Paediatric Upper limb injuries

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INTRODUCTION

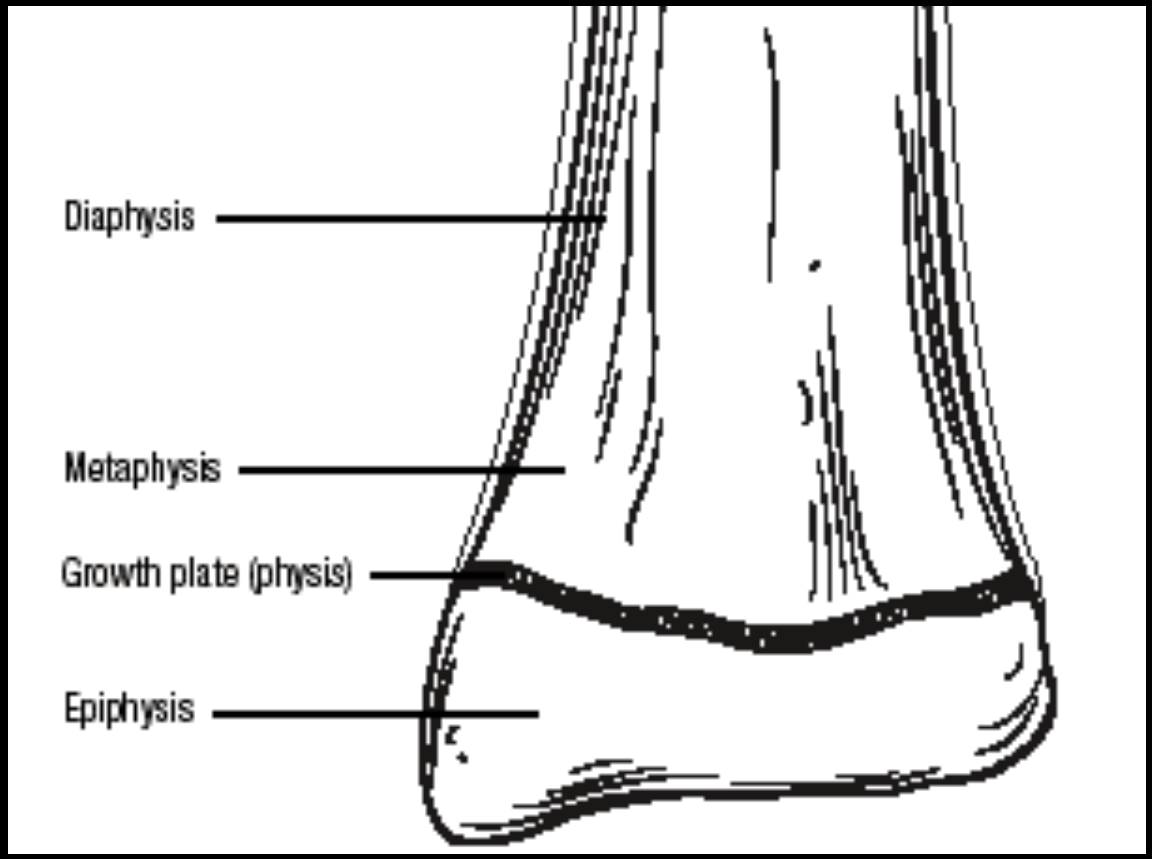
- ANATOMY OF THE GROWING BONE
  - INJURY PATTERN OF BONE
- PHYSEAL INJURIES
- SPECIFIC SITES
  - DISTAL RADIUS
  - ELBOW
  - CLAVICLE
  - Humerus

RELEVANCE

- Nearly 20% of children who present with an injury have a fracture
  - 42% boys, 27% girls will sustain fracture in childhood

ANATOMY OF GROWING BONE

- Epiphysis
- Physis
- Metaphysis
- Diaphysis
- Periosteum



INJURY PATTERN IN GROWING BONES

- Bones tend to BOW rather than BREAK
- Compressive force= TORUS fracture
  - Aka. Buckle fracture
- Force to side of bone may cause break in only one cortex= GREENSTICK fracture
  - The other cortex only BENDS
- In very young children, neither cortex may break= PLASTIC DEFORMATION

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FIGURE 2

Fracture types particular to children

INJURY PATTERNS
CON'T

- Point at which metaphysis connects to physis is an anatomic point of weakness
- Ligaments and tendons are stronger than bone when young
  - Bone is more likely to be injured with force
  - Periosteum is biologically active in children and often stays intact with injury
    - This stabilizes fracture and promotes healing

INJURY PATTERNS
CON'T

- Point at which metaphysis connects to physis is an anatomic point of weakness
- Ligaments and tendons are stronger than bone when young
  - Bone is more likely to be injured than soft tissue
  - Periosteum is biologically active in children and often stays intact with injury
    - This stabilizes fracture and promotes healing

PHYSEAL INJURIES

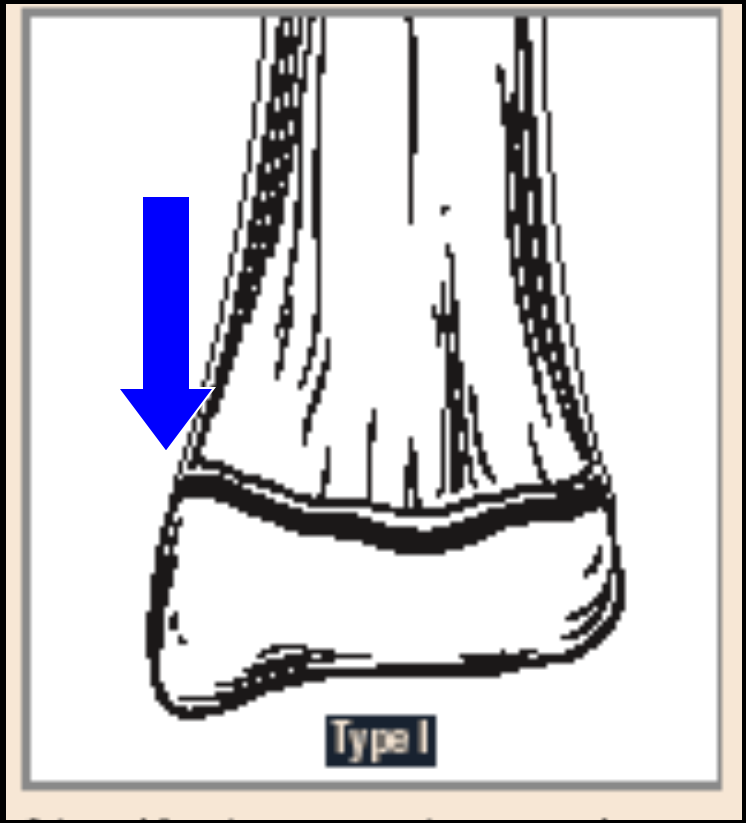
- Many childhood fractures involve the physis
  - 20% of all skeletal injuries in children
  - Can disrupt growth of bone
  - Injury near but not at the physis can stimulate bone to grow more

SALTER HARRIS

- Classification system to delineate risk of growth disturbance
  - Higher grade fractures are more likely to cause growth disturbance
  - Growth disturbance can happen with ANY physeal injury

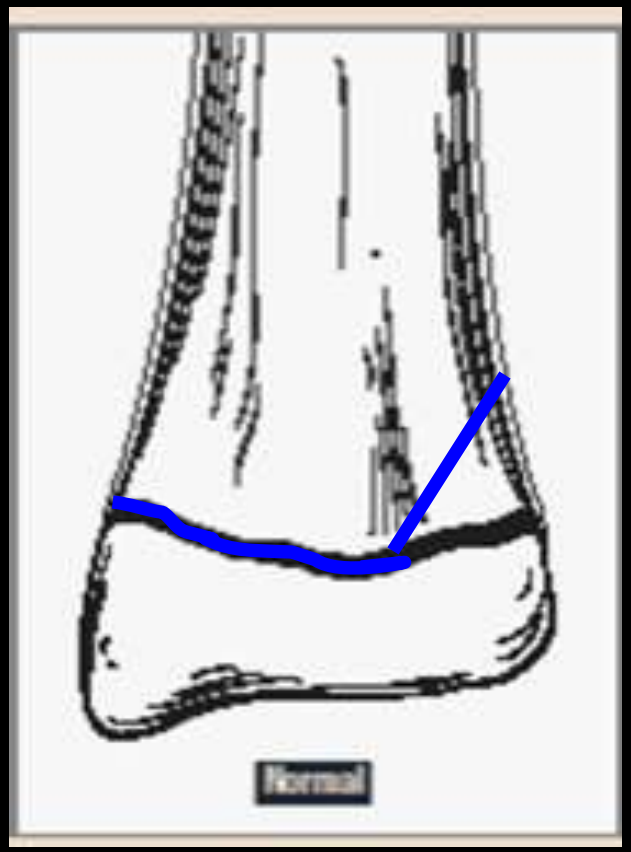
SALTER HARRIS CLASSIFICATION

- I
  - Fracture passes transversely through physis separating epiphysis from metaphysis
- II
- III
- IV
- V



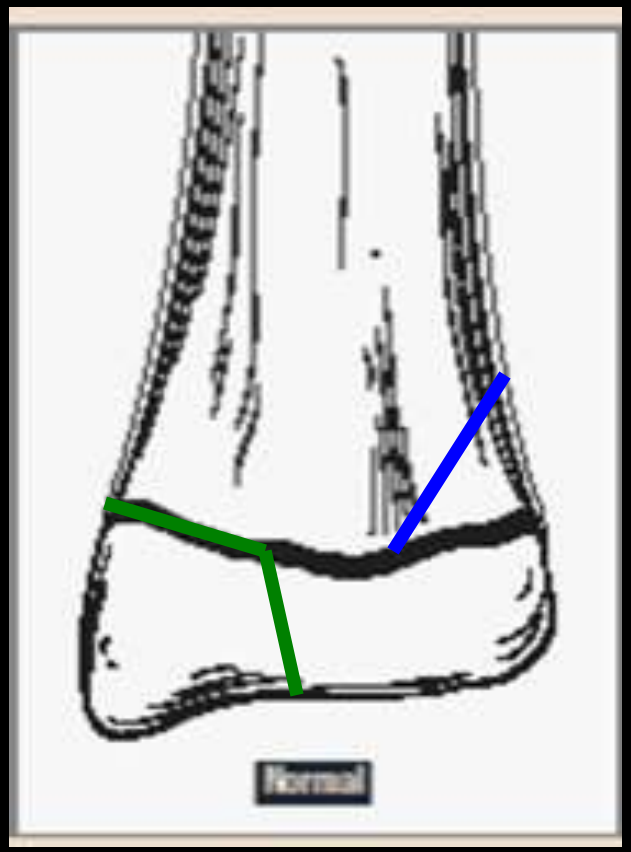
SALTER HARRIS CLASSIFICATION

- I
- **II**
  - Transversely through physis but exits through metaphysis
  - Triangular fragment
- III
- IV
- V



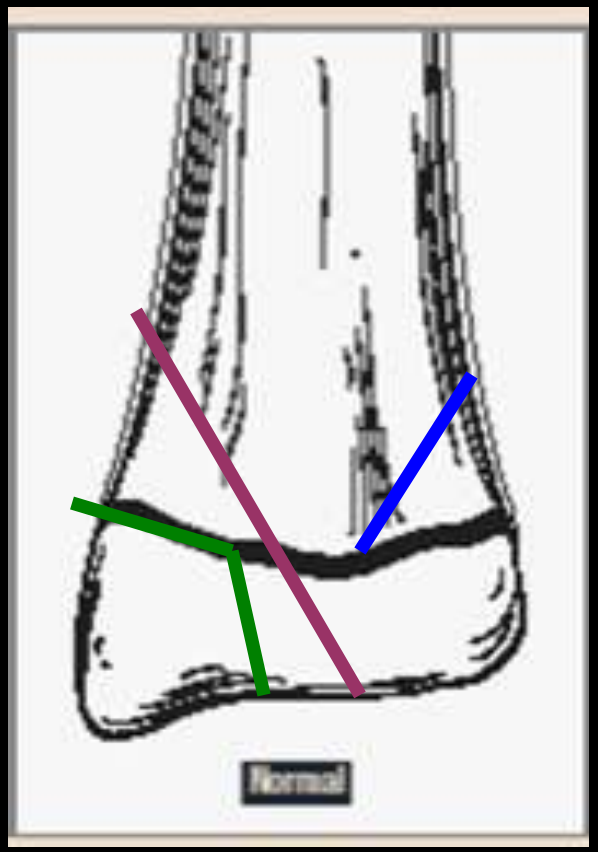
SALTER HARRIS CLASSIFICATION

- I
- II
- **III**
  - Crosses physis and exits through epiphysis at joint space
- IV
- V



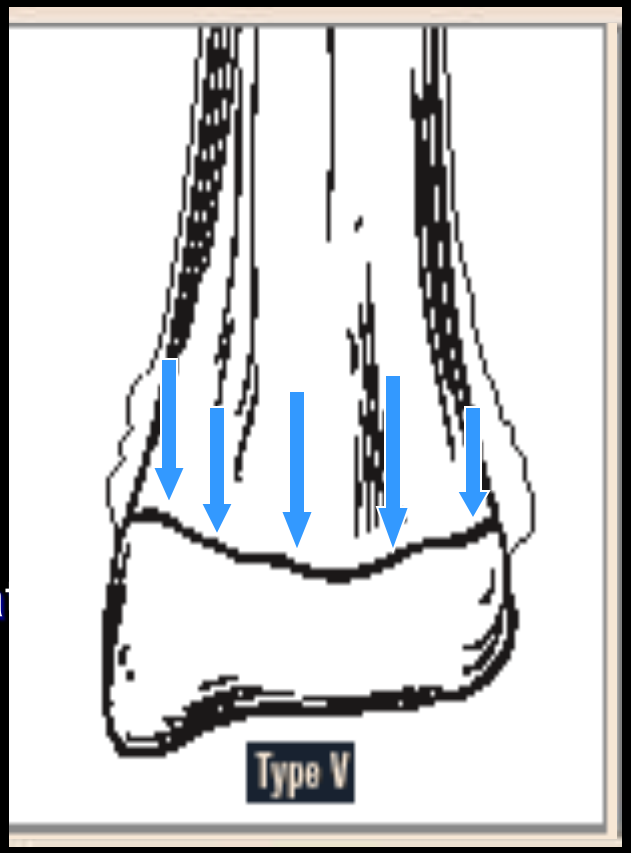
SALTER HARRIS CLASSIFICATION

- I
- II
- III
- **IV**
  - Fracture extends upwards from the joint line, through the physis and out the metaphysis
- V



SALTER HARRIS CLASSIFICATION

- I
- II
- III
- IV
- **V**
  - Crush injury to growth pla



PHYSEAL FRACTURES

- MOST COMMON: Salter Harris ___

PHYSEAL FRACTURES

- MOST COMMON: Salter Harris II
  - Followed by I, III, IV, V
  - Refer to ortho III, IV, V
  - I and II effectively managed by primary care with casting (most commonly)
- Don’t forget to tell Mom and Dad that growth disturbance can happen with any physeal fracture

IT'S GOOD TO BE YOUNG

- Children tend to heal fractures faster than adults
  - Advantage: shorter immobilization times
  - Disadvantage: misaligned fragments become "solid" sooner
- Anticipate remodeling if child has > 2 years of growing left
  - Mild angulation deformities often correct themselves
  - Rotational deformities require reduction (don't remodel)

IT'S GOOD TO BE YOUNG

- Fractures in children may stimulate longitudinal bone growth
  - Some degree of bone overlap is acceptable and may even be helpful
- Children don't tend to get as stiff as adults after immobilization
- After casting, callus is formed but still may be fibrous
  - Avoid contact activities for 2-4 weeks once out of cast

Developing Bone - Anatomy

- Epiphysis
- Physis
- Metaphysis
- Diaphysis

The Developing Bone

- Thicker periosteum
- Bone is more elastic
- Allows for unique fracture types
  - Torus (buckle)
  - Greenstick
  - Bowing
- Avulsion before tendon rupture

Pediatric Fractures

- Heal more rapidly than adults
- Capable of remodeling deformity
- *What favors remodeling?*
  - Younger > older
  - Closer to physis > midshaft
  - Only angulation in the plane of the adjacent joint will remodel

Forearm Fractures

- *Most common site of fracture (50% of all #)*
- Physeal injuries of the distal radius (+/- ulna)
- Metaphyseal fractures radius/ulna
- Midshaft radius/ulna

Physeal Injuries of the Radius

- Usually Salter I or II
- Usually displaced posteriorly (colles-type)
- Smith's-type less common
- Complications uncommon

Physeal Injuries of the Radius

- *Reduction?*
  - *Want physeal injuries close to anatomic*
  - Normally have 0-11º volar tilt at distal radius
  - Want angulation at least neutral and minimum displacement
  - Needs good molding – about 11% will slip

  - Unable to correct dorsal angulation
  - More than 10% displaced

Metaphyseal Injuries of the Radius

- Buckle fractures
- Greenstick
- Complete

Buckle vs Greenstick

- ***Be careful !!!***
- Buckle #
  - Cortex on opposite side must be unaffected
  - These are stable fractures
- Greenstick #
  - Cortex # on one side and bent on other
  - These are unstable – they tend to move back to the position of maximal deformity

Distal Forearm - Buckle

- Stable Fractures
- Management controversial:
  - Immobilize?
  - Cast?
  - Many opt for splint

Wrist buckle fractures. A Plint et al. CJEM March 2003

- *Who might benefit from cast?* More severe buckle, v. young, v. active
- *How long do we immobilize?* 2-3 wks

Does this need a reduction?

What is acceptable angulation in the distal radius?

Distal Forearm - Greenstick & Complete

- *Reduction?*
  - Radial or ulnar angulation
  - Rotational deformity
  - Infants: >30º angulation
  - Children: >15º angulation
  - Peripubertal: need 2-3 yrs growth to remodel

How about this midshaft #?

What is acceptable angulation in a midshaft #?

Midshaft Radius/Ulna Injuries

- *Reduction?*
  - Any radial / ulnar angulation
  - Any rotational deformity
  - Infants: >25º
  - Children: >10º
  - Peripubertal: need 2-3 years to remodel
- *Acceptable displacement?*
  - If young, as much as 90%

Forearm Reductions & Casting

- Greenstick #: Many advocate breaking far cortex to prevent recurrence of deformity (but run the risk of bayonet)
- *Remember that thick periosteum is your friend !!*
- Good 3 point molding essential
- Apply above elbow cast for all reductions

What about Bayoneted # ?

When can you give them a go?

Bayoneted Fractures

- Prepubecsent ~ 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

- *Is this a problem?*

2 yo male

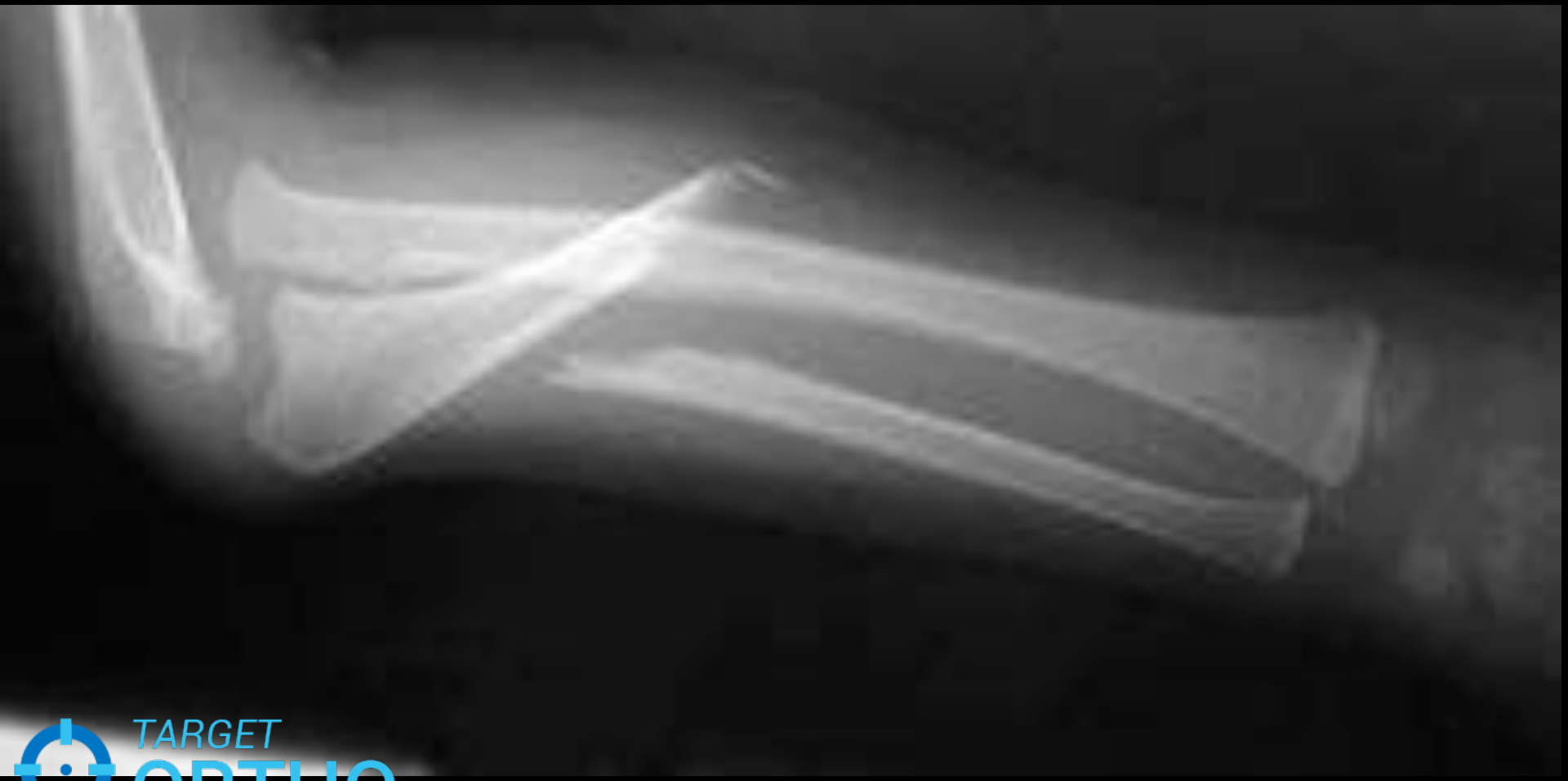
Bowing deformity

- **These will NOT remodel !!**
- Must be reduced if visible deformity or restricted ROM – but difficult
- If attempting reduction – check for full supination & pronation

Ouch !!! What's This?

MONTEGGIA # DISLOCATION

TYPE I

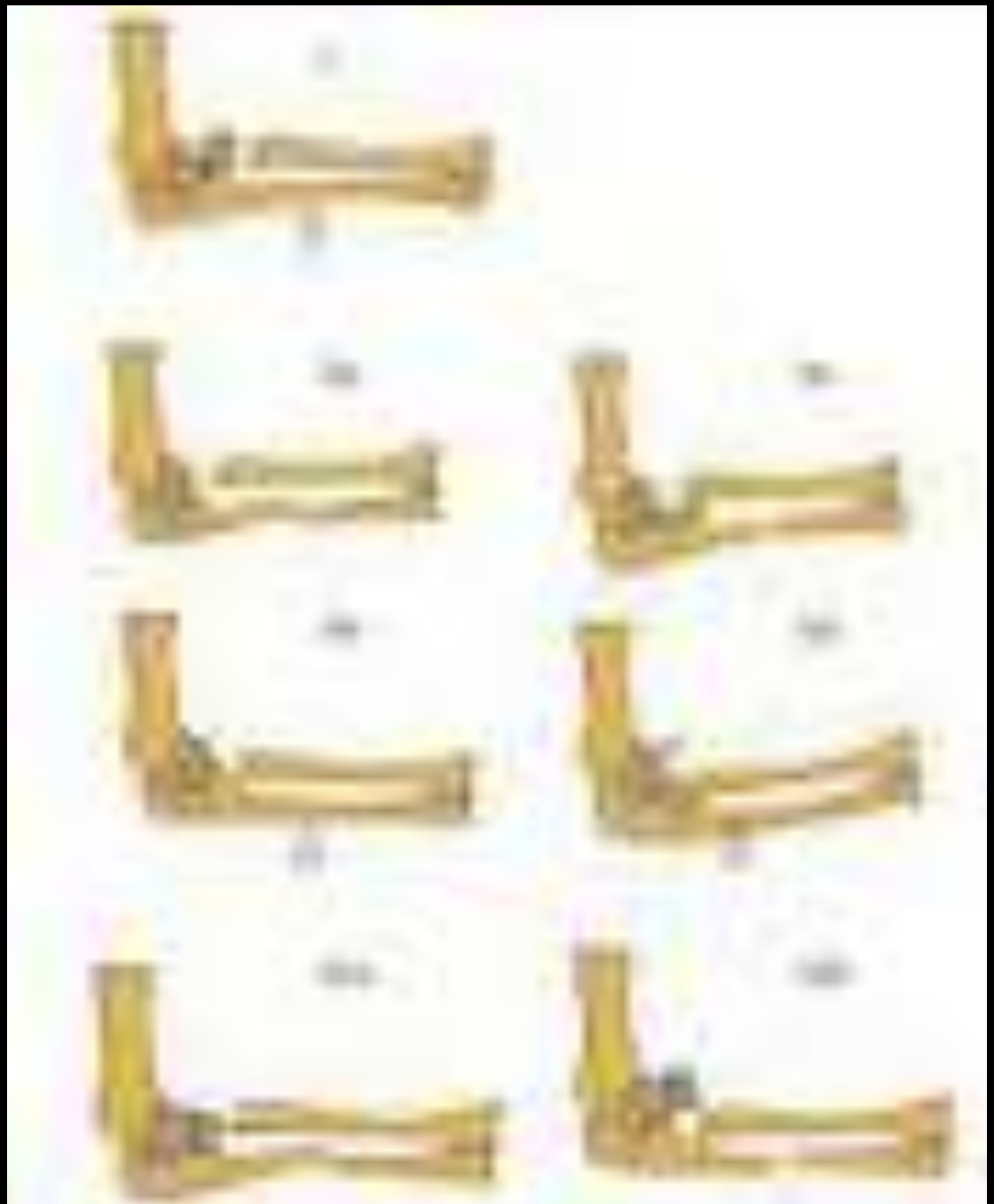


TYPE II

TYPE III

TYPE IV

Proposed classification based on Olney and Cepelík



Lincoln and Mubarak

Elbow

- Supracondylar #
- Lateral condyle #
- Medial epicondyle #
- Proximal radius #

Ossification Centers - CRITOE

Anterior Humeral Line

Should pass through the middle third of the capitellum in the lateral view

Radial Line

Should bisect the radius in ALL views

What's this?

Type I

Type II

Type III

Supracondylar Fracture Complications

- Very high rate of complications!!
- Acutely:
  - Neurologic injury (8-15%)
    - Ant interosseuous branch of median n
    - Radial and ulnar nerves also may be involved
  - Radial artery (2% overall, 50% in Type III)
  - Compartment Syndrome
- Longer term:
  - Cubitus varus, Volkmann's ischemic contract.

What's this?

Lateral Condyle Fracture

- 15% of elbow #s
- Usually Salter-Harris IV
- Peak age 4-10 years
- Lateral Condyle Fractures are the second most common fracture a higher risk of nonunion, malunion, and AVN than other pediatric elbow fractures.

Classification

Lateral Condyle Fracture

Complications

- Stiffness
- Delayed union
- Non union
- Malunion
- Cubitus valgus +_ tardy ulnar neve palsy
- Avn
- Fish tail deformity
- Lateral overgrowth/prominence (spurring

Medial Epicondyle Fracture

- Usually seen in adolescent boys
- Do not involve the joint surface
- Check for ulnar nerve injury
- 50% associated with dislocation –
- If diplacement < 4mm – backslab
- If displacement > 5 mm - pinned

Medial Epicondyle Fractures

- Difficult to identify in young children (so much cartilage)

NORMAL →

- Ossification centre should follow smooth contour

Medial Epicondyle Fracture

What's this?

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
  - 15-30º - posterior slab – early to ortho
  - > 30° angulation – call ortho for reduction

Proximal Radius

What's this?

Proximal Humeral Fractures

- Proximal humeral physis
  - Usually SH type I or II
  - ++ potential for remodelling
  - Age 1-5
    - 70º angulation, 100% displacement
  - Age 5-12
    - 50º angulation, 50% displacement
  - Age >12
    - 30% displacement

Proximal Humeral Fractures

- Management
  - Sugar tong splint & sling, f/u ortho

Clavicle

- 10–15% of all pediatric #s
- 90% middle third
  - Sling
  - Pain management
  - Warn parents about the bump
  - F/U fam doc in 6-8 weeks

Sling vs Figure of 8

- ***Treatment of clavicular fractures. Figure-of-eight bandage versus a simple sling.*** *Andersen K. Jensen PO. Lauritzen J. Acta Orthopaedica Scandinavica. 58(1):71-4, 1987*
  - RCT:
  - 79 pts
  - figure-of-eight bandage vs simple sling
  - simple sling caused less discomfort and perhaps fewer complications than figure-of-eight
  - The functional and cosmetic results of the two methods of treatment were identical and alignment of the healed fractures was unchanged from the initial displacement

Proximal / Distal Clavicle Fractures

- Proximal clavicle #'s (<2%)
  - Usually involve growth plate – SH I or II
  - If clavicle displaced posteriorly, may get tracheo-esophageal compression – if so talk to ortho and get CT
- Distal clavicle #'s
  - Usually involve growth plate – SH I or II
  - Often difficult to distinguish from AC sep
  - Ortho f/u if grossly unstable