

Childhood Fractures

- Incomplete fractures more common
 - Plastic bowing
 - Torus / Buckle
 - Greenstick
- Ligaments stronger than bone
 - Fracture patterns different
 - Physeal injury, not dislocation
- Tendons stronger than bone
 - Apophyseal avulsion
- Fractures may be pathologic
- Remember NAI

Special Considerations in Childhood Injuries

- More agile – avoid falls
- Weigh less – lower forces
- Short limbs – less leverage
- Bones less brittle – elastic and plastic
- Thick periosteum – protects bone
- M > F
- Accidents at home < 15Y
- Sports > 15Y
- Rare in infants < 18m

Special Considerations in Childhood Injuries

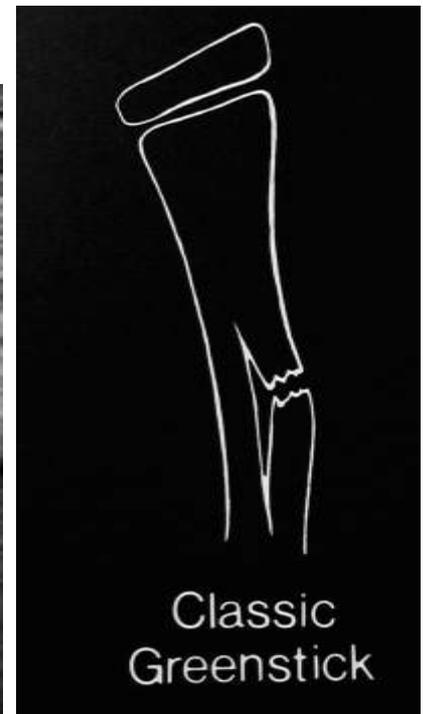
- Toddlers – Fx skull, tibia and femur
- Schoolchildren
 - Distal forearm 30%
 - Hand 20%
 - Clavicle 10% Ankle, foot
- Incomplete Fxs 50%

Special Considerations in Childhood Injuries

- Radiography
 - AP and Lateral away from joints
 - + Obliques at joints
 - Opposite side not routine
 - Joint eff, no Fx, continued pain. FU 7-10d

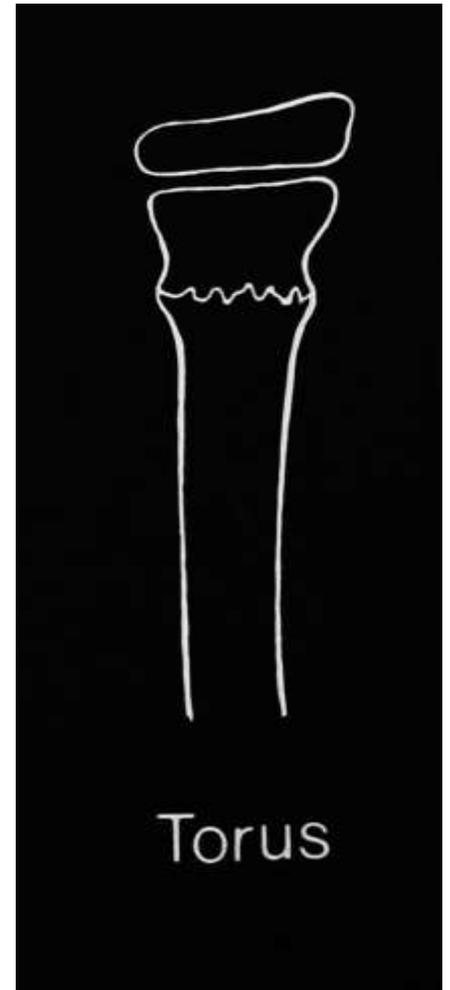
Greenstick Fractures

- Convex surface
 - Tension
 - Incomplete Fx
 - Half cortex
 - May become longitudinal
- Concave surface
 - Compression
 - Bent or bowed
 - Intact
- Midshaft
 - Radius, Ulna, Clavicle



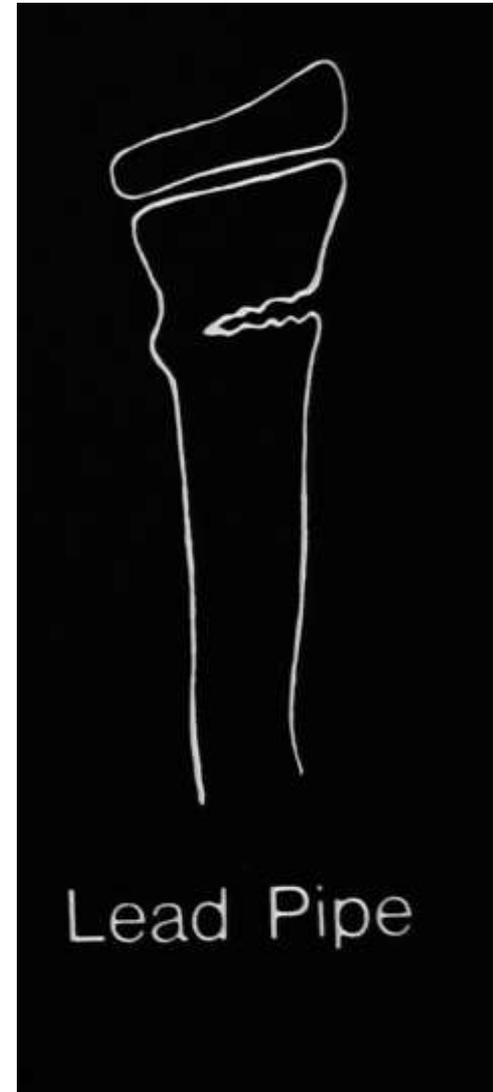
Torus Fractures

- Cortical buckle from compression
- Greek “round swelling”
- Metaphyseal
- No Fx line
- Distal
 - Radius, Ulna, Tibia



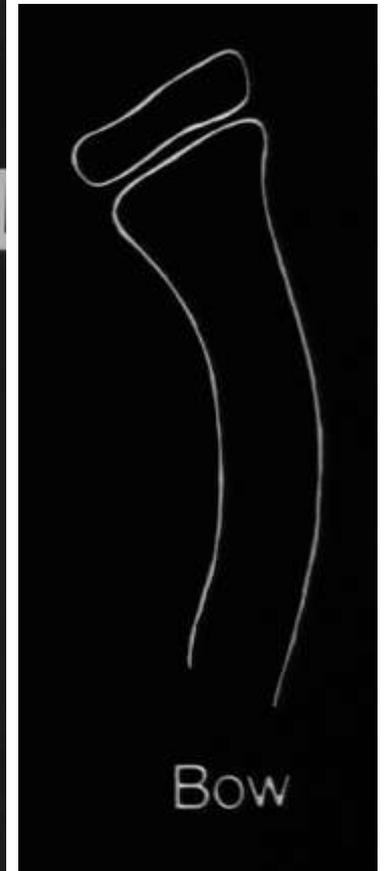
Lead Pipe Fractures

- Incomplete Fx one cortex
- Torus fracture of opposite cortex
- Uncommon
- Metaphyseal
- Distal
 - Radius, Ulna, Tibia



Bow Fractures

- Plastic bowing
- Usually entire length of bone involved
- Easily overlooked
- NM diffuse uptake
- Radius, Ulna, Fibula
- Periosteal reaction on concave surface



Toddler's Fractures

- Stumble, trip and fall. Age 1-3
- Classically distal tibia
 - Tibia 56%, older
 - Femur 30%, younger
 - Metatarsals 11%
- Spiral or oblique
- “Non” displaced – difficult to see
- Often only seen in one projection
- NM more sensitive
- NM diffuse uptake

Physeal Injuries

- Epiphyseal or Apophyseal
- 10% of fractures under 16Y
- Epiphyseal - Analogue of dislocation or ligament injury in adult
- Apophyseal – Analogue of muscle or tendon injury in adult
- Capsule and ligaments 2-5x stronger

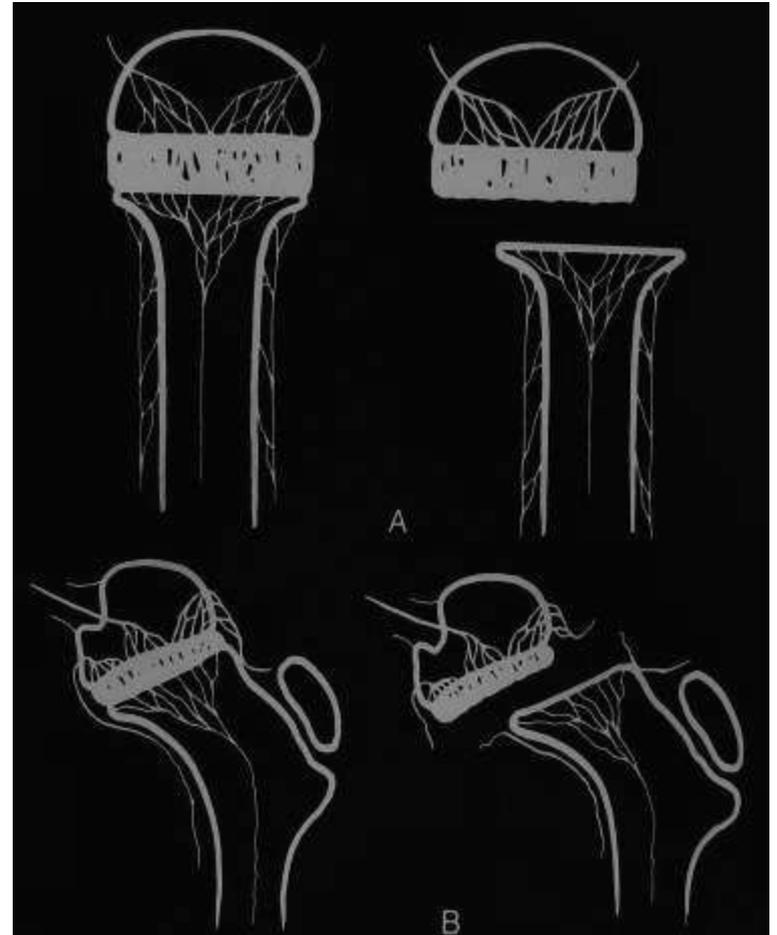
Physeal Injuries

- Growth plate has 4 zones
 - Epiphyseal side
 - 1. Resting cells
 - 2. Proliferating cells
 - 3. Vesicular or hypertrophic cells
 - 4. Provisional zone of calcification
 - Metaphyseal side
- Cells separated by collagen fibers in matrix of chondroitin sulphate, which acts as support and is sparse in zone 3
- Fx in zone 3 or junction of 3-4
- Germinal cells usually spared – if blood supply OK

Physcal Injuries

Blood supply

- A. Usual situation
 - Epiphysis and Metaphysis have separate blood supply
- B. Some joints
 - The growth plate is intraarticular (hip, proximal radius) and blood supply crosses the growth plate



Physeal Injuries

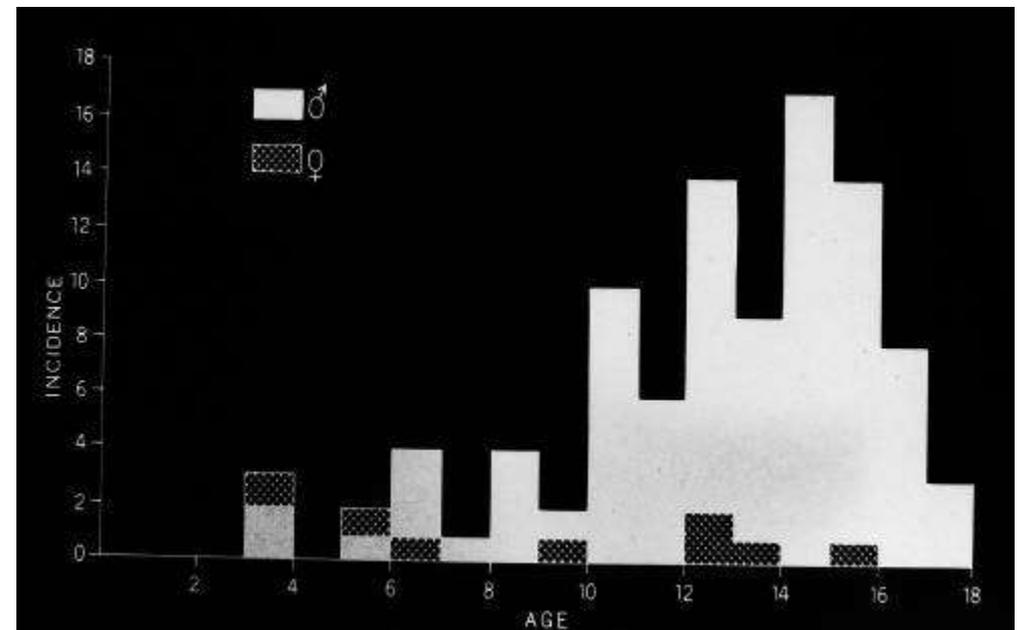
Forces

- A. Shearing or Avulsion 80%
 - Forces parallel to or away from physis
- B. Splitting or Compression 20%
 - Forces compress or split physis
 - Perpendicular to physis
 - Particularly distal humerus and tibia
 - Hinge joints
 - Produce physeal bony bridges – deformity
 - Compression destroys resting cells

Physcal Injuries

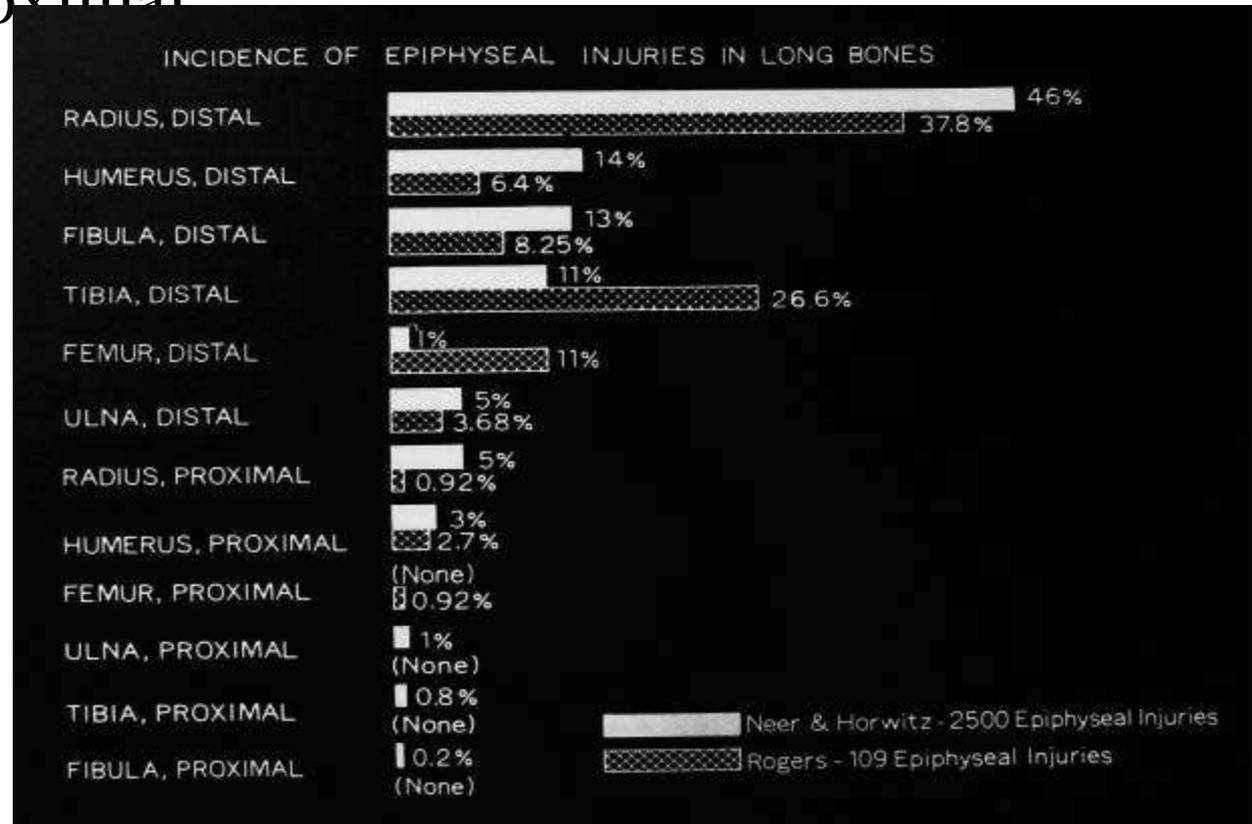
Age of incidence

- 80% between 10 and 16Y
- F younger than M
- $M > F$
- Exception distal humerus $< 10Y$



Physeal Injuries Distribution

- Distal > Proximal



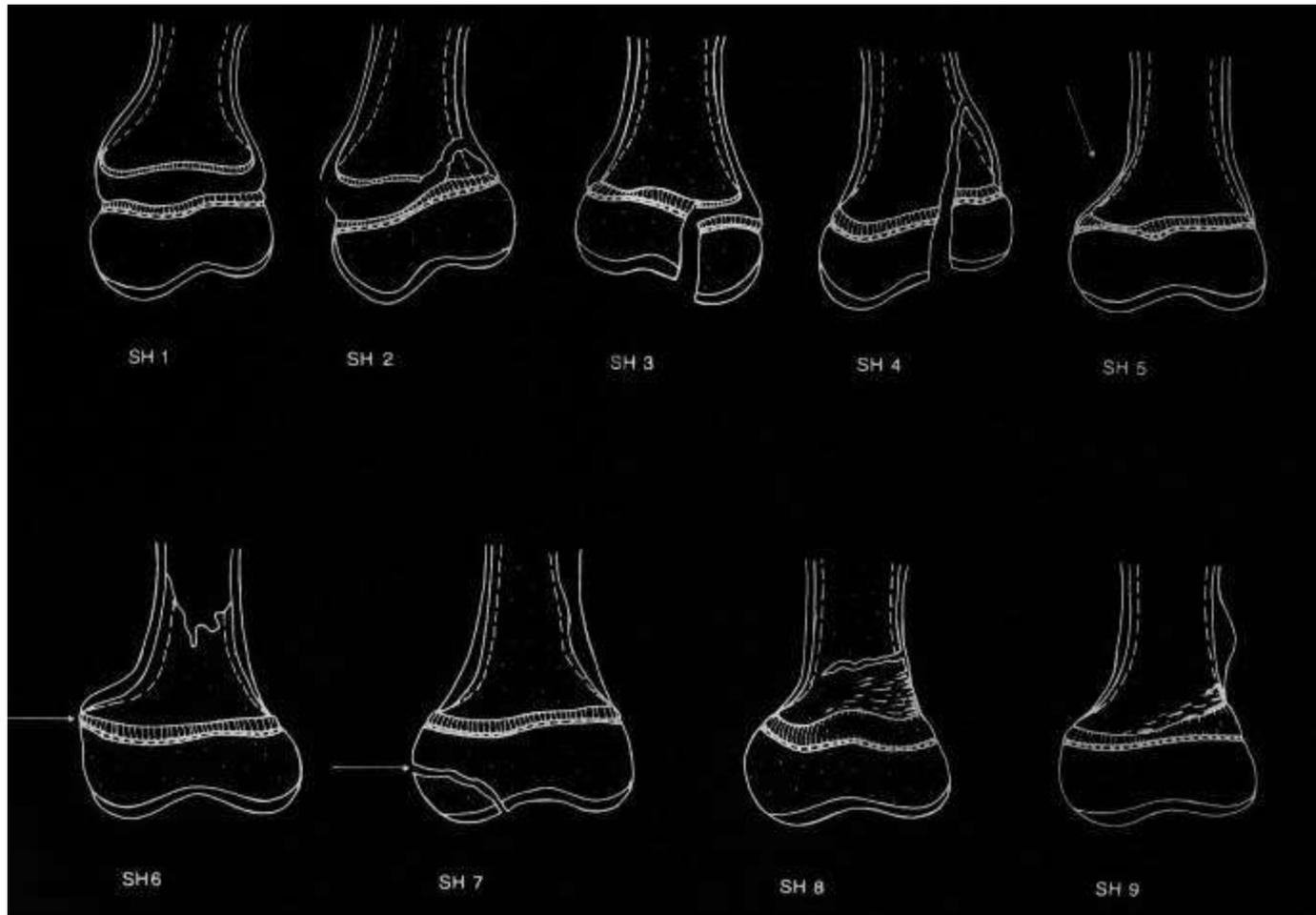
Physeal Injuries Classification

- Salter – Harris
- Prognostic significance

Type		Incidence
1		6%
2		75%
3		8%
4		10%
5		1%

Physical Injuries

- Salter – Harris, Ogden modification



Physeal Injuries

SH Type 1

- Epiphyseal separation
- Hypertrophic zone
- < 5Y or birth
- Pathologic
 - SUFE
 - Ricketts
 - Scurvy



Physeal Injuries

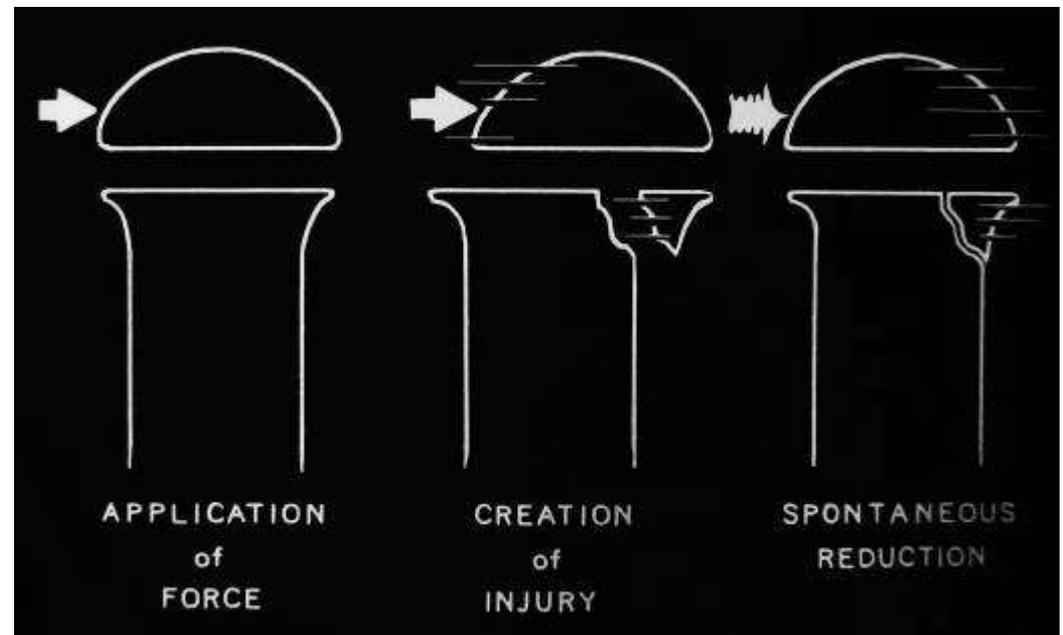
SH Type 2

- 75% of physeal injuries
- Distal radius 40% of physeal injuries
 - Distal tibia, fibula, femur and ulna
- 10-16Y
- Cleavage in hypertrophic zone
- Compression side opposite force
- Plus metaphyseal corner
- Corner sign of Thurston Holland

Physical Injuries

SH Type 2

- Thurston Holland corner sign
 - Fulcrum side
- Lamellar sign – much finer fragment
 - Side of force
- Widened physis



Physeal Injuries

SH Type 3

- Intraarticular shear
- 8%
- Minimal displacement
- Distal tibia > proximal tibia
- 10-15Y
- Needs anatomic reduction



Juvenile Tillaux Fracture

- SH3 injury in children of distal tibia, lateral side, anteriorly, with fragment held by Anterior inferior tibiofibular ligament

Physeal Injuries

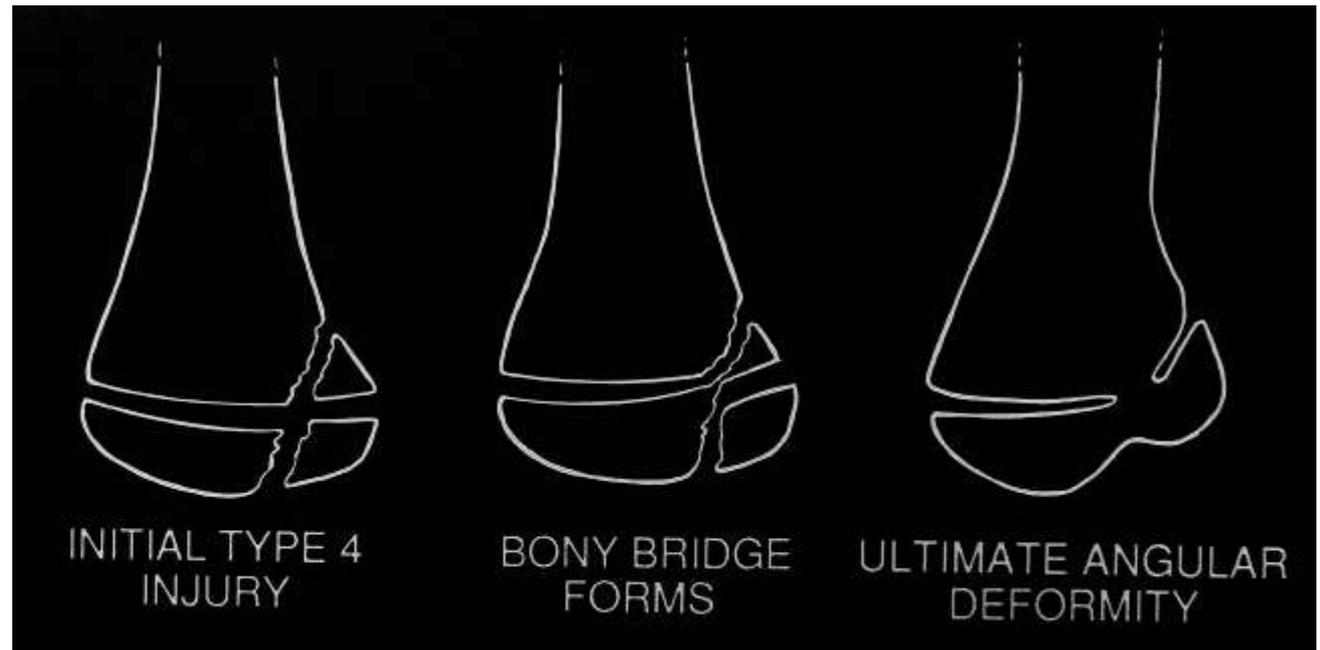
SH Type 4

- Epiphyseal and Metaphyseal Fx
- 10%
- Lateral humeral condyle <10Y
- Distal tibia >10Y
- Growth arrest and deformity possible
- Reduction important

Physeal Injuries

SH Type 4

- Salter – Harris 4 complications



Physeal Injuries

SH Type 5

- Rare 1%
- Crush injury to resting cells
- Initial radiographs normal
- Distal femur, Tibia
- Associated shaft Fxs
- 12-16Y
- Sports and MVAs
- Include joints on FU

Little Leaguer's Shoulder

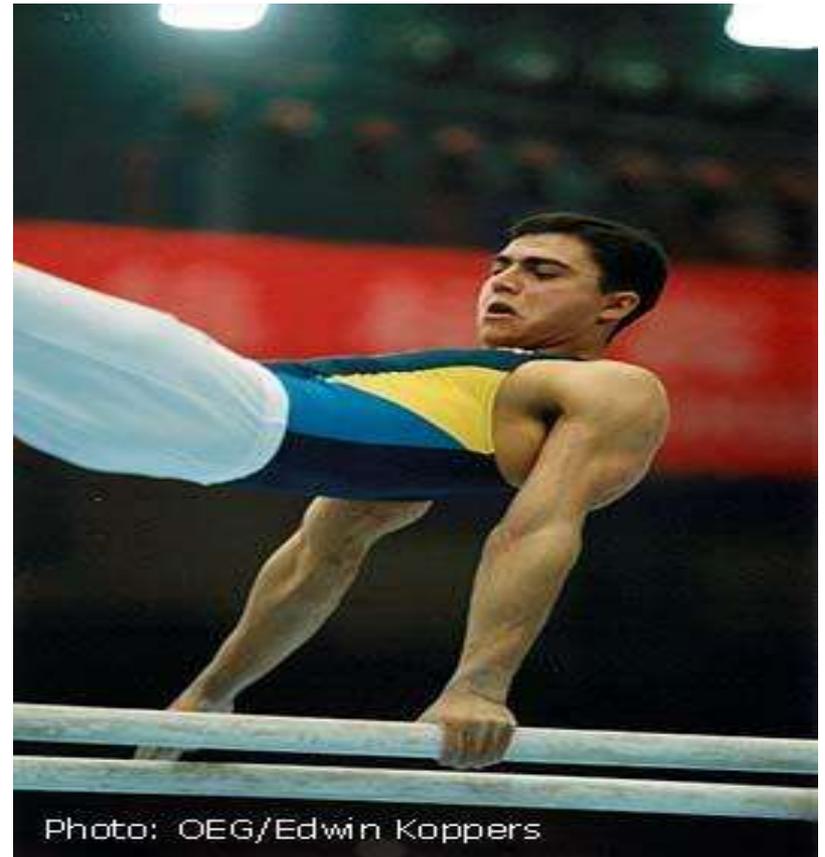
- Overuse fatigue
- Proximal humeral physis
- Salter Harris 1
- Widened and irregular physis
- Compare with contra



Physical Injuries - Stress Related

Gymnast's Wrist

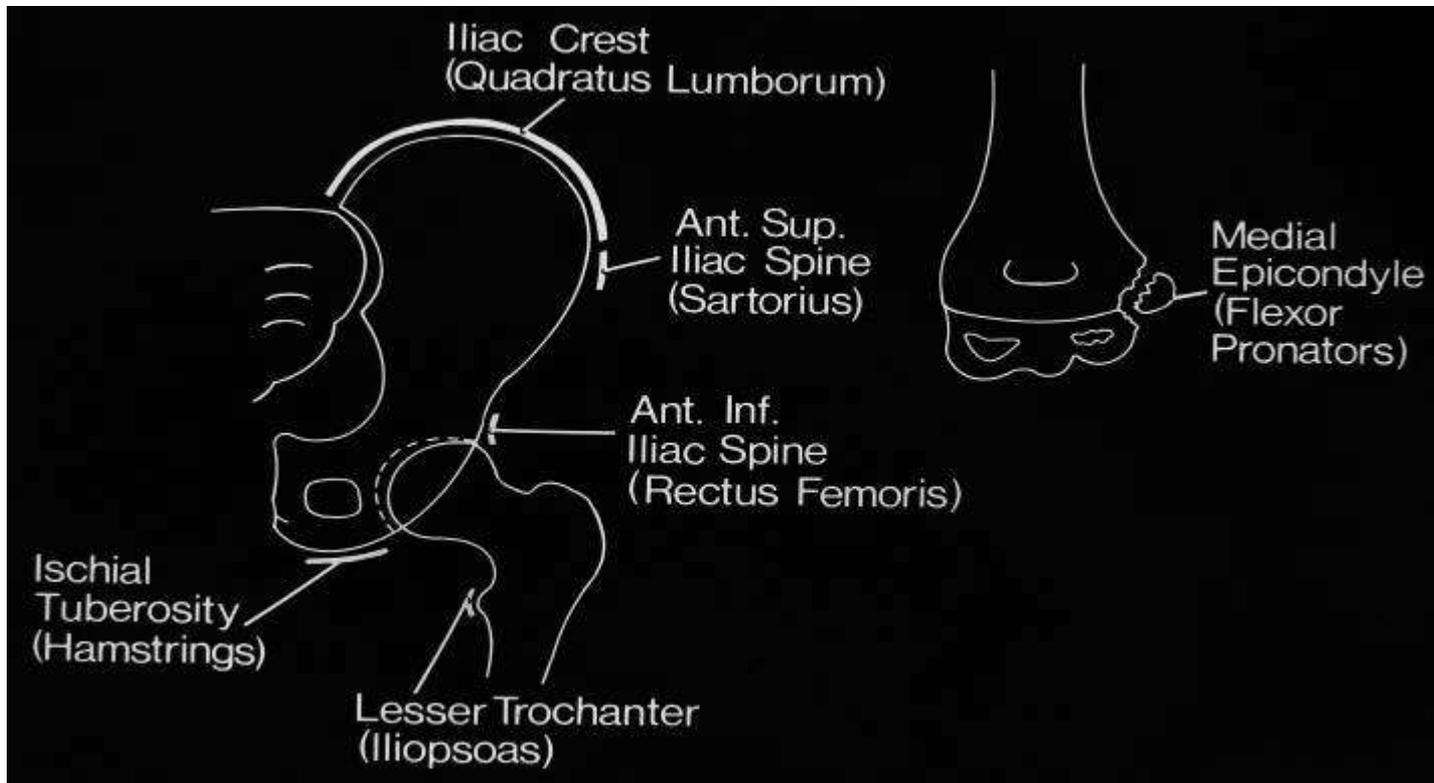
- Salter Harris 1
- Repetitive strain
- Distal radial physis



Birth Injuries

- Physeal injuries presenting as dislocations
- Proximal and distal humerus, proximal femur
- Diabetic mums, big babies
- Displaced shaft, epiphysis not visible
- All physeal separations
- Closed reduction

Apophyseal Avulsion Injuries



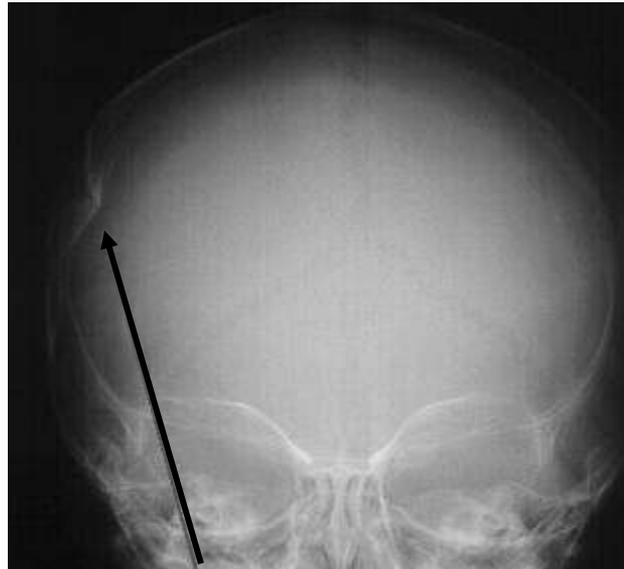
Non-accidental Injuries

- Battered child syndrome
- <6Y (<2Y) 80% of Fxs <18m
- Repeated injury
- Fractures of various ages



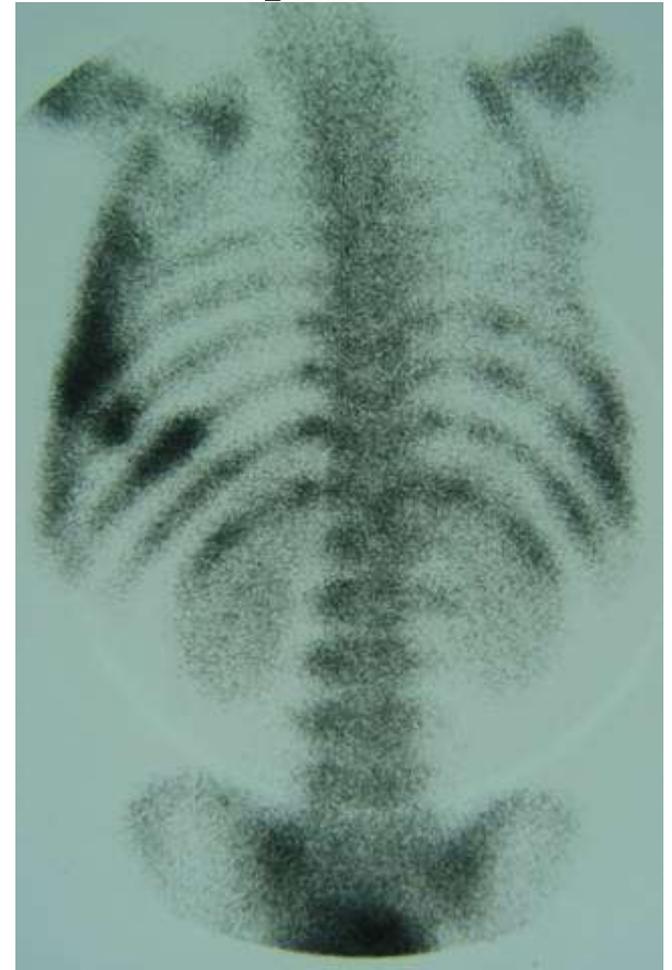
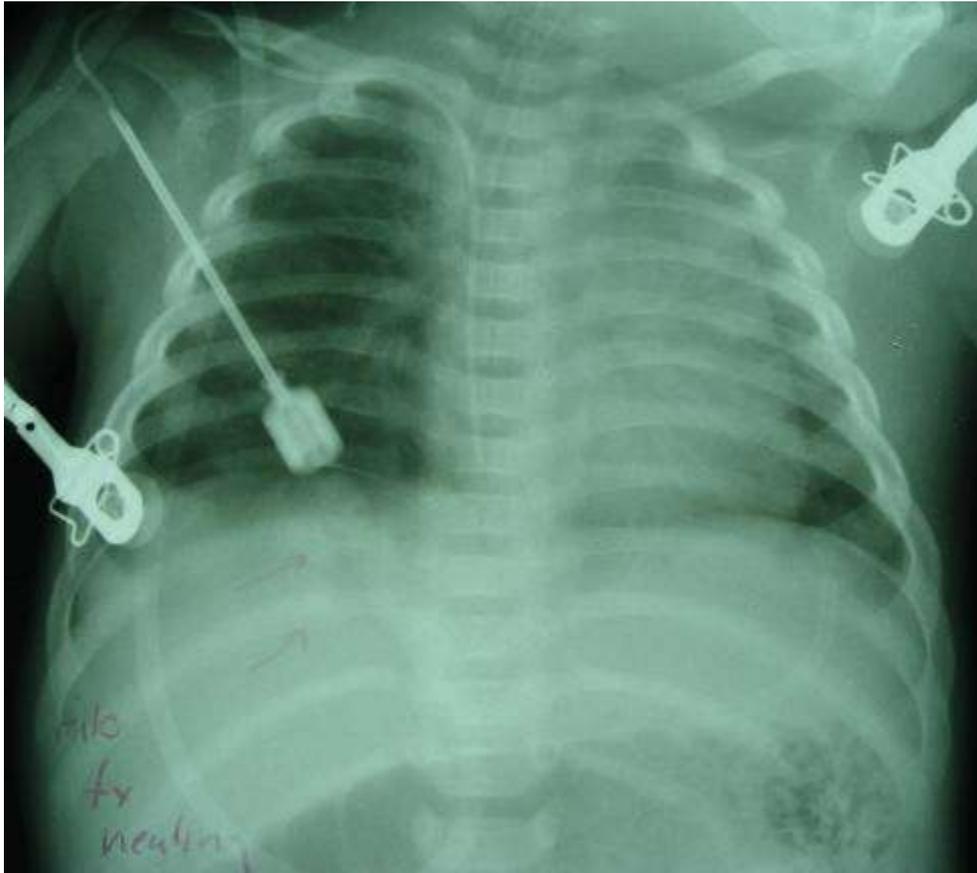
Non-accidental Injuries

- Half have only single Fx
 - Shaft of humerus, femur, tibia
- Skull Fx (complex)
- Fxs at unusual sites
 - Lateral clavicle, Ribs, Scapula, Sternum



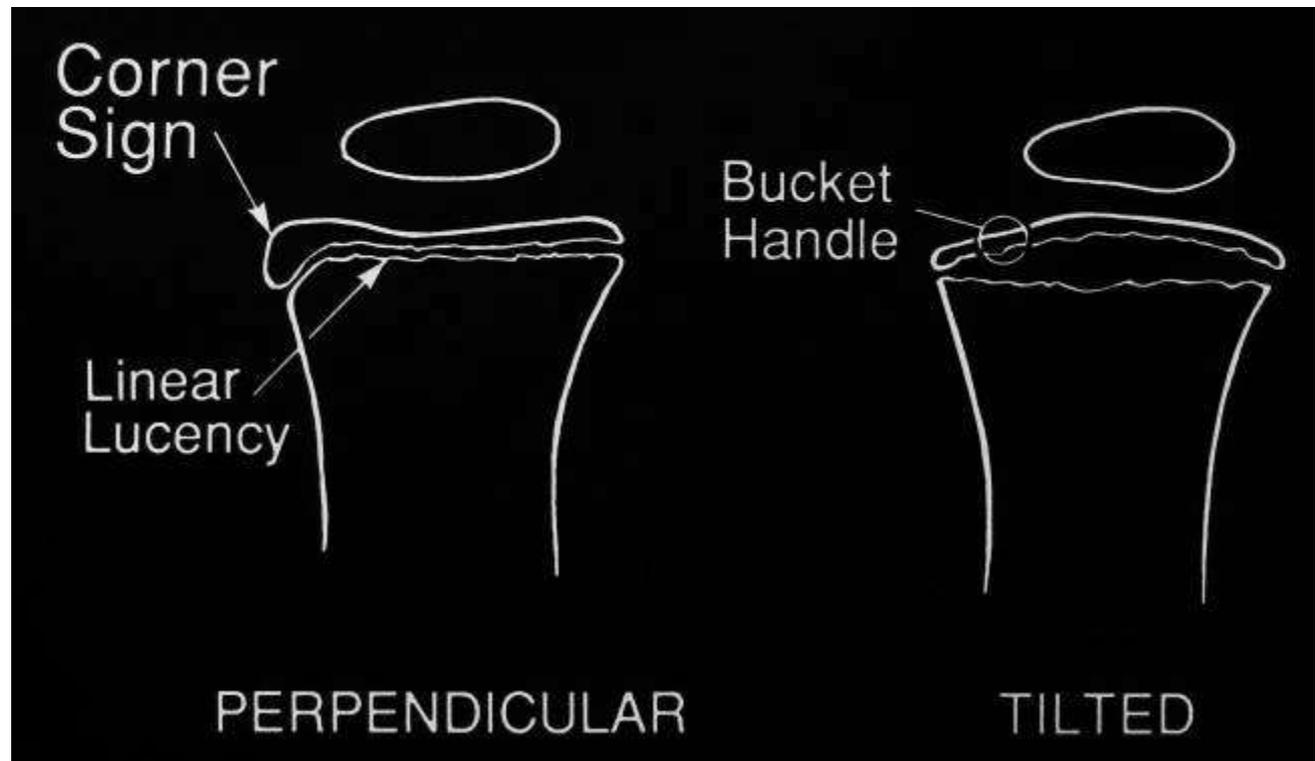
Non-accidental Injuries

- Rib Fxs common and characteristic
 - Multiple, Posteromedial, from anterior compression



Non-accidental Injuries

- Metaphyseal corner Fxs 11% of abuse Fxs
 - Bucket handle – depends on projection
 - Different plane from SH2 and younger



Non-accidental Injuries

- Metaphyseal corner Fxs 11% of abuse Fxs
 - Bucket handle – depends on projection
 - Different plane from SH2 and younger
 - Shaken by arms and legs
- Periosteum tight on metaphysis
- Periosteum loose on diaphysis



Non-accidental Injuries

- Alert clinician
- Confirm diagnosis
- Bodygram
 - Skull series
 - AP and lateral of trunk
 - AP all limbs
- NM less good because Fxs at hot physes
- DDx
 - Congenital indifference to pain
 - Myelomeningocele
 - Scurvy, OI, Cong syphilis, Caffey's