Common Pediatric Fractures

Allyson S. Howe, MD
Maj, USAF, MC
INTRODUCTION

- ANATOMY OF THE GROWING BONE
  - INJURY PATTERN OF BONE
- PHYSEAL INJURIES
- SPECIFIC SITES
  - DISTAL RADIUS
  - ELBOW
  - CLAVICLE
  - TIBIA
- CHILD ABUSE
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
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
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
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
FIGURE 2
Fracture types particular to children

Lateral view of the wrist (A) showing a greenstick fracture of the distal radius (arrow) and a torus (buckle) fracture of the ulna (arrowhead). Anteroposterior view of both legs (B) demonstrating plastic deformation of the left fibula.
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.
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 plate
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
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
COMMON FRACTURES

- Distal radius
- Elbow
- Clavicle
- Tibia
DISTAL RADIUS

- Peak injury time correlates with peak growth time
  - Bone is more porous
- Most injuries result from FOOSH
- Check sensation: median and ulnar nerve
- Nerve injury more likely to occur with significant angulation of fragment or with significant swelling
- Examine elbow (supracondylar) and wrist (scaphoid)
DISTAL RADIUS

- Torus fractures
  - Usually nondisplaced - strong periosteum
  - Subtle, may be best seen on lateral
- Greenstick fractures
  - Compression of dorsal cortex, apex volar angulation
- Complete (transverse) fractures
TORUS FRACTURES

- No reduction needed
- If > 48 hours old, ok to cast at first visit
  - Otherwise splint and cast at 5-7 days
- Short arm cast for 4 weeks
- Repeat x-rays unnecessary unless no clinical improvement after 4 weeks
- Splint an additional 2 weeks
GREENSTICK FRACTURES

- If non-displaced
  - Short arm cast
- If displaced >15 degrees, reduce and immobilize in long arm
- 4 weeks cast, 2 weeks splint
DISTAL RADIUS PHYSIS FRACTURE

- Non-displaced Salter I can appear normal on plain films
- Presence of pronator fat pad along volar distal radius on lateral film = occult fracture
- If tender over physis, treat as fracture
Salter Harris II

Figure 8
Type II fracture of the distal radius

With this type of fracture, the metaphyseal fragment (arrow) is usually located on the dorsal aspect of the radius.
DISTAL RADIUS FRACTURES

- Displaced fractures = reduce asap
- Non-displaced fractures = short arm cast for 3-6 weeks
  - The older the child, the longer immobilization
- If x-rays are normal initially but tenderness is over growth plate, immobilize for 2 weeks
  - Bring child back to re-examine and re-xray
  - If no callus, fracture is unlikely
ELBOW

- 10% of all fractures in children
- Diagnosis and management complex
  - Early recognition and referral
- Most are supracondylar fractures
  - Sequence of ossification:
    - Come Read My Tale Of Love
    - Capitellum, Radial head, Medial epicondyle, Trochlea, Olecranon, Lateral epidondyle
    - Age 1, 3, 5, 7, 9, 11
ELBOW FRACTURE
EXAMINATION

- Check neurovascular status
  - Flex and extend fingers and wrist
  - Oppose thumb and little finger
  - Palpate brachial and radial pulses
  - Capillary refill in fingers

- Immobilize elbow before radiographs to avoid further injury from sharp fragments
  - Flexion 20-30 degrees = least nerve tension
Know basic landmarks on lateral view to give clues to distinguish fracture from normal.

- **Anterior humeral line**
  - middle 1/3 capitellum

- **Radiocapitellar line**
  - points directly to capitellum

- **Disruption** = displaced fracture

- **Fat pad sign** may be only clue if non-displaced.
- Fat Pad sign (aka. Sail Sign)
  - Anterior fat pad sign can be normal
  - Posterior always abnormal
SUPRACONDYLAR FRACTURES

- Weakest part of the elbow joint where humerus flattens and flares
  - Most common fracture is extension type
  - Olecranon driven into humerus with hyperextension
- Marked pain and swelling of elbow
- Potential for vascular compromise
  - Check pulse!!! Reduce fracture if pulse compromised
  - Check nerve function in hand
SUPRACONDYLAR FRACTURE
CLASSIFICATION

- Type I- non-displaced or minimally displaced
- Type II- displaced distal fragment with intact posterior cortex
- Type III- displaced with no contact between fragments
Radiocapitellar Line
FIGURE 11

Displaced capitellum

Note the posterior displacement of the capitellum from the anterior humeral line (A). Often, this is the only clue to the presence of a supracondylar fracture. Normal position of the capitellum (B), with anterior humeral line bisecting capitellum.
A type III supracondylar fracture with no contact between fragments and posterior displacement of the distal portion.
SUPRACONDYLAR FRACTURES
MANAGEMENT

- Most are displaced and need surgery
- Type I can be managed with long arm cast, forearm neutral, elbow 90° for 4 wks
- Bivalve cast if acute
- Follow-up x-rays 3-7 days later to document alignment
- X-rays at 4 weeks to document callus
- Once callus noted at 4 weeks, discontinue cast and start active ROM
SUPRACONDYLAR FRACTURES

COMPLICATIONS

- Malunion
  - Often varus deformity at elbow with loss of full extension ("gunstock" deformity)
  - Cosmetic concerns, usually no functional deficit
LATERAL CONDYLAR FRACTURES

- Second most common elbow fracture
- Most common physeal elbow injury
- FOOSH + Varus force = lateral condyle avulsion
- Exam: focal swelling at lateral distal humerus
LATERAL CONDYLAR FRACTURES

- Most common
- Fracture line begins in distal humeral metaphysis and extends just medial to capitellar physis into the joint
- Neurovascular injury rarely

![Lateral Condylar Fracture Image](image-url)

**FIGURE 13**

Nondisplaced lateral condylar fracture

In the most common pattern of a lateral condylar fracture, the fracture line begins in the distal humeral metaphysis and extends just medial to the capitellar physis into the joint.
LATERAL CONDYLAR FRACTURES
MANAGEMENT

- Intraarticular = open reduction
- If non-displaced, can treat with casting
- Posterior splint acutely, elbow 90°
- At follow-up (weekly), check for late displacement
- If stable x 2 weeks, long arm cast for another 4-6 weeks
- Complications: growth arrest, non-union
CLAVICLE

- Most occur in the _____ third of the bone
CLAVICLE

- Most occur in the **middle** third of the bone
  - 80%
- 15% distal third, 5% proximal third
- **FOOSH**, fall on shoulder, direct trauma
- **Clinical**: pain with any shoulder movement, holds arm to chest
- Point tender over fracture, subQ crepitus
- Often obvious deformity
CLAVICULAR FRACTURE

- AP view often sufficient to diagnose if midshaft
- Consider 45° cephalic tilt view if needed
CLAVICULAR FRACTURE

- In displaced fracture: sternocleidomastoid pulls upward to displace medial clavicle, lateral fragment pulled downward by weight of arm.
CLAVICULAR FRACTURE
MANAGEMENT

- Sling versus figure-of-eight bandage
- Fracture fully healed when pt has painless ROM at shoulder and non tender to palpation at fracture
- Generally back to full activity by 4 weeks
- Protect from contact sports x 6 weeks
- Warn of the healed ‘bulge’
TIBIA

- Tibia and fibula fractures often occur together
  - If you see a tibial fracture, hunt for a fibular one
  - Fibular fracture could be plastic deformity
- Mechanism: falls and twisting injury of the foot
  - Low force, intact periosteum and support from fibula prevent displacement commonly
TIBIAL FRACTURE

- When to refer:
  - Displaced fracture
  - Tib/fib fractures
  - Fractures with > 15° varus angulation
TIBIAL FRACTURE
MANAGEMENT

- Posterior lower leg splint if acute
- Non-displaced fractures: long leg cast for 6-8 weeks
- Repeat radiographs weekly to check position
- Refer if angulates more than 15°
TODDLER’S FRACTURES

- Children younger than 2 years old learning to walk
- No specific injury notable most of the time
- Child refuses to bear weight on leg
  - Examine hip, thigh and knee to rule out other causes of limping
TODDLER’S FRACTURES

- If you suspect it, get AP and lateral views of entire tib/fib area
- Typical: nondisplaced spiral fracture of tibia with no fibular fracture
- Initial x-ray often normal, diagnosis on f/u films with lucent line or periosteal reaction
TODDLER’S FRACTURES

- Consider and rule out abuse when needed
- Examine for soft tissue injury to buttocks, back of legs, head, neck
- Transverse fractures of mid-shaft are more suspicious for child abuse
- Management: long leg cast x 3-4 weeks
- Weight bearing as tolerated
- Heals completely in 6-8 weeks
FRACTURES OF ABUSE

- Majority of fractures in child < 1 year are from abuse
  - High percentage of fractures <3yo = abuse
- Greater risk of abuse: first-born, premature infants, stepchildren, children with learning or physical disabilities
- Most common sites: femur, humerus, tibia
- Also: radius, skull, spine, ribs, ulna, fibula
Child Abuse Concerns

- Unexplained fractures in different stages of healing as shown on radiology
- Femoral fracture in child < 1 year
- Scapular fracture in child without a clear history of violent trauma
- Epiphyseal and metaphyseal fractures of the long bones
- Corner or “chip” fractures of the metaphyses
CHILD ABUSE

- If suspected, skeletal survey should be considered
- Bone scan may be useful as complementary study
CONCLUSIONS

- Nearly 20% of children with injury have a fracture
- Always take post-reduction x-rays
- Physeal injuries are common and may have no radiographic findings
  - Treat as fracture!!
- Don’t forget to tell Mom and Dad about possible growth problems