Joint Injuries of the Hand and Wrist

DISASTER PREVENTION

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Discussion of Specific Injuries with Long-Term Consequences and Difficult Salvage

- Hand and wrist complex anatomy
  - Allows complex function and abilities
    - Bones
    - Ligaments
    - Tendon-Muscle unit
    - Neurovascular structures
Hand and Wrist Injuries

- Very common
- 25% of all athletic injuries involve hand and wrist
- Mechanisms vary
  - Falls, impaction injuries, crush injuries, grip/twisting/loading injuries
- Home/layperson diagnosis common
  - “Sprain,” “jammed finger,” “bruised”
- Delays in diagnosis and management can add significant morbidity and impact long-term outcomes
“How to Stay Out of Trouble Lecture”
DIP-PIP Joint Anatomy

Sagittal section

- Epiphysis
- Nail matrix
- Nail root
- Cuticle (eponychium)
- Lunula
- Nail bed
- Nail body
- Distal phalanx
- Nerves
- Arteries
- Septa
- Distal anterior closed space (pulp)
- Synovial membrane
- Articular cartilage
- Middle phalanx
- Flexor digitorum superficialis tendon
- Flexor digitorum profundus tendon
- Fibrous digital sheath
- Synovial sheath of flexor tendons
- Palmar ligament (plate)
- Joint cavity

Extensor digitorum tendon
Mallet Injury/Fracture

- Most common closed tendon injury in athletes
- Disruption of terminal extensor tendon at distal phalanx insertion
  - “Drop finger”
  - Baseball finger
- Tendon avulsion vs. bony mallet fracture
Mallet Finger

- **Mechanism**
  - Impact injury to extended fingertip
    - Object vs. finger
    - Fingertip vs. object
      - Volleyball, basketball/reaching, cleaning, etc.
  - Forced flexion moment of DIP joint while terminal extensor tendon is contracting
  - Hyperextension – Impaction injury
Mallet Finger

- Concerns
  - Residual extensor lag/extensor imbalance
  - Secondary PIP joint hyperextension/swan neck deformity
  - DIP joint subluxation/incongruity/arthritic risks/nonunion
Mallet Finger-Diagnosis

- Pain, swelling, tenderness
- No active DIP joint extension/extensor lag
- Ecchymosis indicates probable fracture
- Possible PIP joint hyperextension
  - Important to identify
Mallet Finger: X-ray

- Necessary to diagnose fracture variant

- DIP joint congruity/joint subluxation
  - Greater than 30-40% of articular surface/fracture fragment
Mallet Finger-Treatment

- Soft tissue avulsion/small bone fleck with congruent joint
  - DIP extension splint times 6-8 weeks
    - CONTINUOUSLY
    - Followed by 2-4 weeks of night splinting
      - 6 weeks with athletes/heavy use individuals
    - Skin checks/avoid hyperextension/skin pallor
    - Stress PIP joint range of motion
  - Percutaneous buried K-wire
Bony Mallet Fracture

- Joint congruent and reduced
  - Standard mallet extension splinting protocol
  - Careful weekly followup/x-ray times 3 weeks
Consider surgical intervention vs. typical splint immobilization

- Preferred surgical technique—percutaneous/blocking K-wire fixation
- Open repair
  - Significant risks

Studies suggest long-term functional outcomes similar with surgical vs. nonsurgical management
Mallet Outcomes

- Slight extensor lag common
- Residual flexor range of motion loss possible
- With appropriate adequate treatment, swan neck deformity rare
- Functional/full activity outcome - Common

- Late presentation/recurrent mallet deformity
  - Standard splint protocol repeated
  - Surgical treatment last resort
Flexor Digitorum Profundus (FDP) Tendon Avulsion

- Jersey Finger
- 75%-ring finger
- Mechanism: Forceful passive extension of DIP joint with FDP contraction
- Treatment “always” surgical within 7-10 days/prefer early
- Missed/delayed diagnosis commonly results in long-term functional limitations
FDP Avulsion-Diagnosis

- Frequently missed (sprain)
- Loss of active DIP joint flexion
- Block DIP joint to check active flexion
- Digit posture
- X-ray necessary
  - Soft tissue vs. bony
  - Most common – soft tissue avulsion without fracture

- Leddy classification
  - I) MCP
  - II) PIP
  - III) DIP
FDP Avulsion

- **Concerns: Misdiagnosis/delayed presentation**
  - Short surgical window to repair
    - Or tendon retraction/musculotendinous unit contracture is permanent
  - Tendon vascular supply
  - REFER within days
FDP Avulsion

- **Treatment**
  - **Surgical treatment**
    - Repair/attachment
    - Soft tissue vs. fracture
      - Anchor vs. bone tunnel/button
      - Open reduction internal fixation (ORIF)
  - **Acute**—most within 7-10 days, but depends on tendon retraction level
  - **Late/chronic presentation**
    - “Superficialis finger”
      - No surgical treatment/OT
    - Staged surgical reconstruction
      - Silastic rod (I), tendon graft (II)—(Compromised outcome)
      - Age/occupation dependent
FDP Avulsion

- Postop OT-Specialized hand therapy necessary
  - Minimum 3 months recovery
  - Outcomes good for acute, but tendon rupture/adhesions possible

- Delayed/missed diagnosis
  - Compromised function
    - Stiffness, weakness, absent function possible
Direction refers to middle phalanx location in relation to proximal phalanx
- Dorsal (most common)
- Volar
- Lateral
- Fracture-dislocation
- Open/closed
- Reducible/irreducible
PIP Joint

Extensor apparatus

Proximal phalanx

Middle phalanx

Volar plate

Accessory ligament

Collateral ligament
PIP Joint Dislocations

- Extensor apparatus
- Middle phalanx
- Proximal phalanx
- Collateral ligament
- Torn accessory ligament
- Volar plate
- Accessory ligament
- Extensor apparatus
- Middle phalanx
- Proximal phalanx
- Volar plate
- Accessory ligament
- Collateral ligament
PIP Joint

- Hinged joint-100 degree motion arc
- Supplies 85% of motion for grasp
- Stability bony/soft tissue
- Propensity for stiffness with injury/immobilization
- Extended recovery period
Dorsal PIP Dislocations

- Mechanism PIP joint hyperextension/axial load
  - Jammed finger-into object or on fall
Dorsal PIP Dislocation

- Volar plate/collateral ligament disruption
- X-ray necessary
- Fracture possible
  - Volar shear/middle phalanx base fracture
  - Pilon fracture
PIP Fracture-Dislocation

- X-ray—lateral view
- Direction of dislocation
- Displaced/interposed fragments
- Congruency of PIP reduction
- Dorsal “V-sign”
  - Divergence of dorsal articular surfaces
- Volar avulsion fragment size
PIP Joint Dislocation

- Clinical findings
  - Swelling
  - Pain
  - Tenderness
  - Deformity
  - Ecchymosis
- Collateral ligament tear/instability
- Volar plate instability
- Central slip avulsion
- Joint congruity/subluxation
- Open vs. closed
Dorsal PIP Fracture-Dislocation

- Lateral X-ray
  - Volar plate avulsion fracture
  - Chip fracture-joint reduced/congruent
  - Impaction/shear fracture-volar middle phalanx
  - Fracture-greater than 30% of joint-likely unstable
    - Stable vs. unstable very important
PIP Fracture-Dislocation

- Pilon fracture
  - Impacted middle phalangeal fracture with compression/axial load
Goal: Restore congruent joint alignment
Maintain stability to allow early range of motion
Range of motion
- Glide vs. hinge
PIP Dislocation Management

• PIP dislocation-dorsal/stable (No fracture or small chip fracture)
  ○ Reduce-early motion (within 1-3 days)
  ○ Protect volar plate/collateral ligament
    ▪ Buddy tape 3-6 weeks
    ▪ Prolonged splinting results in stiffness and contracture
PIP Fracture-Dislocation Dorsal Unstable

- Congruent reduction possible
- Fracture fragment < 30% of joint
- Tend to be stable in flexion
- Extension block splinting with careful weekly followup times 4-6 weeks
- Allow full active flexion with gradual progression into extension
Unstable PIP Dorsal Fracture-Dislocation

- Treatment options
  - Percutaneous pinning/extension block (30 degrees)
Unstable Dorsal PIP Fracture-Dislocation

- Dynamic external fixator
- Complications common
- Remodeling of the joint surface
- Comminuted fractures
Unstable Dorsal PIP Fracture-Dislocation

- Open reduction internal fixation
  - Technically challenging
  - Complications frequent
Unstable Dorsal PIP Fracture-Dislocation

- Outcomes
  - Stiffness
  - DJD possible
  - Re-dislocations possible, two thirds of which require arthrodesis or arthroplasty
Volar PIP Joint Dislocation

- Important distinction from dorsal dislocation
- Central avulsion of extensor mechanism
- May have dorsal lip middle phalangeal fracture involvement
- May involve rotatory displacement with collateral ligament involvement
Central slip avulsion
Reduce
ORIF if displaced fractures
Immobilize PIP joint in full extension times 4-6 weeks
Early DIP joint range of motion
Unrecognized volar PIP dislocation-disaster
- Presents late as boutonniere deformity and outcomes potentially compromised
Boutonniere – Missed Central Slip Avulsion

Fixed deformity very difficult late salvage
Simple PIP Dislocation Outcomes

- **Dorsal**
  - Usually full recovery within 4-8 weeks, but residual stiffness/fullness (6-9 months)

- **Volar**
  - OT necessary after 6 weeks extension immobilization
  - Possible stiffness with mild PIP extensor lag
Wrist Scaphoid Fractures

- 70% of carpal fractures
- 1 out of 100 college football players sustain a scaphoid fracture in their career
- Mechanism
  - Fall on an outstretched hand
  - Hyperextension injury
- Misdiagnosis “sprain”
- Delayed presentation
- Nonunion rate 5-10% of all scaphoid fractures
- Avascular necrosis 13-50%
- Initial “negative” x-rays
Scaphoid Anatomy

- Radial - wrist linking proximal distal rows
- Distal/waist/proximal
**Scaphoid Anatomy**

- Scaphoid blood supply
  - Dorsal ridge (primary)
  - Distal
  - Proximal pole
  - Interosseous only
Scaphoid Fracture Diagnosis

- **History**
  - Fall on outstretched hand
  - Hyperextension injury
    - Frequently regarded as “minor” injury

- **Acute exam**
  - Swelling, snuffbox tenderness, distal tubercle tenderness
  - Range of motion initially limited
  - High level of suspicion necessary
Scaphoid Fracture Diagnosis

- **X-rays**
  - Navicular view 65-70% sensitive for fracture

- **Negative x-rays, but suspicious**
  - Splint/cast
    - Repeat x-ray 10-14 days
  - MRI
    - 95-100% sensitive for fracture
    - Gold standard/specific
    - Allows detection of other injured structures (S-L ligament)
    - Proximal pole vascularity assessment
  - Bone scan sensitive, but not specific
    - False positives
Scaphoid Fracture Classification Pattern

**Type A:** Stable Acute Fractures
- A1: Fracture of Tubercle
- A2: Incomplete Fracture Through Waist

**Type B:** Unstable Acute Fractures
- B1: Distal Oblique Fracture
- B2: Complete Fracture of Waist
- B3: Proximal Pole Fracture
- B4: Trans-Scafoid Perilunate Fracture Dislocation of Carpus

**Type C:** Delayed Union
- C: Delayed Union

**Type D:** Established Nonunion
- D1: Fibrous Union
- D2: Pseudarthrosis

Diagram showing the classification of scaphoid fractures with anatomical references to the distal pole, waist, and proximal pole.
Acute Scaphoid Fracture Treatment

- Cast immobilization (6-12 weeks) vs. surgical management (percutaneous/arthroscopic/ORIF)

  - **Considerations**
    - Stiffness
    - Union rates (depends upon fracture configuration and location)
    - Hardware
    - Complications
Acute Scaphoid Fracture Treatment

- LAC vs. SAC
- Thumb spica?
- Cast stiffness
- Length of immobilization
Acute Scaphoid Fracture Surgical Management

- Percutaneous/arthroscopic ally-assisted screw fixation/ORIF
  - Displaced fractures
  - Proximal pole fractures
    - Difficult to diagnose on x-ray
    - Vascularity/AVN concerns
  - Waist fracture
    - Consider screw fixation
      - Union rates/early return
  - 10-16 weeks healing time with careful follow up
  - Possible CT scan confirmation of healing
Fig. 10. Fluoroscopic confirmation of the ideal position of the guide wire within the scaphoid on the posterior-anterior view.

Fig. 11. The ideal length of the headless cannulated screw has been determined, and the guide wire has been advanced out of the volar aspect of the hand. The near cortex of the scaphoid is then reamed.
Scaphoid Fractures

K-wire
Cannulated screw
Trapezium lip removed
Fracture line on scaphoid
Scaphoid Nonunions

- Unrecognized fractures
- Displaced fractures (malunion)
  - Humpback deformity
- Proximal pole (vascularity)
  - AVN (avascular necrosis)
- Cystic resorption
Scaphoid Nonunions

- **Treatment**
  - Open reduction with bone graft
  - Union rates 70-90%
  - Bone graft
    - Standard versus vascularized (1-2 ICSRA)
  - 3-6 months healing time
  - CT confirmation of healing
  - Asymptomatic fibrous unions?
Scaphoid Fracture

- Clinical suspicion based on history and exam
- Initial immobilization if suspicious
- Follow-up x-rays critical
- Consider MRI
- SNAC (scaphoid nonunion advanced collapse)
  - Long-term outcome of untreated nonunion
  - Proximal row carpectomy vs. limited fusion
Conclusions

- Mallet fracture-dislocation
- FDP tendon avulsion
- PIP joint dislocation
  - Dorsal
  - Volar
- PIP fracture-dislocation
- Thumb MCP joint ulnar collateral ligament tear
- Scaphoid fracture
- Scapholunate dissociation

- Recognition and diagnosis critical to maximizing outcomes
- Late presentation/unrecognized injury often results in long-term disability and functional limitations
THANK YOU