

How to Bend but not Break... Managing Pediatric Orthopedic Injuries in the Emergency Department

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Disclosure

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Learning Objectives

- and adult fractures
- Understand the appropriate ER management of upper and lower extremity pediatric fractures
- Understand which fractures require orthopedic consultation

A Quick Review

- epiphysis
- **P** (growth plate)
- metaphysis
- diaphysis



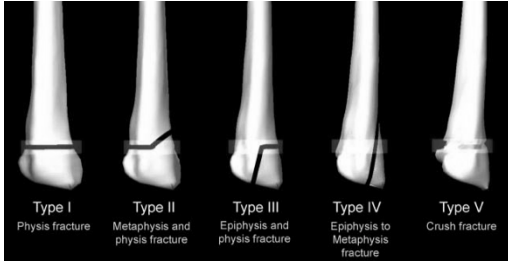
The Developing Bone

- Thicker periosteum
- Bone is more elastic
- Allows for unique fracture types
 -
 -
 -
- Avulsion before tendon rupture

Pediatric Fractures

- Capable of remodeling deformity
- What factors favor remodeling?
 -
 - physis > midshaft

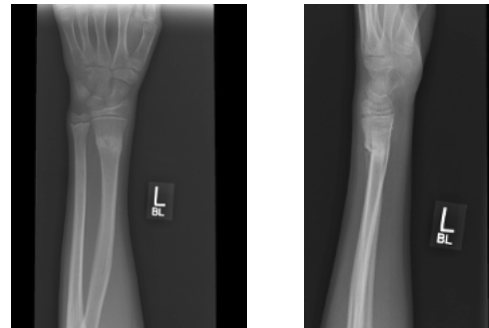
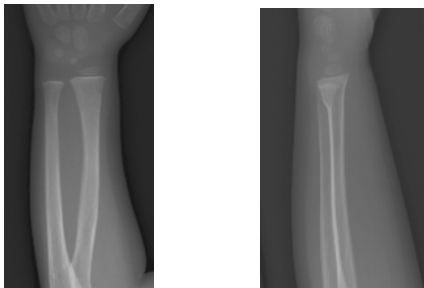
Growth Plate Injuries



Pain Management

- Early splinting
- - po Codeine and ibuprofen
 - IV morphine for obvious deformity
- - Ketamine +/- propofol
 - Bier block?

Case 1



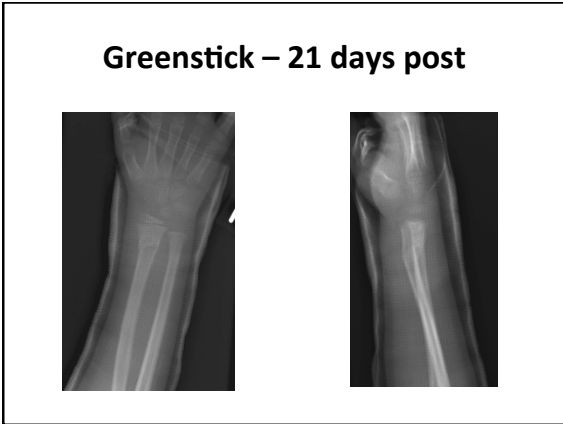
Buckle Fracture - Pearl

- - Below elbow vs. splint
 - Both acceptable
- - More severe buckle
 - Very young
 - Very active




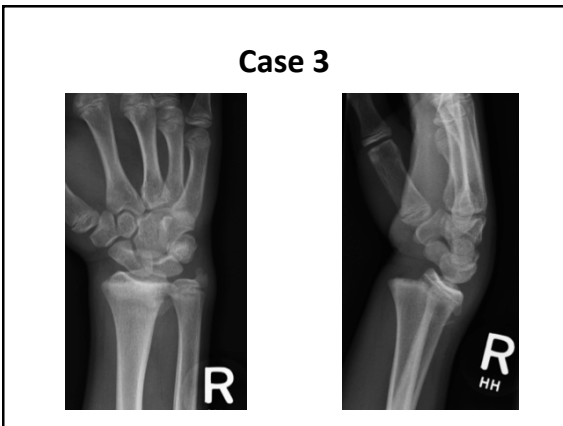
Buckle vs. Greenstick Fractures

- **Be careful !**
- - Buckling of bone; NO cortical disruption
 - Stable fracture
- - Cortex disrupted on one side, bent on other
 - Unstable fracture



Greenstick Fractures - Pearl

- Need good molding
- Consider above elbow cast initially
- Need closer follow-up than buckle fracture
- Re-xray in 7-10 days





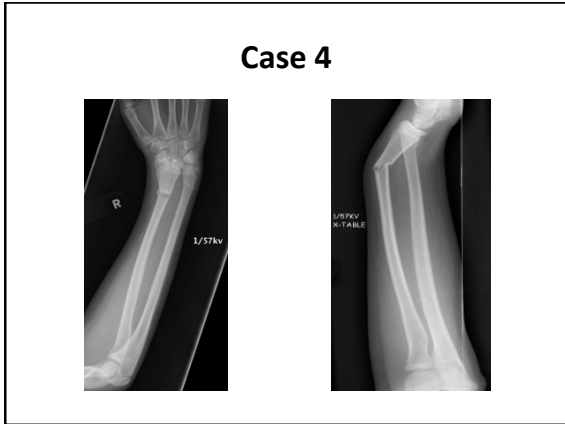
Physeal Injuries of the Radius

- - **Want physeal injuries close to anatomic**
 - Normally have 0-11 degree of volar tilt at distal radius
 - Want angulation neutral with minimal displacement
- - Unable to correct angulation
 - More than 10% displaced

Radial tilt

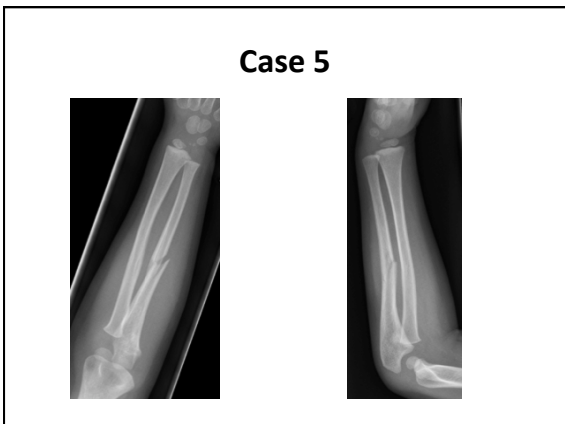
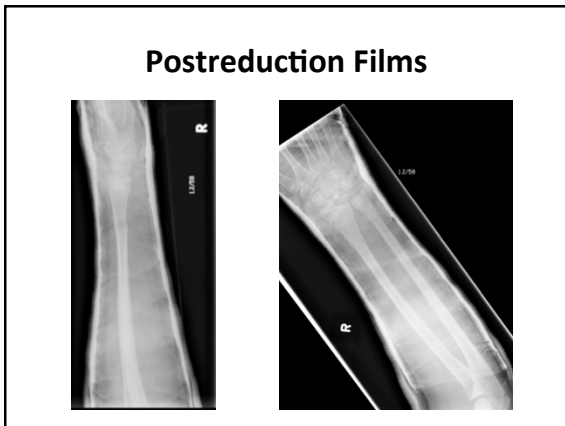
- lateral radiograph
- Angle between a line along the distal radial articular surface and the line perpendicular to the longitudinal axis of the radius at the joint margin
- Normal volar tilt averages 11° and has a range of 2°-20°.





Forearm Fractures – Distal Third

- Reduction?
 - Radial or ulnar angulation
 - Rotational deformity
 - Infants: >30 degrees angulation
 - Children: >15 degrees angulation
 - **Visible deformity**



Midshaft Radius / Ulna Injuries

- Reduction?
 - Any radial / ulnar angulation
 - Any rotational deformity
 - Infants > 25 degrees
 - Children > 10 degrees
 - **Visible deformity**
- Acceptable Displacement?
 - If infant, as much as 90%



Forearm Casting

- **Above elbow cast** for all forearm reductions
- Good 3 point molding is essential
- Orthopedics followup in 7-10 days

Bowing Deformity

- **These will NOT remodel**
- :
 - Visible deformity
 - Restricted ROM
- If attempting reduction – check for full supination and pronation
- Ortho followup essential



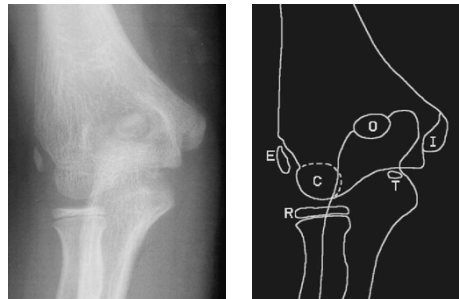
The Dreaded Elbow



Ossification Centers of the Elbow

Capitellum	2mo – 2 years	2
R		4
Internal (medial) Epicondyle	4 – 7 years	6
T		8
Olecranon	8 – 10 years	10
E		12

Ossification Centers



Ossification Centers

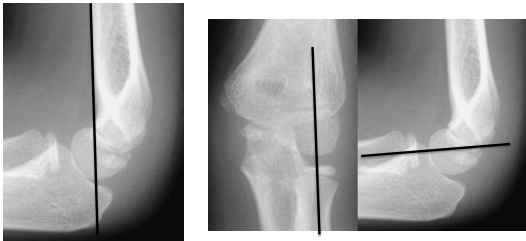


Pediatric Elbow – Fat Pads

- - Flat = normal
 - Bulging = abnormal
- - Always abnormal



Anterior Humeral and Radial Line



Elbow Xrays - Pearl

- **Ensure you have a true lateral**
 - Look for the hourglass
 - If not
 -
 - anterior humeral line
 - You may miss supracondylar fractures

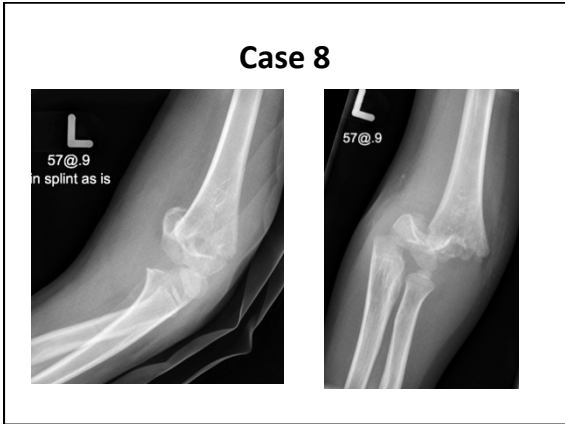


Case 6



Case 7




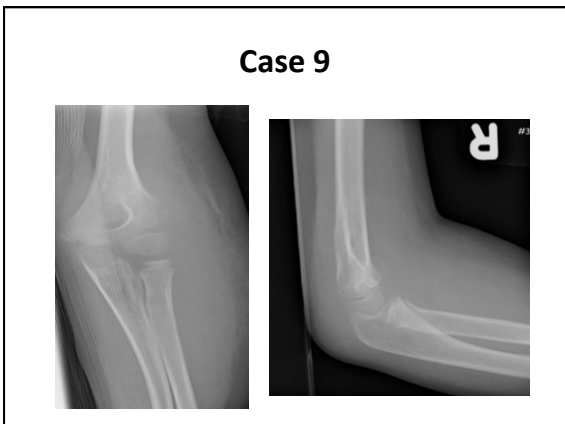
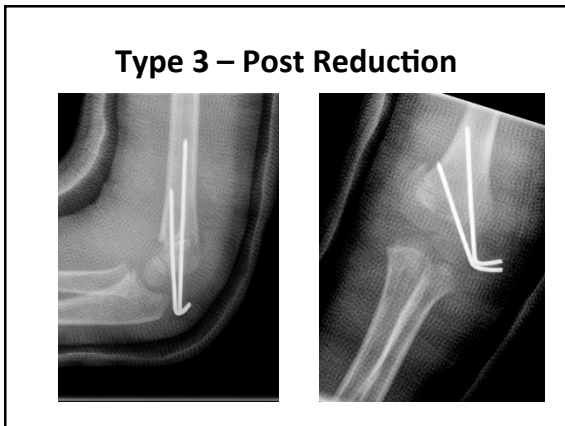


Supracondylar Fractures

- 75% of elbow fractures
- Classification
 - Type 1 – non or minimally displaced
 - Type 2 – displaced and hinged on posterior cortex
 - Type 3 – completely displaced, posterior cortex disrupted

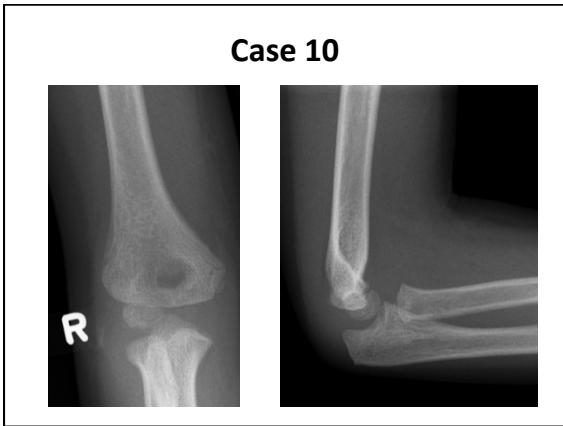
Management

- - Backslab at 90 degrees, ortho 1 week
- - Backslab and immediate referral
 - If pulseless child **usually holding arm in extension, try flexing at the elbow 15 degrees**

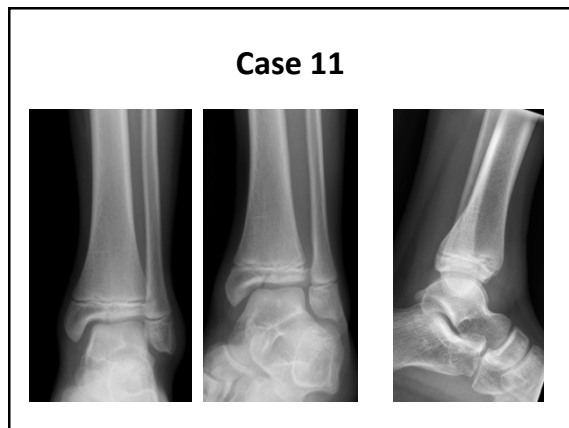
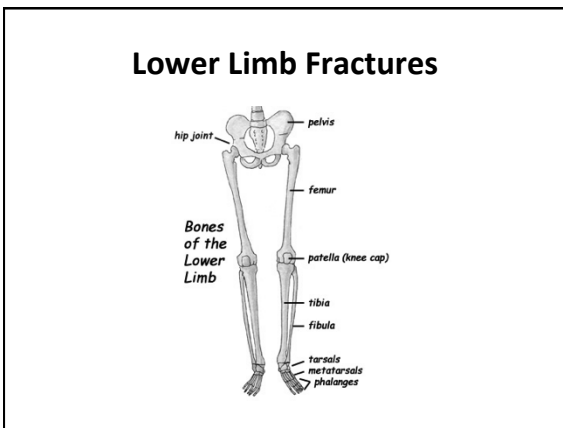
Lateral Condyle Fracture

- Degree of displacement
 - < 2 mm – backslab at 90 degrees, early Ortho followup
 - > 2 mm – immediate referral for pinning



Medial Epicondyle Fracture

- Degree of displacement
 - < 4 mm – backslab, early ortho followup
 - > 4 mm – immediate referral, pinning



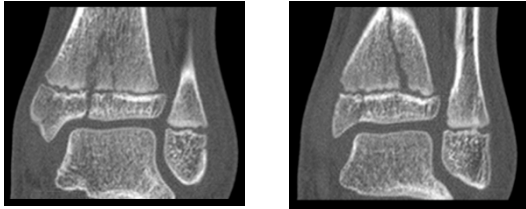
Tillaux Fracture

- Forced external rotation of foot or medial rotation of the leg on fixed foot
- Street placed on anterior tibiofibular ligament
- Often caused by low energy trauma

Tillaux Fracture - Pearl

- Fracture of the antero-lateral tibial epiphysis
- Salter III injury
- - Low threshold for CT
 - Immediate Ortho referral

Case 11 – CT Images

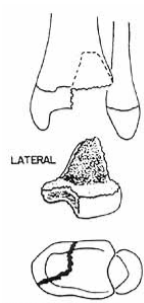


Triplane Fracture



Triplane Fracture

- CT usually required
- Ortho referral
- Operative management in 70%



Case 11



Toddler's Fracture

- Common – spiral fracture of tibia
- Low energy mechanism – often no obvious injury
- **Xray normal in 25%**
- - Above knee cast, 15-20 degrees flexion
 - 3 weeks



Helpful Websites

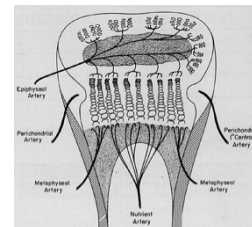
- <http://www.hawaii.edu/medicine/pediatrics/pemxray/pemxray.html>
 - Fantastic website focusing on radiologic findings in paediatric emergency cases
 - Many excellent orthopaedic cases
- <http://wheeless.orthoweb.be/med.htm>
 - *orthopaedic textbook*

Acknowledgement

- Dr. Kelly Millar – Alberta Children’s Hospital

The Developing Bone

- Physis
 - Multiple zones or cartilage cells
 - Rapidly dividing
 - Not yet calcified
 - Common site of fracture



Brighton CT: Clin Orthop 136:23-32

Radial length or height

- measured on the PA radiograph
- distance between: a line perpendicular to the long axis of the radius passing through the distal tip of the radial styloid and a line intersecting the distal articular surface of ulnar head
- measurement averages 10-13 mm in mature skeleton.



Forearm Fractures

- Physeal injuries
 - Distal radius/ulna (metaphysis)
 - Midshaft radius/ulna (diaphysis)
 - *Most are fairly straightforward to identify – the question is which ones can you leave alone, which need reduction, and which need referral!*

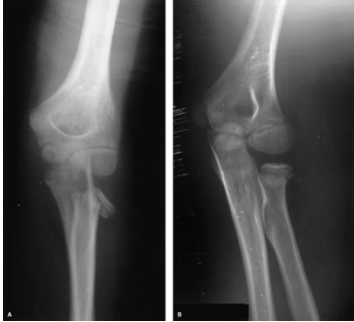
What about Bayonet



Bayoneted Fractures

- Prepubescent ~ if distal or midshaft, can give it a try ~ often difficult to get ulna back on (most of us discuss the options with the parents)
- Peripubertal / Teens
 - may consider trying metaphyseal #
 - Midshaft or proximal – refer to ortho
- Often associated with post reduction swelling and need to split cast

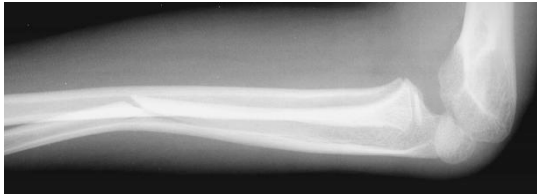
Proximal Radius



Proximal Radius Fractures

- Most common in ages 8 - 12
- Usually involve the metaphysis or the physis, and not the radial head
- **Management?**
 - < 15° angulation - posterior slab, F/U with ortho in 1 week
 - 15-30° - posterior slab – early to ortho
 - > 30° angulation – call ortho for reduction

What's this?



Monteggia Fracture



Monteggia

- Ulnar fracture + proximal radial dislocation
- "Monteggia equivalent" with plastic deformation of the ulna occurs in 17%
- 8--17% associated neurologic deficits (usually posterior interosseous branch of the radial nerve)
- Management: call ortho!

Tib / Fib Shaft Fractures

- If non-displaced: above-knee cast (15° at knee), non-weight bearing, f/u ortho 1 week (may need sedation for unstable tibial shaft #)
- Minimally displaced – often reduce quite easily during casting (use sedation)
- Always do post-cast films and be careful of foot position
- For significant displacement, or *involvement of the proximal physis or metaphysis* – d/w ortho