Common Fingertip Injuries and Fractures

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Learning Objectives

- Review anatomy and physiology of the finger and nail unit
- Approach to finger and nail injuries: history and physical examination
- Review of common finger and fingertip injuries and review of latest trends and studies
- Review of common finger fractures and management
- Post injury wound care and antibiotic therapy

Outline

- Approach to the hand injury patient
- Finger and fingertip anatomy
- Physical examination
- Most common fingertip injuries
- Tendon injuries
- Finger fractures
- Hand infections and antibiotic usage
**Introduction**

- The hand is a very vital part of the human body
- 4 requirements for a functioning hand
  1. Supple (moving with ease)
  2. Sensate
  3. Pain free
  4. Coordinated
- Account for 5-10% of hospital ER visits
- Great potential for serious handicap
- Proper initial diagnosis and timely treatment will reduce morbidity

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**APPROACH TO HAND TRAUMA PATIENT**

**History:**

- General
  - Age
  - Hand dominance
  - Occupation/hobbies
  - History of previous hand problems
- When and where did the injury take place?
  - Determine the likelihood of severe injury and probability of contamination with foreign matter.
- How was the trauma sustained?
  - This gives clues to the most likely injury.
- Past history of previous treatment surgery in the hand

**Physical examination**

- Entire upper limb should be exposed and carefully inspected (Muscle wasting, color change, asymmetry, fixed abnormal posture etc.)
- Extensor, flexor and extensor muscles and their tendons’ injuries.
- Intrinsic muscles (Thenar, lumbricals, interossei, and hypothenar muscles) must be tested
- Joint pain and stability.
- Range of motion of all digits to lasting ease of ROM
- Sensory examination.
- Circulation for color change, Allen test.
**Approach to Hand Trauma Patient**

**Imaging Studies**
- **Radiography**
  - Plain-films of the hand or wrist should be obtained when a patient presents with a soft tissue injury suggestive of fracture or an occult foreign body.
- **US**
  - Has a growing role in locating foreign bodies and in evaluating soft tissues
  - Can detect ruptured tendons and assess dynamic function of tendons non-invasively.
- **MRI**
  - Highly sensitive in detecting ruptured tendons.
  - However, it does not have a role in emergent management of hand wounds.

**Mechanism of Injury**
- **Isolated nail bed injury** occurs typically due to blunt trauma
  - Crushed in a door jam
  - Knives
  - Slicers
  - Exercise equipment
  - Power tools
  - Lawn equipment
- In contrast to adults, complete or partial avulsions heal extremely well in children and adolescence.
- Literature indicates that children younger than 2 years of age are very likely to demonstrate complete distal tip regeneration after amputation when managed without repair.

**Finger Anatomy**
Fingertip Anatomy

- **Hyponychium**: Skin edge at the distal margin under nail plate where nail bed meets the skin.
- **Perionychium** (nail complex):
  - Nail plate
  - Nail bed
  - Germinal matrix: 90% of nail growth
  - Sterile matrix: nail adheres to nail bed
- **Paronychium**: Skin folds on side
- **Eponychium**: Skin folds proximally
- **Cuticle**: Provides a seal

Fingertip Anatomy

- **Distal pad**:
  - Fatty septations provide padding
- **Capillary beds**
- **Nerve fibers**
- **Extensor/flexor tendon**
- **Mechanisms attach**
Fingertip Injuries

- Trauma: lacerations, crush, avulsion and amputation
  - Comprised of:
    - Subungual hematoma
    - Nail bed laceration (matrix)
    - Nail bed/plate avulsion (partial vs. complete)
    - Germinal matrix: Responsible for nail growth and development
      - Extensor tendon inserts 1-2 mm proximal to germinal matrix
      - Complete nail regrowth takes 4-6 months

GOALS
- Satisfactory appearance
- Adequate padding (durable)
- Pain-free (avoid neuromas)
- Good sensibility and preservation of length

Key historical elements (Decision making factors)

- Age and skeletal maturity
- Mechanism and time of injury
- Digit position during time of injury
  - Flexed vs. Extended
- Dominant hand
- Occupation
- Prior hand conditions, injuries or interventions

Physical Examination

- "Compare both hands"
- Appearance:
  - Fingernail posture
  - Edema/cyanosis
  - Lacerations
  - Swelling
  - Erythema
  - Deformity
Physical Examination

- Circulation
  - Allen’s test
  - Control lacerations-direct pressure, don’t clamp, may use a “T-ring”
  - May inflate BP cuff to help reduce bleeding
  - Capillary refill can change depending on age and disease state
    - Generally less than 2 seconds
      - May be best to test unaffected finger to assist with interpretation
      - Can try placing pulse ox on finger to assess perfusion

Physical Examination - Neurological Assessment

- Motor: Quick assessment
  - Thumbs up-radial
  - Spread fingers apart-ulnar
  - “Okay” sign-median
  - If deficit detected, proceed to more thorough motor exam
Physical Examination

Extensor tendon Injury:
- Divided into Zones according to anatomical location of injury
- In the hand and wrist there are 7 extensor tendon zones

Radiographs
- AP, lateral and oblique
- Distal phalanx is comprised of 3 zones:
  - Base
  - Shaft
  - Tuft (ungual tuberosity)
- Look for tuft fractures
- Post procedure splinting

Subungual hematoma
- Laceration of nailbed
  - Usually blunt trauma
  - Damage to matrix
- MOI: direct blow trauma—painful
- <50% laceration
- >50% nail plate removal and direct matrix repair
  - Look for fracture on x-rays
- Pediatric population
  - Trephination alone regardless of hematoma size, mechanism, fracture, age
  - No complications
Subungual hematoma

- Trephination
  - Sterile prep
  - 18 G needle, drill, scalpels (11 blade), heated paper clip, cautery probe
  - 2 mm or larger window
  - Soak daily with warm H2O to facilitate continued drainage
  - No data regarding risk of infection with associated fracture
  - Antibiotics prophylaxis and check Tetanus status

Nail plate/matrix avulsion

- High energy injury to remove all or portion of nail
- Distal phalanx fracture possible
- Associated nail-bed laceration or avulsion of germinal matrix
- Concerns for long-term deformity

ER visit

- 13 yo male jams finger playing football
- Seen in ER, bleeding at nail bed base
- Full ROM, NV intact
- ???
Seymour Fracture

- Displaced distal phalanx fracture with nail bed injury
- Can mimic a mallet finger
- X-rays: AP-normal. Lateral: flexion deformity/widened physis
- Frequently missed - may spontaneously reduce
- Bleeding from eponychium

Seymore Fracture

- Proximal nail plate may sit on top of eponychial fold
- Nail looks "too long"
- Nail plate still adherent distally
Seymore Fractures

- Can be subtle to obvious

Treatment:
- Closed, non-displaced: closed reduction and splinting by hand surgeon
- Displaced: CRPP and nail bed repair in the OR in less than 24 hours ideal
  - 0% infection if treated in OR <24 hours!
  - 15% infection if partial treatment, even if <24 hour
  - 45% infection if treatment delayed >24 hour

Neglected Seymour fracture can lead to:
- Chronic infection / osteomyelitis
- Growth arrest
- Chronic mallet deformity
Nail bed injury and repair

- Digital block and betadine soaks, apply tourniquet
- Remove fingernail with curved hemostat or fine tipped scissors slowly distal to proximal
- Irrigate with ~200+ml of saline
- 5-0 chromic gut suture for proximal or lateral folds
- 4-0 or 5-0 chronic gut for finger pad
- Fast absorbing gut absorbs quickest

Nail bed injury use 6-0 or 7-0
- Direct need distal to proximal to avoid tearing tissue and use as minimal sutures as possible
- Can use tissue adhesives, 2-octylcyanoacrylate (Dermabond). *Risk of infection.
- 118 patient study showed similar cosmesis and decreased time of repair

Finger lacerations

- Very common cause of trauma
- Regardless of size, always have a high suspicion for more serious injury.
- Remember, glass only ever stops cutting when it hits bone.
- Lacerated tendon when repaired takes 6-8 weeks of healing and hand therapy to recover.
- Nerve repairs often take 3-6 months to get some benefit from the repair
Fingertip amputation injuries

- Treatment goals: Least invasive procedure to obtain optimal outcome
  - Sensation
  - Stable and mobile tip
  - Non-tender soft tissue coverage

- Described in many ways according to angle of loss:
  - Lateral
  - Dorsal
  - Transverse
  - Palmar

- Skeletal loss:
  - Soft tissue only
  - Soft tissue with bone
  - Shaft
  - Base

- Zone of injury relating to mechanism of injury:
  - Sharp
  - Crush
  - Saw blade
  - Thermal knife

- Options:
  - Reattaching amputated piece
  - Skin grafting/flaps
  - Secondary intention

Allen Classification
- Level 1: no bone exposed, only soft tissue
- Level 2: involves skin and nail bed
- Level 3: some loss of distal phalanx
- Level 4: germinal matrix and nail fold
- Level 5: insertion of flexor/extensor tendon
Fingertip Amputations

- If just skin is removed and the defect is less than a centimeter in diameter, it is often possible to treat these injuries with simple dressing changes.
- If there is a little bit of bone exposed at the tip, it can sometimes be trimmed back slightly and treated with V-Y plasty.

Fingertip avulsion

- Taping or tourniquet and skin adhesive if adequate hemostasis
- Helps to avoid electrocautery
- Topical lidocaine soaks or digital block
- Always explore for foreign body
- Absorbable sutures for deep wounds
- Avoids daily soaking, cleaning and dressing changes
- Protective cast for 10-14 days

Fingertip amputation injuries

- Can attempt a V-Y Flap (Atasoy):
  - Indications: adequate volar skin (transverse & dorsal oblique)
  - Advantages: restores contour, preserves sensibility
  - Disadvantages: difficult in ER and time consuming
  - Risk issue may be under tension puts the flap at risk for partial or full necrosis
  - Sutured skin may not survive but serves as a barrier to dressing
V-Y Advancement flap

- Local bone shortening (rongeur, can ask for hand tray)
- Partial nail removal
- Soft tissue advancement

Fingertip amputation injuries

Secondary intention closures good for <2 cm of skin loss:
- Digital block
- Thorough irrigation
- Mild debridement of devitalized tissue
- Shorten any exposed bone (rongeur)
- Apply nonadherent sterile dressing (xeroform) covered with dry gauze and a splint

Fingertip amputation injuries

- Partial amputation from a pair of scissors, Allen II
- Can use xeroform, or Tegaderm (semi-occlusive) with routine dressing changes

Day of Injury 30 days
Fingertip amputation injuries

20 days

34 days

Fingertip amputation injuries

48 days post injury. Fingertip with slightly abnormally rounded tip

Antibiotic therapy

- Reported infection rate is 6%. Wound debridement and irrigation most important factors
- Healthy patients with clean or minimally contaminated fingertip injuries should NOT receive empiric antibiotics
- Recommend antibiotics for excessive wound contamination (e.g., soil contamination), vascular insufficiency (e.g., devascularized wound, peripheral artery disease), or immunocompromised patients
- Multiple studies reviewed show no difference in infection rate whether receiving antibiotics or not
- Always inquire about Tetanus status

*Altergott C: Pediatric Fingertip Injuries: Do prophylactic antibiotics alter infection rates; Ped Emerg Care
Flexor/Extensor Tendon Injuries

- Complex
- 2 flexor tendons (FDS and FDP)
- Extensor mechanism many interdependent components
  - Central slip at PIP
  - Terminal tendon at DIP

Presentation:
- Sharp laceration
- Sudden force
- Felt a "pop"
- Finger dislocation
- May have an obvious deficit or resting deformity
- Closed wounds uncommon - exception is jersey pull of fifth digit

The KEY is accurate diagnosis:
- Based on physical exam
- Guided by history and laceration site if present
- X-rays for avulsion fragments
Diagnosis/Treatment of flexor tendon injuries

- Independently test all 9 flexor tendons
- FPL: thumb IP flexion
- FDS to each digit - flex with others extended to block FDP
- FDP to each digit - isolated DIP flexion

Treatment: Depends on location, chronicity. Most benefit from surgical repair. Splint until repair, stat referral

Diagnosis/Treatment of extensor tendons

- Terminal tendon rupture - Mallet finger
- May be repaired in ED
- STAT referral to hand service

Mallet Finger

- Extensor tendon injury at distal phalanx (DIP)
- "Baseball finger"
- Rupture, laceration, avulsion or fracture
- Open or closed
Mallet Finger

Symptoms
- Painful and swollen DIP joint after an impact injury

Physical exam
- Fingertip rests at 45 degrees of flexion
- Lack of active DIP extension

Imaging
- Radiographs
  - Bony avulsion of distal phalanx
  - Ligamentous with normal bony anatomy
Mallet Finger-Treatment

Treatment
  - Nonoperative
    - Extension splinting of DIP joint 6-8 weeks
    - Non-displaced bony mallet injury
  - Operative
    - CRPP vs ORIF
      - Volar subluxation of distal phalanx
      - >50% of articular surface involved
      - >2mm articular gap

Mallet Finger
Phalangeal Fractures

- 10% of all fractures: distal > middle > proximal
- More common in males 2:1

Stable fractures
- Non-displaced or reduced fractures with a stable configuration

Unstable fractures
- Excessive shortening
- Angular deformity
- Rotational malalignment
- Intra-articular step-off
- If it looks unstable it probably is...

Discal Phalanx:
- Extra-articular fractures are common, associated with significant soft tissue injury, rarely displaced
- Crush injuries from a perpendicular force (injuries from a car door or hammer)
- Often comminuted, may have subungual hematoma

Examination:
- Inspection:
- Neurovascular status should be examined.
- Palpation: swelling and tenderness

Closed treatment is recommended with splinting and if necessary closed reduction

Middle Phalanx:
- Blunt or crush force perpendicular to the long axis of the bone.
- Angulation and rotation are two features of instability that must be examined.
- Rotational deformities are serious injuries and are detected clinically.
  - Examination:
    - Inspect for dislocations and subluxations. Ask patient to fully flex the phalanx to examine alignment of digits.
    - Palpation: swelling and tenderness
  - Treatment:
    - Nondisplaced without impaction/step-off require only dynamic splinting buddy taping for 2-3 weeks.
    - Operative: angulation >10° or >2mm shortening or rotational deformity, or irreducible or unstable fracture pattern
Middle Phalanx Fracture

- Volar base injury
  - Hyperextension injury or axial loading
  - Represents avulsion of volar plate
  - Unstable if >40% articular surface involved requiring ORIF or CRPP
- Surgical indications:
  - Displaced intraarticular fractures
  - Irreducible or unstable fracture patterns
  - Extraarticular fractures >10° angulation or >2mm shortening

Phalangeal Fractures

- Proximal Phalanx:
  - More common than middle phalanx fractures
  - May result in a great deal of disability
  - Dorsal or palmar angulation may occur with these fractures
- Examination:
  - Inspection
  - Neurovascular status
  - Palpation is done for tenderness
- Treatment:
  - Nondisplaced fractures with minimal (<2mm) shortening: usually stable and treated by closed reduction and dynamic splinting/buddy taping. ~3 weeks followed by motion
  - Angulated (>10°) or unstable fractures may require internal or external fixation, CRPP vs. ORIF
Finger Infections

- What's this?

Herpetic Whitlow

- HSV 1 60%, HSV 2 40%
- Common in children, health care workers, immunocompromised
- Inoculation occurs through breakage in skin barrier
- Incubation period 2-20 days
- Intense burning pain followed by erythema, malaise
- Crust over, no longer infective
- Tx: Acyclovir, allow vesicles to rupture
- Observe for bacterial superinfection
**Paronychia**

- Infection of the finger involving the tissue at edges of the fingernail
- Most common hand infection (thumb)
- Common in children, women 3:1 men
- Staph most common bacteria

**Treatment**
- Wound care alone if no fluctuance
- Pus in bed around nail, may remove nail if pus under nail
- Oral antibiotics and wound care at home

**Finger Infection**

- What's this?

**Felon**

- Abscess of fingertip pad and soft tissue associated with it
- Local inoculation (glucose needle stick) vs. no history of trauma
- Thumb/index finger most common
- Presentation: Severe pain, swelling, and pressure within microcompartments lead to "compartment syndrome" of the pulp
Felon treatment

- Incision and drainage
  - Incision will be made on one or both sides of the fingertip or volarly
  - Break up the compartments
  - Gauze will be placed into the wound to aid the initial drainage.
  - Flush out with a sterile solution
  - Gram stain/Cx: antibiotics
  - Close follow up

Felon Complications

- Finger tip necrosis
- Tenosynovitis
- Osteomyelitis
- Neuroma (from I and D)
- Admit to hospital—immunocompromised, systemic symptoms, failure to respond to abx

Finger Infection

- What's this?
Flexor Tenosynovitis

- infection involves the tendon sheaths and deep spaces. Staph Aureus most common. MRSA-IVDA
- penetrating trauma that introduces bacteria or from direct spread (felon, septic joint)
- surgical emergency and will require rapid treatment with IV antibiotics. Low threshold to operate once suspected

Kanavel's cardinal signs

1. Intense pain
   - along the course of tendon with extension
   - this is the earliest and most important sign
2. Flexion posture
3. Uniform swelling
4. Percussion tenderness along the course of the tendon sheath

References

- Plastic Surgery, Grabb and Smith, 3rd edition.
- www.emedicine.com
- www.orthobullets.com