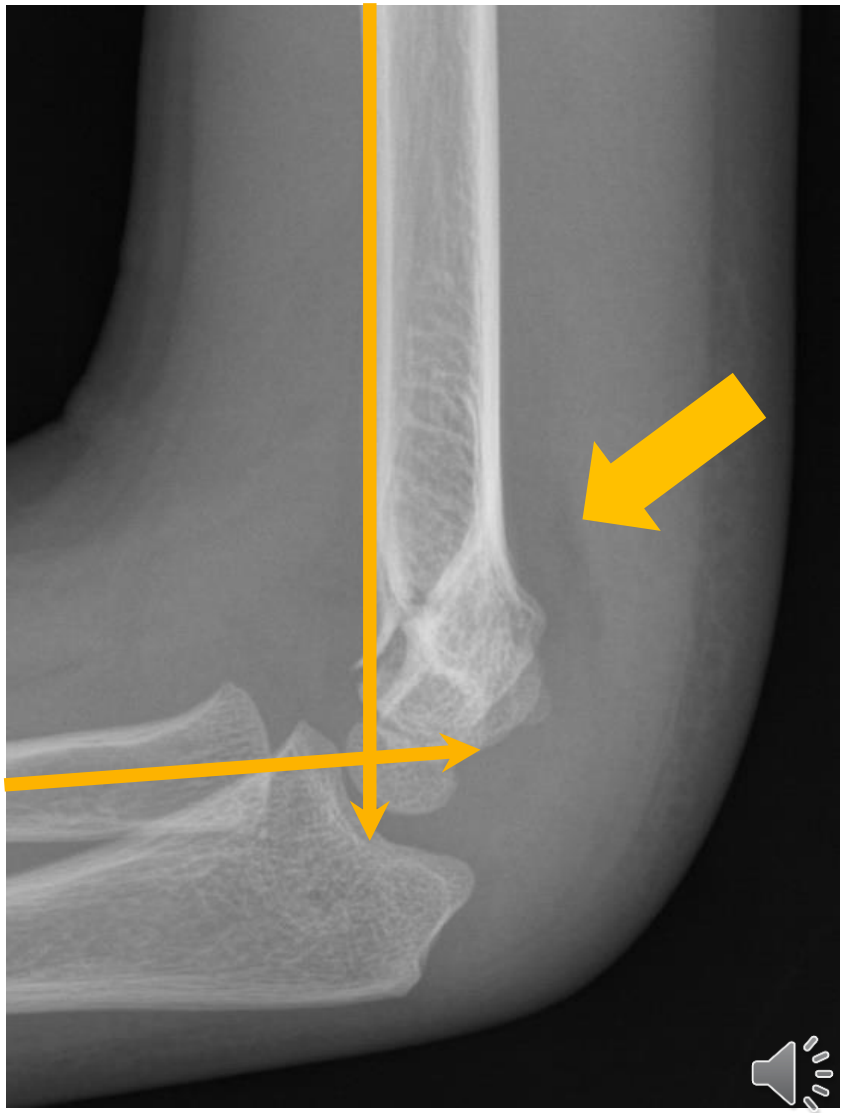
Etiology:

- FOOSH
- Most common elbow fracture
  - 50-60%
- Most common surgically treated fracture.[5,6]

Supracondylar Fracture

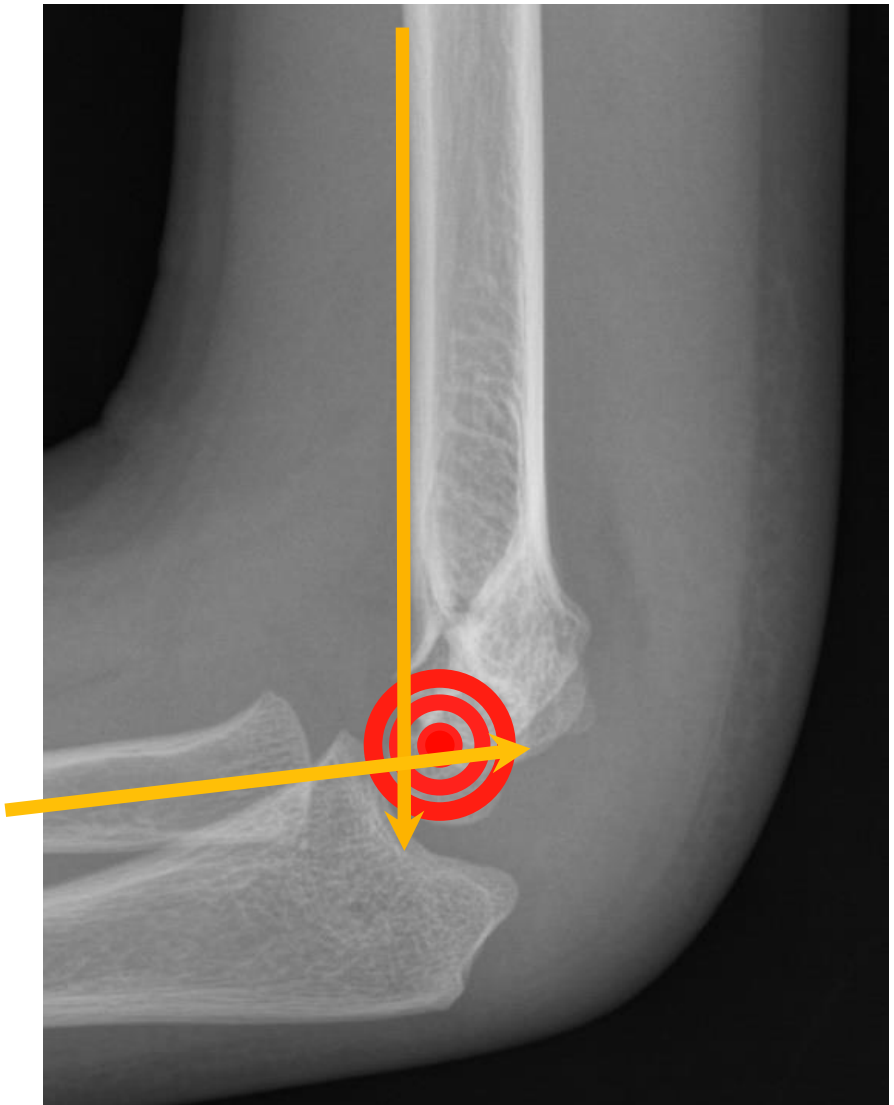
Radiology:

- AP and Lateral:
  1. ***Anterior Humeral Line***
  2. ***Radiocapitellar line***
- ***Effusion = Fracture***
  - No other radiologic evidence of fracture:
    - 76% had evidence of fracture healing at three weeks
    - 53% were SC[8]



The Elbow: Radiology Pearls

1. Anterior Humeral Line 2.Radiocapitellar Line

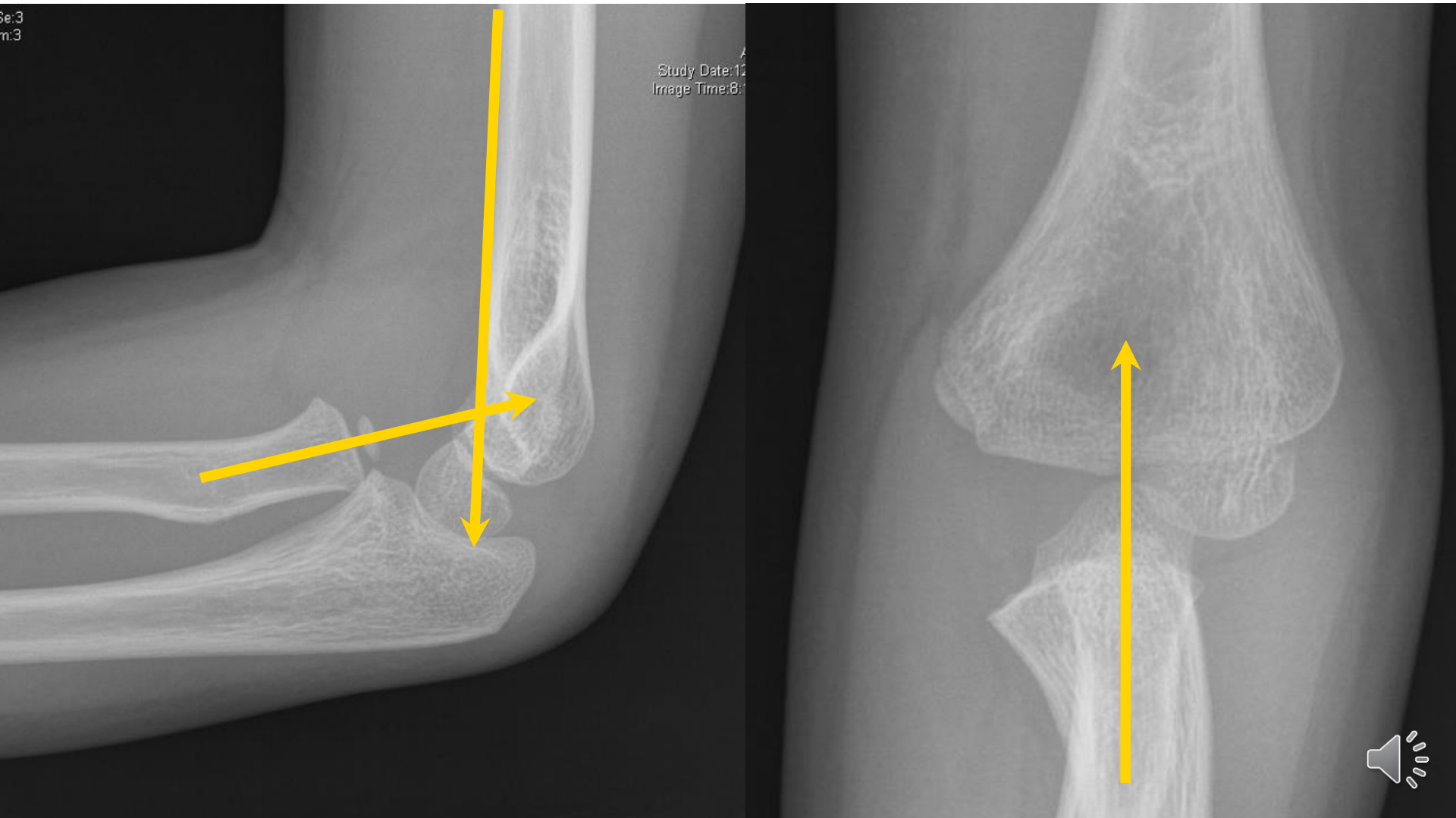


Case

HPI: 6yo girl, painful/swollen elbow after fall from monkey bars at recess.

O: Painful swollen elbow. Significant pain with attempts at supination/pronation, flexion/extension

The Elbow: Radiology Pearls



Case

HPI: 5yo boy, painful/swollen elbow after fall from monkey bars at recess.

O: Significant swelling of the elbow
Significant pain with attempts at ROM

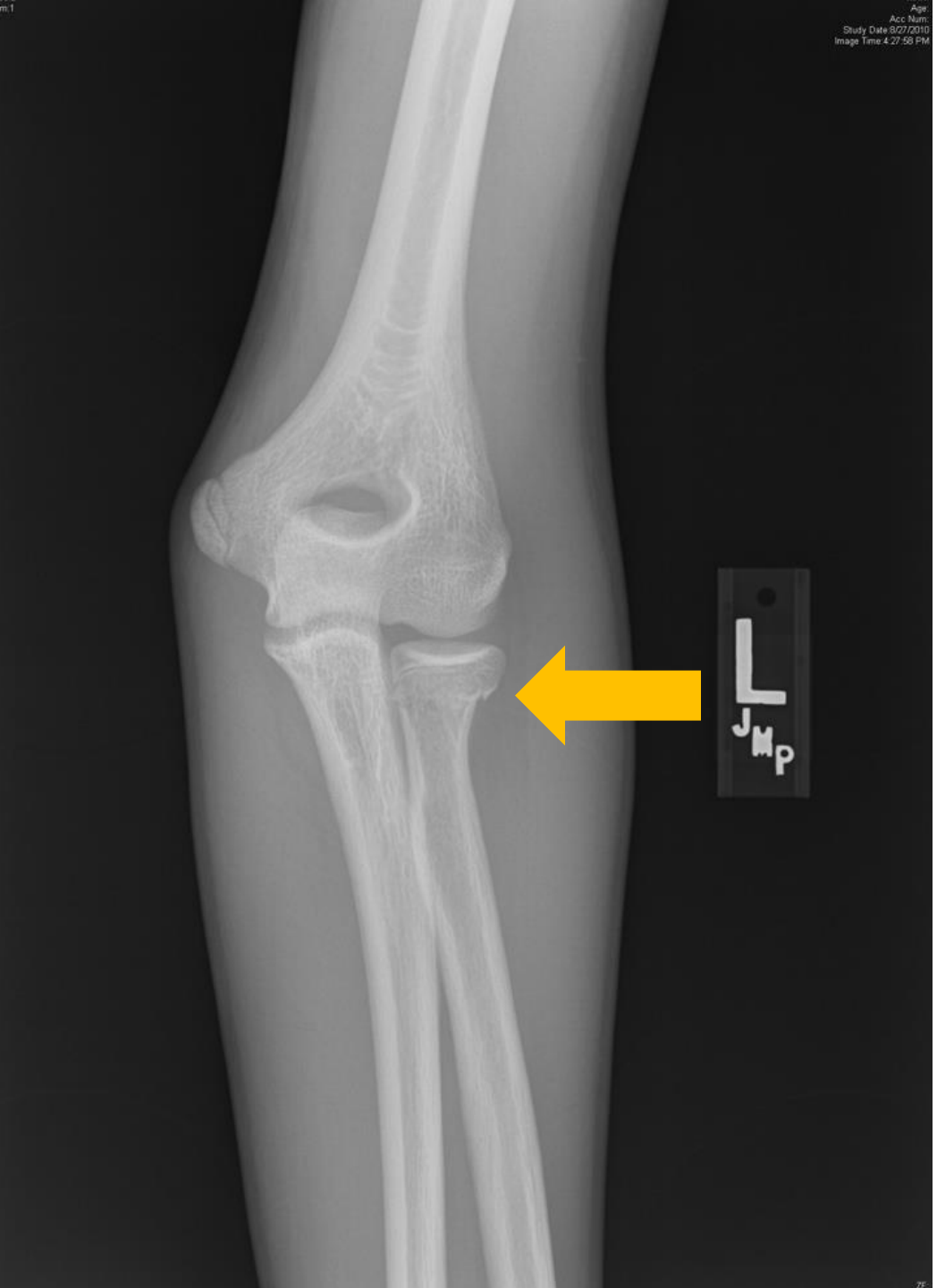
4 days

3 weeks

Case

HPI: 15 yo male with elbow pain after attempted backflip.

O: Nontender through supracondylar region, pain with supination and pronation and palpation over radial head/neck.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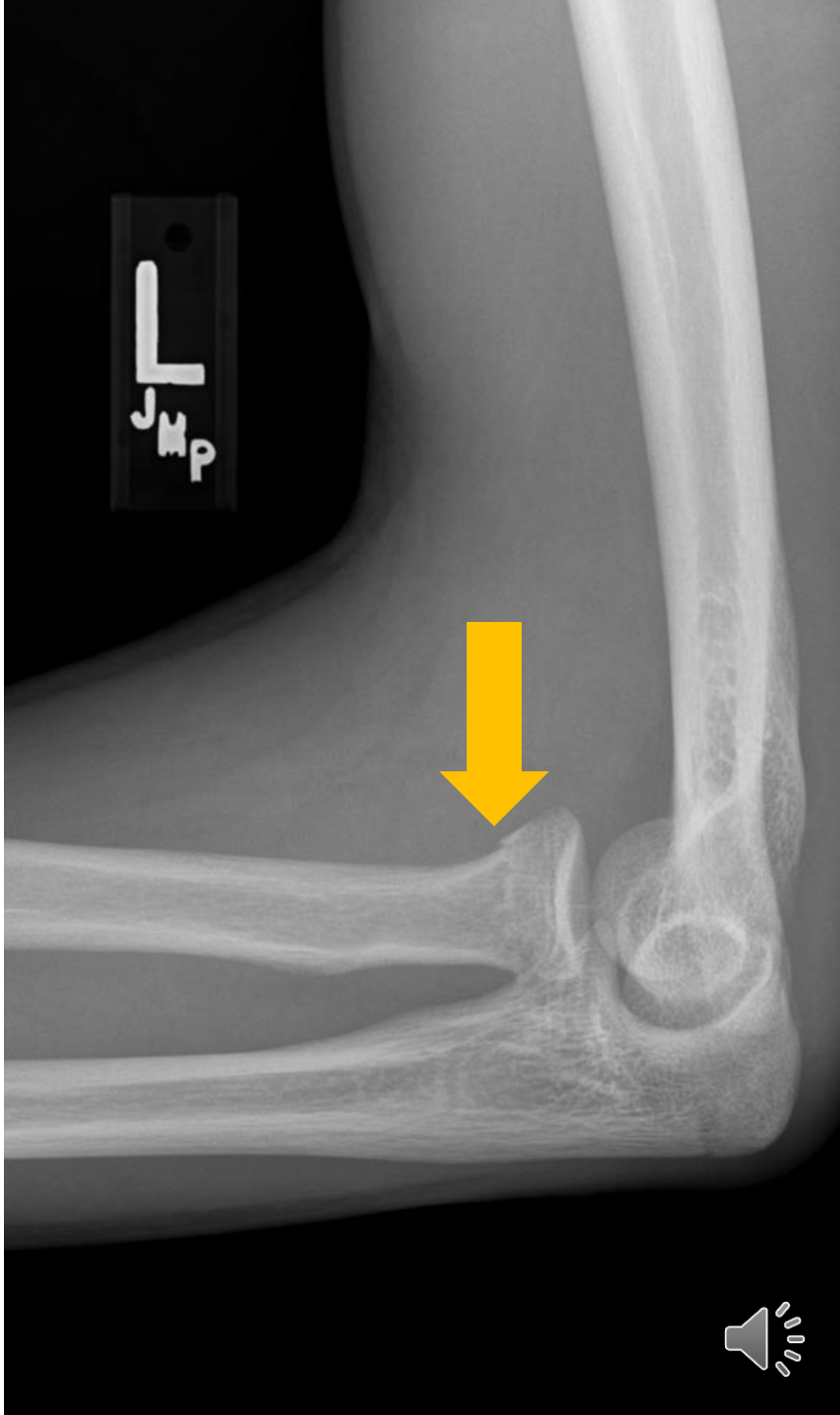
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Radial Head/Neck Fractures

Etiology:

- FOOSH
  - ***Can be associated with other fractures/posterior dislocation***

Radiology:

- AP, Lat, Rad/Cap
  - ***Radiocapitellar line***
  - ***Look for other fractures***

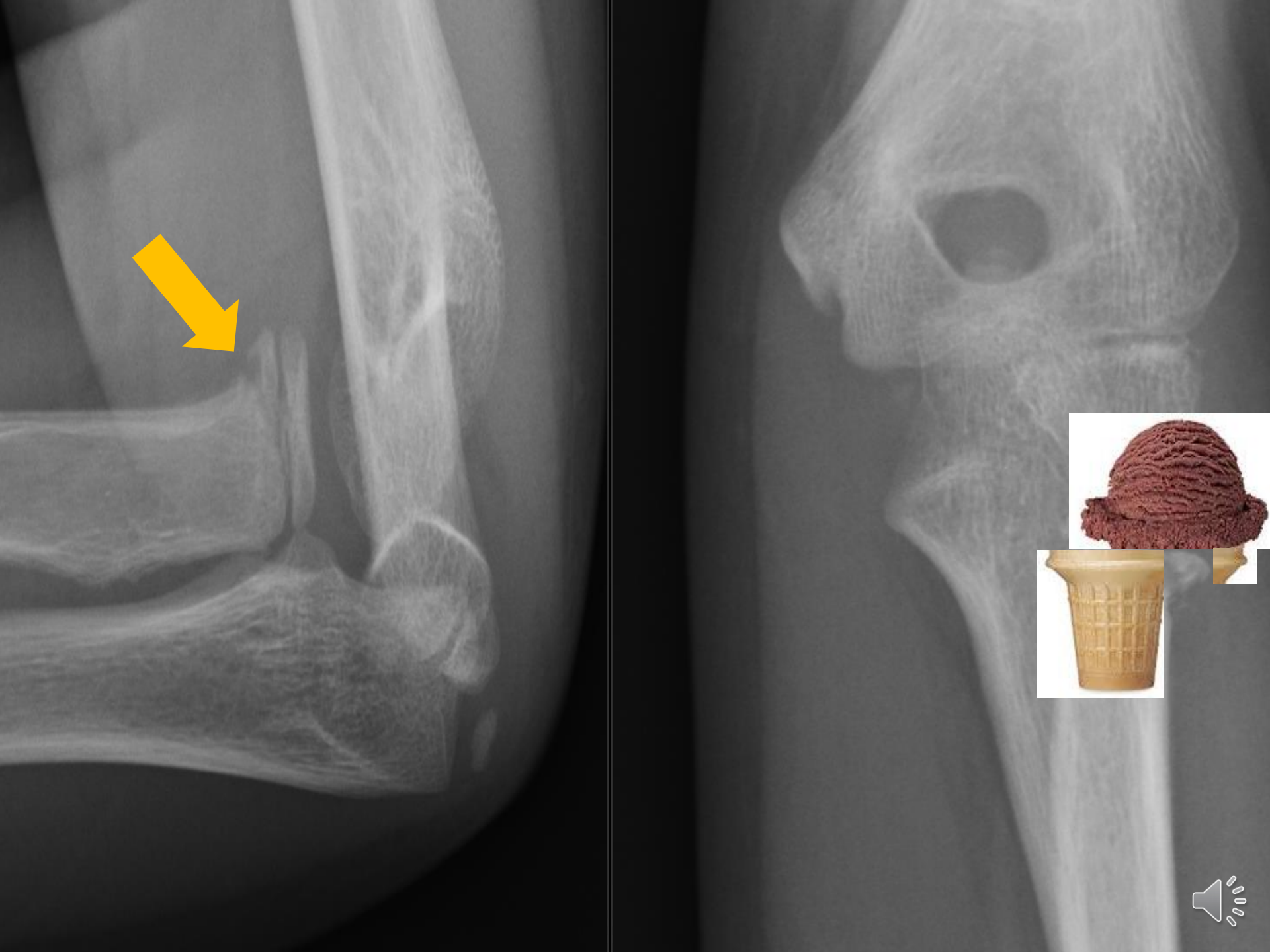
Treatment:

- Angulation = refer
- Neck = cast vs. sling depending on age

Case

HPI: 7 yo girl fell from quad
Immediate elbow pain and swelling

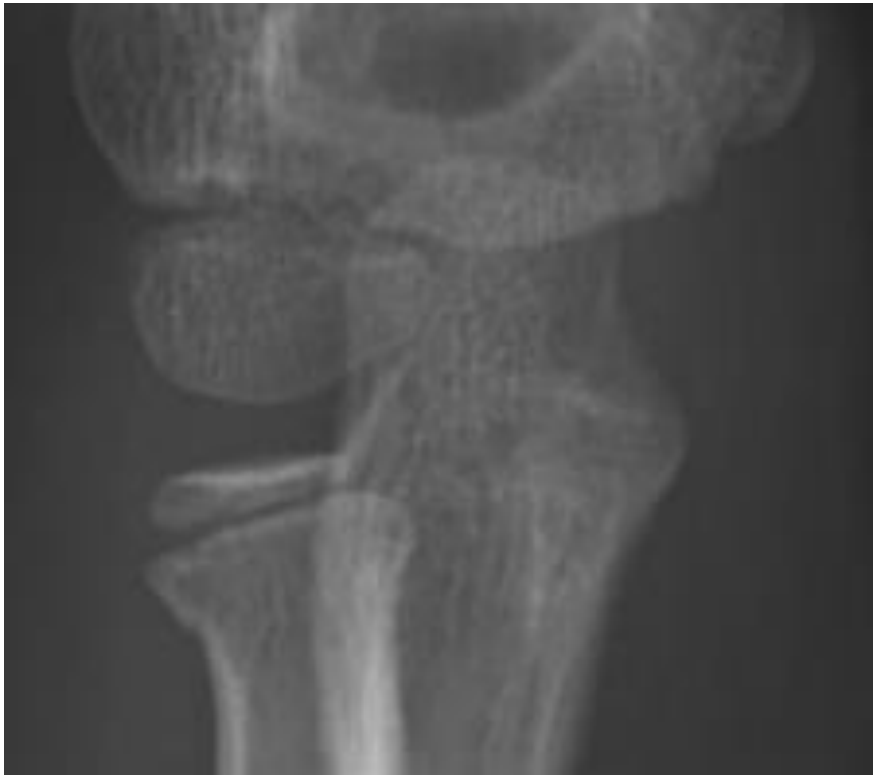
O: Swelling of elbow
Pain over radial head with supination/pronation
Minimal pain with elbow extension



SH II Radial Neck Fracture

Pearl/Pitfall:

- ***Consider Physeal Arrest***



Case

HPI: 3 yo boy not using R arm after a 4th of July party.

O: Patient is holding arm slightly flexed. No swelling or tenderness. Pain with flex/ext.

Picture from 4th of July party with Uncle Larry:

The Pulled Elbow (Nursemaids)

Etiology:

- 1-4 yo
- aprox. 1% of children each year[9]
- Usually hear story of child being ***pulled*** by wrist.
- ***Diagnosis of exclusion***
- ***History of fall is not a pull***

Clinically:

- elbow slightly flexed and pronated
- no swelling/tenderness

Radiology:

- normal

Treatment:

1. Fully Extend, Supinate, Full flexion

The Pulled Elbow (Nursemaids)

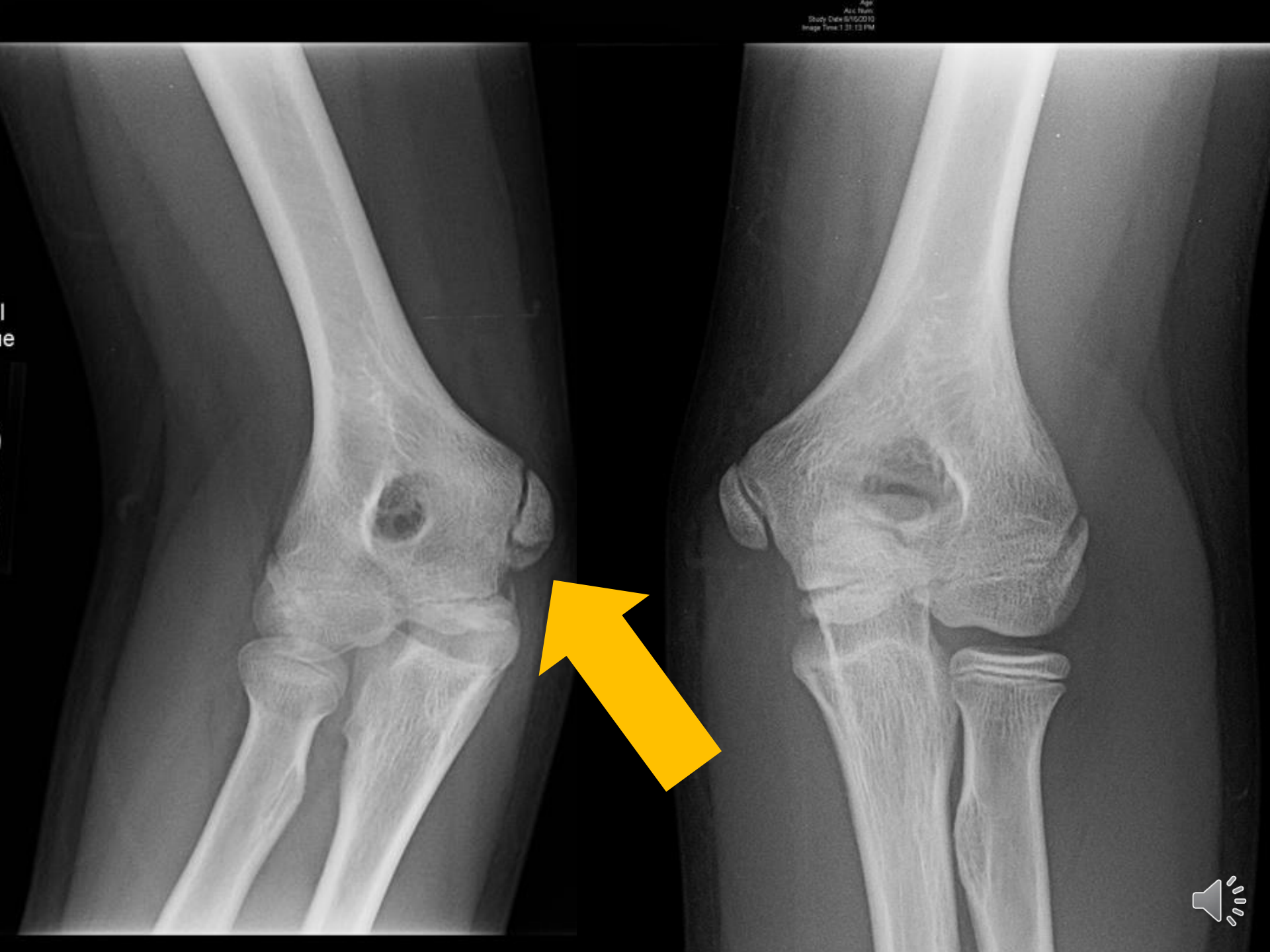
<u>Please</u> consider:

- Septic elbow
- Fractures
  - Supracondylar fracture
  - Radial head/neck fracture
  - Olecranon fracture
  - Lateral condyle fracture

Case

HPI: 13 yo boy with medial elbow pain with pitching. Getting worse over the past two months. Unable to pitch after throwing a curve ball last week and hearing a “pop”.

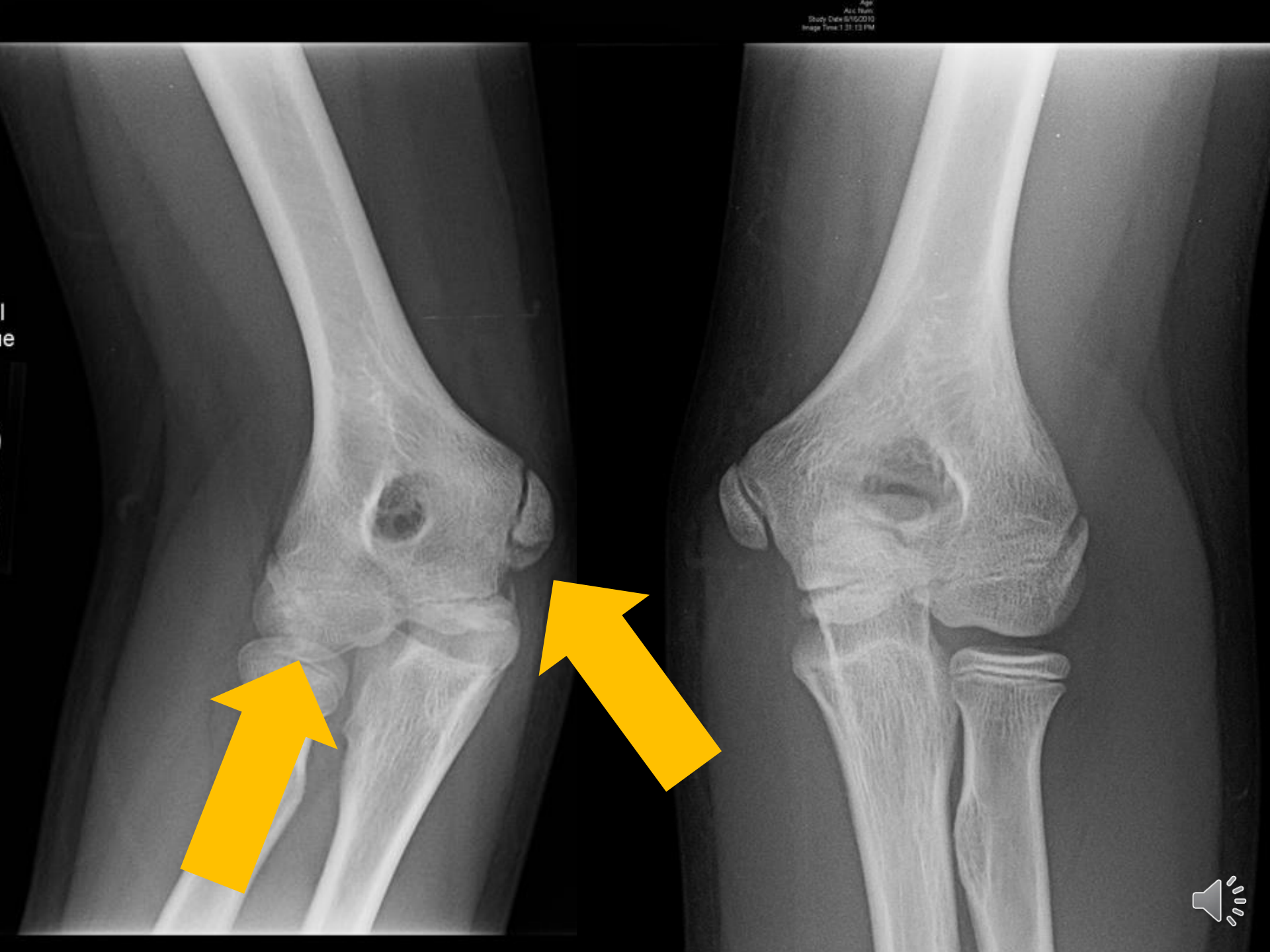
O: Full range, tender over medial and lateral elbow, pain with supination/pronation, flexion/extension. Significant pain with resisted pronation.



The Elbow: Little League Elbow

Etiology:

- Repetitive Stress
- Excessive valgus loading =
  1. ***traction medially***
  2. ***compression laterally***
- common origin of forearm flexors and pronators
- poor mechanics



The Elbow: Little League Elbow

Encompasses:

- Medial epicondylar apophysitis
- Medial epicondylar avulsion fracture
- UCL sprain/tear
- Olecranon apophysitis
- Osteochondrosis/osteochondritis of:
  - capitellum
  - radial head

Radiology:

- AP, Lat, Ext Oblq
- ***Comparison if uncertain***
  - Only one view (ap or oblq)

The Elbow: Little League Elbow

Treatment:

- Acute:
  - Immobilization
    - 2-3 weeks in cast/sling
- Chronic:
  - 3-6mo rest
- Surgery
  - Displaced medial epicondyle fx

Case

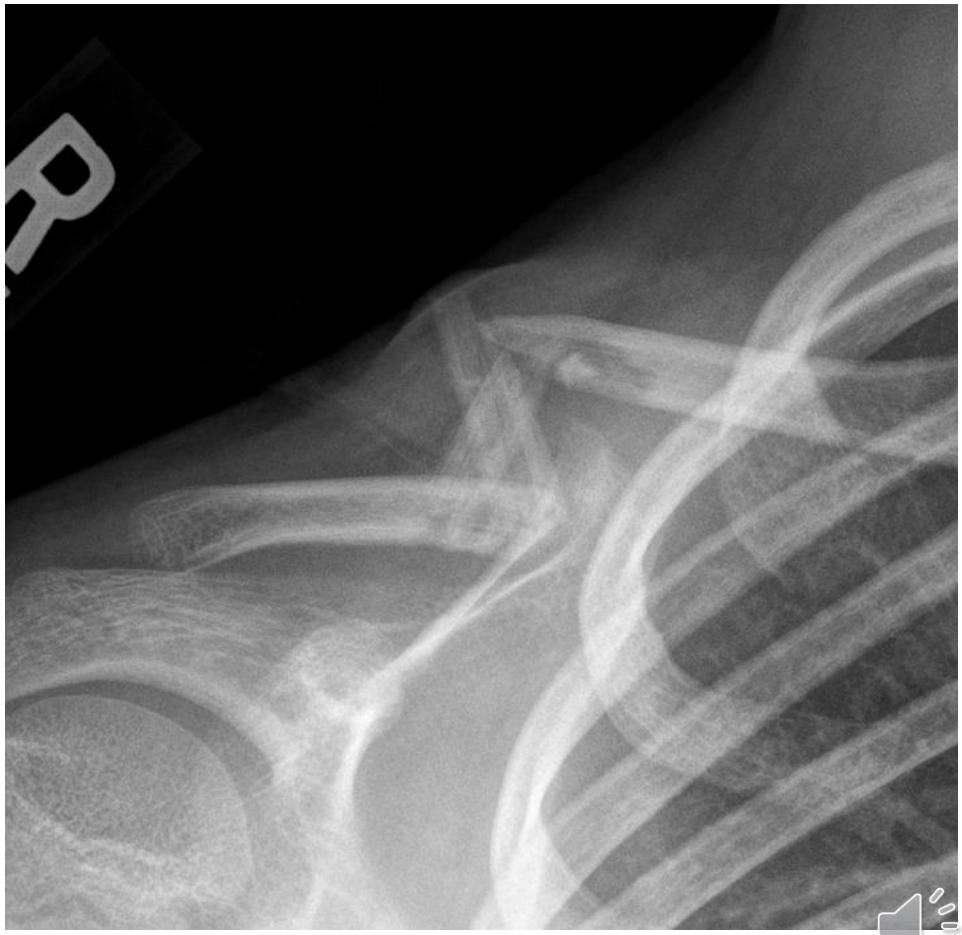
HPI: 2 yo not using Left arm after fall from bar stool. Diagnosed with possible elbow fracture in outside ED. X-rays of forearm and elbow negative.

O: Child removed from long arm, posterior splint. Not using Left upper extremity. Minor swelling over clavicle on left. Non tender at hand, wrist, elbow and proximal humerus. Tender over mid-shaft of clavicle.

The Shoulder: Clavicle Fractures

Etiology:

- Direct and Indirect
  1. FOOSH ***(Examine the whole patient!)***
  2. Newborn shoulder dystocia and high birth weight.



Treatment:

- Sling
- Skin at risk=reduce
- Surgery gaining popularity in adolescents.[11]

Summary: 10 Upper Extremity Pearls

1. Let your history and exam determine the differential.
2. X-rays confirm not deny
3. Rotation/Cascade
4. Angulation = Unstable
5. Radiocapitellar line
6. Effusion = fracture or infection
7. Pulled elbow needs a pull in the history
8. Beware of infection
9. Comparison x-ray's can be useful in children.
10. Your history & exam rules!

Post-test

1. What are the two most important components of evaluating the pediatric trauma patient?
   a) Physical exam and patient weight
   b) X-ray and MRI
   c) Physical exam and X-ray
   d) Physical exam and history

Post-test

2. What are the two most important considerations in reading the pediatric elbow X-ray?
   a) Anterior Humeral Line and Bowman's Angle
   b) Anterior Humeral Line and Radiocapitellar Line
   c) Anterior Humeral Line and Krengel Angle
   d) Anterior Humeral Line and Radial-Olecranon Line

Post-test

3. Are all pediatric fractures seen on initial X-ray?
   a) No
   b) Yes
   c) Maybe, depends on if swelling is present
   d) Depends on the cooperation of the child

Thank you.

Bibliography

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