Pediatric Orthopedic Emergencies

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1) Structural & Physiologic Differences between kids and adults

A. Thick periosteum, physiologically active, lots callous formation
B. Growth plate (physes)
C. More porous thus more pliable >> less strength >> increase fractures
D. Ligaments stronger than physes thus sprains less common
E. Remodeling possible > @ the metaphysis: amount remodeling decrease with age as well as further the fx is from the epiphysis

2) Important Concepts:

a) In pre-adolescents, ligaments are stronger than the physes, thus sprains are less common

b) Point tenderness over a joint in a pre-adolescent is a Salter 1 fx until proven otherwise regardless of Xray findings: when in doubt splint

c) As a general rule, patients treated with a splint need Ortho followup in 1 week

d) Treatment for most Orthopedic injuries includes RICE: rest, ice, compression, and elevation. Also a good anti-inflammatory such as ibuprofen

3) History & Physical, Radiographs

A. Mechanism
B. Pulses, perfusion, sensation, strength, deformity (open vs. closed)
C. Signs of abuse
D. Radiographs: 2 views minimum (AP & lat.), ? comparison view, joint above and below, subtle signs (fat pad, soft tissue swelling)

3) Fractures Unique to kids

A. Physeal: Salter I-V  Potential for growth arrest > with each class
   I. Separation of epiphysis & metaphysis
   II. separation Above growth plate involving metaphysis
   III. separation Lower than growth plate involving epihysis
   IV. injury Through the metaphysis, plate, and epiphysis
   V. Compression injury
B. Torus/Buckle - usually metaphysis, secondary to compression
C. Greenstick - cortex intact on one side, diaphysis/metaphysis junction
D. Bowing - force short of causing a fracture (fx), little remodeling
E. Avulsion - most common hip and tibial tubercles, conservative management
4) Fracture Description

A. Fracture pattern: spiral (secondary to twisting)  
   oblique (secondary to bending)  
   transverse (secondary to direct blow)  

Displacement - bone movement from usual position (describe in distance ie.  
mm or cm and direction ie. laterally)

A. Angulation - angle the proximal and distal ends of a bone are malaligned  
B. Communition - crushed  
C. Consultation: open fx, neurovascular compromise, unacceptable displacement  
or angulation (usually 10 degrees midshaft, 15-20 degrees @  
distal metaphysis), Salter III - V, joint space involvement

Upper Extremity Fractures

A. Clavicular Fractures  
   1. Most common childhood fracture, midshaft 80%  
   2. Mechanism: fall on outstretched hand  
   3. Symptoms: point tenderness, decreased mobility, neurovascular compromise  
rare  
   4. Orthopedic referral: displaced medial shaft fx otherwise can accept large  
degree of displacement  
   5. Treatment: figure 8 or sling & swathe, ibuprofen  
   6. Disposition: f/u 2-3 weeks

B. Humerus Fractures  

1. Proximal: 80% of growth here, more common in adolescent, nonunion unlikely  
   - allow up to 50-70 degrees angulation prior to adolescence  
   - consult Ortho for angulation over 50 degrees, neurovascular compromise  
   - treat with sling & swathe  

2. Shaft: less common, spiral fx less than 3 years of age consider abuse  
   - r/o radial nerve injury, may see humeral vascular groove distally  
   - consult if > 15-20 degrees angulation prior to adolescence or if  
   > 10 degrees as an adolescent  
   - treatment: sling & swathe

C. The Elbow  

1. Multiple growth (ossification) centers  
   A. capitellum 1 year  
   B. radial head 3-5 years  
   C. medial epicondyle 4-6 years  
   D. trochlea 6-8 years  
   E. olecranon 8-10 years  
   F. lateral epicondyle 10-12 years  

2. Radiographs: 1) posterior fat pad or anteriorly displaced anterior pad abnormal  
   2) anterior humeral line (nl through middle 1/3 of capitellum)  
   3) radial head lines up with capitellum o/w consider dislocation
3. Types of Elbow Fractures

i. Supracondylar - fall on outstretched arm with hyperextension
   - posterior angulation or displacement of distal fragment
   - complications: neurovascular, compartment syndrome
   - treatment: immobilize in deformed position, refer all

ii. Lateral Condylar Fracture - fall on extended arm with varus stress
    - usually a Salter Harris IV (unstable)
    - consult Ortho for all

iii. Medial Epicondylar Fracture - fall on extended arm with valgus stress
    - consult Ortho

iv. Olecranon - infrequently fx alone, check fat pads because can be very subtle
    - treatment with splint ie. sugartong or posterior elbow (partial extension)

D. The Forearm

1. Radial head/neck - involvement of head rare, pain may be referred to the wrist
   - complications common, Ortho consult

2. Nursemaid’s elbow - radial head subluxation due to annular ligament detachment
   - mechanism: usually arm pulled upward by parent
   - signs/symptoms: arm held to the side and flexed, pain on pronation/supination
   - if history and/or physical not consistent then order an Xray
   - treatment: manual reduction by supination & flexion

3. Radius & Ulna - ¾ of fractures distal, rare to see isolated ulna fracture
   - very common, mechanism: fall on outstretched hand
   - neurovascular compromise rare, remodels well
   - Orthopedic consult: angulation >10 degrees midshaft and >15 degrees distal
   - treatment: sugartong or volar splint

E. The Wrist

A. Carpals - rare fracture, adolescent with Navicular fx:
   1. fall hyperextended wrist
   2. snuffbox tenderness
   3. treat with thumb spica

B. Metacarpals
   Boxer’s Fracture - distal 5th metacarpal, reduce if angulation > 30 degrees otherwise ulna gutter

C. Phalanges: 1) fingertip injuries with bone exposed = Ortho consult
   2) distal tip fractures without exposure = anatomic closure & buddy tape or finger splint for immobilization
Game Keeper’s Thumb - avulsion of ulna collateral ligament of the proximal phalanx of the thumb
1) mechanism: hyperextension of the thumb
2) signs: pain in 1st web space and extraction of the thumb
3) treatment: open reduction

G. Hip & Pelvis
A. Slipped capital femoral epiphysis (SCFE)
   : hip or knee pain, limitation of internal rotation, abduction on exam
   : AP & frog leg view: widening of epiphysis & femoral neck “bump”
   : prompt pinning required (immediate Ortho consult)

B. Avulsions - active contractions of muscle on secondary ossification centers during sporting activities, symptomatic treatment
   - crutches 4-6 weeks

C. Pelvic ring fx., acetabular fx. and hip dislocation rare (major trauma)

H. Femur
a. Legg Calve Perthes - avascular necrosis of the femoral head
   - may present as trauma, > males, age 4 - 8 yo., 20% w/ knee pain
   - signs: insidious onset, antalgic gait
   - Xray: widened joint space, small femoral head
   - treatment: traction

a. Neck & shaft fractures - trauma or abuse, usually an Ortho consult

I. Knee
   - Fractures uncommon, but more common than ligamentous injuries
   - med. collateral and ant. cruciate most common of ligamentous injuries
   - avulsion of ant. tibial spine equivalent to ant. cruciate injury

Hx: rotation = meniscal injury
    change in direction = ligament
    sudden stop = ant.cruciate
    pop or snap = ant. cruciate, fx         2 pops = patellar dislocation & relocation
    knee give out = ant. cruciate, hypermobile knee cap
    locked knee = meniscus tear, loose body
    symptoms: sudden bleeding = ant. cruciate
    several hour delay = meniscus tear   12 - 24hrs = reactive synovial

Physical Exam: see attachment

a. Ligamentous injuries
   : if suspected place in knee immobilizer & arrange Ortho. followup
   : if large hemarthrosis present consider arthrocentesis
   : see attachment for classification of knee sprains
b. Patellar fractures / dislocation - fractures rare
   - fracture tx conservative unless displaced > 3-4mm (Ortho consult)
   - dislocation reduced by extending the knee with a medial and upward force on the lateral patella, 4 weeks immobilization

J. Tibia & Fibula

1) Osgood-Schlatter Disease
   - 12-17 yrs., males more common
   - avulsion fracture of *tibial tuberosity*
   - pain due to repetitive microfractures, point tenderness over the tubercle
   - management: displaced fractures consult Ortho., otherwise rest, ibuprofen, avoid knee extension

2) proximal tibial metaphyseal fx - compartment syndrome, Ortho consult
3) tibial & fibula shaft fractures - most common fractures of the lower extremity
   - minor fx treat with a posterior splint

   Toddler fracture - oblique nondisplaced fx, distal tibia, 9 - 36 months
   - minor fall, may see very subtle findings
   - order oblique film in addition to AP & lateral
   - generally immobilize with splint

K. Ankle

- ligamentous injury more common in adolescents
- inversion injuries (85%) - lateral ligaments affected (see attachment)
- Xray if Grade II - III strain (inversion injuries r/o salter fx of the distal fibula), skeletally immature patients, eversion injuries(high incidence of associated fractures)

Grade I strain: ligaments streched - mild pain w/ stress, tx with RICE, ace wrap for several days until symptoms abate
Grade II strain: partial tear - swelling, pain, ambulation poor, tx with RICE, immobilize with either posterior leg or sugartong splint or both and followup with Ortho in 1 week
Grade III strain: complete tear, loss of stability - immobilize as above and f/u

L. Metatarsals / Phalangeal fractures - common

   Jones fx - shaft of the 5th metatarsal due to extreme inversion
   - high incidence of non-union, Ortho consult

Splinting Pointers
1. Use appropriate size / shape
2. Pad all bony prominences especially the elbow, ankle and heels
3. Avoid circumferential splints
4. Wrap splint somewhat loosely
5. Splint in position of function: wrist neutral like holding a can for sugartongs MCP 60-90 degrees, IP 10-20, thumb abducted

See attachment for indications and diagrams