Pediatric Hand Injuries and How to Treat Them

Ben Rogozinski, MD
Hand and Upper Extremity
Knoxville Orthopaedic Clinic
History and Physical Examination of the Hand
Current Complaint: Ask About--

- Onset of the condition: timing and mechanism
- Pain
- Numbness
- Tingling (paresthesias)
- Weakness
- Discoloration
- Coldness
Physical Examination: 8

Parts

- Inspection
- Palpation
- Range of motion
- Stability
- Muscle and Tendon Function
- Nerve Assessment
- Vascular Assessment
- Integument Assessment
Inspection: Look For--

- Discoloration
- Deformity
- Swelling
- Wounds
- Also: compare to normal hand
Malrotation of ring finger due to proximal phalanx fracture. Note that malrotation is most obvious when fingers are flexed and viewed end-on.
Note the location of this wound—associated with laceration of both the sublimus and profundus flexor tendons. The normal flexor tone is absent in the long finger.
Pediatric Hand Fractures
Epidemiology

- Hand injuries are common in children
- Fractures account for ~15-20% of acute hand injuries presenting to pediatric emergency departments
- <2 years old: fingertip injuries
- 12-16 years old: sports-related fractures
Epidemiology

• Fracture patterns
  – 65% extra-physeal
  – 55% non-displaced
  – 95% closed

• >90% of hand fractures may be effectively managed non-operatively

• Most do well
Epidemiology

• Small percentage of fractures → large percentage of complications and poor functional outcomes

• Risks for fracture malunion, poor results
  – Failure to obtain adequate radiographs
  – False assumptions about bony remodeling

• Key is identification of problematic injuries and timely treatment
Unique Considerations

• Challenges in physical examination
• Small size of musculoskeletal structures
• Imaging of epiphyseal injury can be difficult
• Need for more restrictive immobilization
• Characteristic patterns of injury not seen in adults
Anatomic Considerations in Kids

• Physis
  – Growth plate injuries

• Ligaments more resistant to injury than physeal regions → pure ligamentous disruptions relatively uncommon
Examination Techniques

- Anxiety, pain, and limited ability to communicate or cooperate limits the examination

- Adequate analgesia is critical

- Careful observation for deformity and swelling is informative
Examination Techniques

• Utilize active finger flexion when possible to assess for rotational deformity
Distal Phalanx Fracture

- Finger tip injury
- Radiographs often demonstrate growth plate fracture/separation in children
- In cases of displacement or joint instability, may require operative fixation
Seymour’s Fracture

- Characteristic crush injury of childhood
- Physeal fracture of distal phalanx with nailbed laceration → open fracture with growth plate injury
- Often with incarceration of the germinal matrix in the fracture
- Requires high index of suspicion for accurate diagnosis
Seymour’s Fracture

- Radiographs demonstrate displaced transverse physeal or juxta-physeal fracture
- Treatment: nail plate removal, irrigation and debridement of fracture site, fracture reduction, nailbed repair
- Closed reduction alone often unsuccessful

Courtesy of Philip E. Blazar, MD/Donald S. Bae, MD
Phalangeal Neck Fracture

• Characteristic childhood injury
• Mechanism: “door jamb injury”
  – Initial crush
  – Rotation, displacement as hand withdrawn
• Clinical presentation
  – Middle > proximal phalanx
  – Border digits most commonly affected
Phalangeal Neck Fracture

- Radiographs
  - Key to diagnosis is true lateral x-ray
  - Often innocuous with only small fleck or “cap” of displaced bone

Courtesy of Philip E. Blazar, MD/Donald S. Bae, MD
Phalangeal Neck Fracture

• Acute treatment
  – Displaced injuries have little remodeling potential
  – Surgical indications:
    • Irreducible fractures
    • Unstable fractures
    • Displaced fractures
  – Treatment options:
    • Closed reduction
    • Percutaneous pin fixation
    • Open reduction with internal fixation

• Fracture malunions may require reconstruction for angular or rotatory deformity

Courtesy of Philip E. Blazar, MD/Donald S. Bae, MD
Intercondylar Phalangeal Fracture

- Intra-articular fractures, involve the joint
- Often angular and/or rotational deformity due to fracture displacement
Intercondylar Phalangeal Fracture

• Radiographs
  – Phalangeal condyles may be incompletely ossified
  – Significant osteochondral fragments may appear as small innocuous “flakes” of bone

• Treatment options:
  – Closed reduction
  – Percutaneous pin fixation
  – Open reduction with internal fixation

Courtesy of Philip E. Blazar, MD/Donald S. Bae, MD
Physeal Phalangeal Fracture

- More common than diaphyseal fractures
- Salter-Harris II fracture pattern is most common
- May have angular or rotational deformity
  - e.g. “extra-octave”

Salter-Harris II fracture of small finger proximal phalanx

Courtesy of Philip E. Blazar, MD/Donald S. Bae, MD
Physeal Phalangeal Fracture

• AP, lateral, oblique radiographs confirm diagnosis

• Treatment
  – Closed reduction with corrective force applied with the MCP joint in flexion
  – Immobilization incorporating adjacent digit
Metacarpal Neck Fractures

• Common, particularly in adolescents
  – Boxer’s Fracture

• Due to axial load imparted to flexed MCP joint

• Present with pain, swelling, deformity

• Radiographs confirm diagnosis

• Most amenable to closed reduction and immobilization but rotational malalignment may require operative treatment
Salter-Harris III Fractures of Thumb Proximal Phalanx

- Pediatric equivalent of adult “skier’s thumb”
- Avulsion fracture of ulnar collateral ligament due to radial deviation of MCP joint
- Present with pain, swelling, ecchymosis, deformity, and MCP joint instability
Salter-Harris III Fractures of Thumb Proximal Phalanx

- Radiographs demonstrate fracture displacement, articular incongruity
- Treatment
  - Open reduction and pin fixation
  - Must restore articular congruity and joint stability

Courtesy of Philip E. Blazar, MD/Donald S. Bae, MD
Summary

• The anatomy of the pediatric hand is associated with fractures that are unique
  – Bone rather than ligament injuries
  – Growth Plate injuries
Pediatric Fractures of the Distal Radius
Epidemiology

- Distal radius fractures are common in children
- Constitute ~30-50% of all pediatric fractures
- Reported annual incidence of up to 10.4 per 1000 children
- Most common in females 11-13 years and males 12-15 years old
Epidemiology

- Historically, almost all fractures have been treated with closed reduction and immobilization.

Courtesy of Philip E. Blazar, MD/Donald S. Bae, MD
Unique Considerations

- Pediatric fractures have significant capacity for remodeling.
- The younger the child, the greater the capacity for remodeling.
- Rotational deformities do not remodel significantly.
- Growth disturbance is uncommon after a physeal fracture.
- Fracture stability is enhanced because of a thick periosteum.
Fracture Remodeling

• In particular, distal radius fractures have a high remodeling potential due to:
  – Proximity to distal radial physis
  – Large contribution of distal physis to longitudinal growth of the radius

• Significant residual fracture displacement and angulation may correct with continued growth
Growth Disturbance

- Occurs in ~3-4% of physeal fractures
- Subsequent progressive deformity may lead to:
  - Abnormal wrist mechanics
  - Pain
  - Stiffness
  - Ulnocarpal impaction
  - TFCC tears
  - DRUJ instability

Courtesy of Philip E. Blazar, MD/Donald S. Bae, MD
Distal Radius Fractures

• Distal metaphyseal fractures
  – “buckle” or torus fractures
  – Bicortical fractures
• Distal physeal fractures
Torus Fractures

- Compression, “buckle,” or “torus” fractures of the distal metaphysis are stable injuries
- Recommended treatment: below-elbow cast or removable splint immobilization for 3 to 4 weeks
Bicortical Metaphyseal Fractures

• Method of reduction:
  – Adequate anesthesia
  – Fluoroscopy/radiographs
  – Reduction maneuver:
    • Recreate the deformity
    • Longitudinal traction
    • Reposition the fracture fragments
    • Cast immobilization with a 3-point mold to preserve reduction
Bicortical Metaphyseal Fractures

• Closed reduction followed by casting:
  – Above-elbow cast x 3-4 weeks, then
  – Below-elbow cast until healing

• Loss of reduction may occur:
  – Reported incidence 10-91%
  – Remanipulation or percutaneous pin fixation may be needed when alignment is unacceptable
Distal Radius Physeal Fractures

• Salter-Harris type II fractures most common

• Mechanism commonly fall onto outstretched upper extremity

• Present with pain, swelling, deformity

• Radiographs confirm diagnosis and guide treatment
Distal Radius Physeal Fractures

• Non-displaced fractures
  – Treated with cast immobilization x 3-6 weeks

• Displaced Salter-Harris I and II fractures
  – Treated with closed reduction and cast immobilization
Distal Radius Physeal Fractures

• Displaced fractures
  – Gentle reduction maneuvers with adequate anesthesia
  – Multiple reduction attempts should be avoided
  – Late reduction attempts may be associated with physeal injury
Normal Anatomy/Physiology

• Nail Function
  – Contributes to stability of fingertip
  – Provides firm durable edge for manipulation
  – Limited ability to tear and cut objects
Nail Bed and Fingertip Injuries

• Very common-presenting complaint
  – 6 million ER visits
  – 12 million Office visits

• Demographics
  – Ages
    • < 1 year
    • Until death
  – Setting
    • Home
    • Industrial
    • Recreational

Courtesy of Craig S. Williams, MD
Nail Bed and Fingertip Injuries

• Characteristics/ considerations
  – Patient - age, occupation, needs, co-morbidity
  – Type of injury
    • Sharp - regular/ irregular
    • Crush
    • Avulsion
    • Combination
  – Soft tissue loss
Nail bed laceration

- Repair
  - Clean and replace nail plate
- Horizontal suture prox.
- Simple suture distally
- Prevents synechiae
- Helps shape contour
- Acts as splint for any underlying fractures

Courtesy of Craig S. Williams, MD
• **Repair**
  - Place substitute
  - beneath fold if nail unavailable
  - Dressing - Adaptic or Xeroform
  - Foil from suture pack
  - Silicone sheet
Paronychia

- Painful nailfold infection
- One of the most common hand infections
Paronychia

• For established abscess:
  – Irrigation and debridement
  – Update tetanus immunization
  – Begin oral antibiotics
  – Begin intensive local wound care
Paronychia

- More severe infections may “run around” the entire nail and require nail removal and more aggressive debridement.

Remove the entire nail to drain this abscess.
Felon

- Painful bacterial infection of the digital pulp
- Common hand infection
- Painful, swollen digital pulp
Felon: Treatment

• Irrigation and Debridement
• To ensure complete drainage of the abscess, use a curved hemostat to break up the septae in the tuft
• Begin oral antibiotics
• Begin intensive local care and occupational therapy
Pyogenic Flexor Tenosynovitis

Kanavel's four cardinal signs of flexor tendon sheath infection:
1. Slight flexion
2. Swelling
3. Tenderness over flexor tendon sheath
4. Pain on passive extension
Pyogenic Flexor Tenosynovitis

- Surgical Treatment
Herpetic Whitlow: History

- Small children (who have their fingers in their mouths)
Herpetic Whitlow: Physical Examination

- Painful vesicles filled with clear fluid
- Surrounding erythema
Herpetic Whitlow: Treatment

• Local care of the finger
• Evaluate for super-infection with bacterial organisms
• Usually resolves in 2-3 weeks
• Oral Acyclovir may shorten the duration of illness
Bite Injuries
Goals

• To review common “bite” injuries and their treatment

• Specifically review:
  – Human bites
  – Bee stings
  – Snake bites
  – Spider bites
  – Cat and dog bites
Human Bites: “Fight Bites”

• Usually occur:
  – Dorsum of the hand
  – Ring and little fingers metacarpal head

• Often an accurate history may not be given
Don’t Miss an Intra-articular Injury

- Injury occurs with the fingers in flexion
- Examination and exploration usually done with the fingers in extension
- Carefully explore the wound with the fingers both flexed and extended to evaluate for possible joint penetration

Courtesy of John G. Seiler, MD
Intra-articular Injuries

• If it is uncertain whether or not the joint has been violated, it is generally safer to presume that it has
Human Bites

• Can cause severe infections
• Delayed presentation not uncommon
Treatment: General

- Cleanse all wounds thoroughly
- Leave wounds open
- Follow the wounds closely
- Have patients return promptly if they develop signs or symptoms of progressive infection
- Often need surgical debridement
Dog Bites

• More common in children than adults
  – Arm and hand most commonly affected
  – For children (0-4 years): head and neck is the most common site of bite
Patient Assessment

• Obtain information about the animal
  – Domestic or wild?
  – Provoked or spontaneous bite?
  – Is the animal immunized?
  – Is the animal observable?

• Infectious disease consultation may be required if rabies vaccination status of dog is uncertain
Treatment: Early

• Update tetanus status
• Local irrigation and debridement
• Open treatment for most wounds
  – Large gaping wounds may be very loosely approximated while edges are packed open
• Oral antibiotics: Augmentin
• Early follow up (24-48 hours) to check the wound
Cat Bites

• Commonly a simple puncture wound from canine teeth
  – Results in deep inoculation with feline saliva
  – Tooth track closes preventing drainage of infectious / inflammatory material
  – Beware inoculation of joint or tendon sheath
Treatment

• Early (<24 hours) – no evidence of infection
  – Update tetanus status
  – Local irrigation and debridement
    • Unroof any scab or eschar
    • Direct irrigation of tooth track if possible
  – Open treatment for most wounds
  – Oral antibiotics: Augmentin
  – Early follow up to check the wound
Bee Stings

• Background
  – The honeybee stinger is a barbed hollow device
  – Once implanted the bee must pull loose and leave the stinger embedded
  – Wasps have smoother stingers that allow multiple stings from the same bee
Patient Assessment

• Assess for general signs of anaphylaxis

• Local findings include
  – Warmth
  – Swelling
  – Pain
Treatment: Local

- Clean the sting(s) with soap and water
- Rub a 4 x 4 gauze over the affected area to try and remove a stinger if present
- Apply ice to the affected area
- Consider local application of Benadryl cream
Venomous Snake Bite

- Crotalid venom is proteolytic
- May result in localized swelling
- Severe limb edema may occur
- Systemic effects may include
  - Coagulopathy
  - Hypotension
  - Cardiac arrhythmias
Antivenin

• More severe envenomations require treatment with antivenin
Treatments that are NOT effective for crotalid envenomation

- Cryotherapy
- Venom extraction devices
- Tourniquets applied to the limb
Arachnid Envenomation

Spider Bite

• Most domestic spider bites are not significantly venomous

• Spider bites that are significantly venomous are:
  – Widow spiders (Latrodectus species)
  – Brown recluse spiders (Loxescele species)
    • Most common in the Southeast
  – Hobo spider (Tegenaria species)
    • Most common in the Pacific Northwest
Patient Assessment

• Local findings
  – Bite may initially be painless
  – Local swelling, induration
  – Necrosis of local tissues
Treatment: Local

- Update tetanus status
- Local wound care
- Oral first generation cephalosporin
- Some patients will need debridement and soft tissue coverage once the margins of the wound are clear
Summary

- Human, dog, cat and other animal bites are associated with bacterial contamination and infection.
- For animal bites presenting early, aggressive antibiotic treatment and local wound care may prevent progressive infection.
- Bee, snake, spider, and insect bites produce local symptoms due to envenomation.
- Envenomation may produce systemic symptoms and even death.
- Appropriate consultation for severe envenomation injuries should be considered.
Foreign Bodies in the Hand and Wrist
Clinical History

• Presentation
  – Acute less than 24 hours
    • Usually following a puncture wound
    • Frequently in the emergency room
    • Occasionally office setting
  – Delayed presentation
    • Persistent symptoms related to presumed foreign body
    • Infection related to presumed foreign body
    • Neurologic or mechanical symptoms related to foreign body
Clinical History

• Symptoms
  – Pain/ tenderness/ sticking
  – Infection
  – Mass
  – Loss of function
    • Tendon-rupture or triggering
    • Nerve dysfunction

Courtesy of Craig S. Williams, MD
Clinical History

• Material
  – Mechanical symptoms
    – Maybe caused by all foreign bodies of significant size
    – Mechanical symptoms only (if not infected)
      » Glass
      » Metal
      » Plastic
      » Fiberglass
      » Pencil graphite
      » Ceramic
      » Animal tooth
      » Fishbone
Clinical History

- **Material**
  - Possible foreign body reaction (organic)
    - Wood
    - Twig
    - Plant needle
    - Cactus/plant spine
  - Special- chemical irritants and known reactions
    - Buck thorn
    - Rose thorn
    - Sea urchin spine
    - Shotgun wadding
Clinical Evaluation

• Observation
  – Swelling
  – Redness
  – Decreased range of motion

• Palpation
  – Tenderness
  – Palpable foreign body
  – Associated nerve or tendon dysfunction
Imaging

• X-ray/ soft tissue technique
  – Metal
  – Leaded glass
  – Bone/tooth
  – Ceramic?
  – Wood (covered with leaded paint)
  – Sea urchin spine
  – Bony changes
    • Secondary to chronic foreign body reaction pressure

Faintly seen piece of metal screen
Imaging

• Ultrasound
  – 94% sensitive, 99% specific
  – Used to characterize non-radiopaque foreign bodies
    • Size
    • Number
    • Location
  – Materials
    • Wood
    • Plastic
    • Plant material
    • Fiberglass

MRI preferable to CT
  – When x-ray/ultrasound negative and clinical suspicion of foreign body still exists
Treatment Plan

• Infection
  – Treat infection
    (without regard to presence or absence of foreign body)
    • Cellulitis -> antibiotics
      – Deal with foreign body when it improves/resolves
    • Abscess/tendon sheath infection/septic arthritis
      – Appropriate surgical management + removal of foreign body
Treatment Plan

• Surgical removal
  • Be prepared
    – Easy hard case
      rather than a hard easy case

Piece of wire found intravenously

Courtesy of Craig S. Williams, MD
Thank you