Topics

1. Hand Fracture Reduction Methods
2. Fracture Healing Essentials
3. Therapy Basics
4. Characteristics of Specific Fractures
5. Special Cases

Hand Fracture Reduction Methods

Closed reduction with immobilization
Open reduction with plate and screws

Closed reduction with K-wire
Open reduction with screws
Closed Reduction
• Cast vs Splint
• Splint = Orthosis
• Prevents displacement of a fracture with good alignment
• Protects tendon and soft tissue injuries
• Works by compression of soft tissues
• Three point support of the fracture in all directions

ORIF
Open Reduction Internal Fixation
• Unstable fracture
• Displaced fracture
• Soft tissue injury
• Fractures with bone loss
• Rotational deformity
• Angulation

Surgical Fixation
Requires...
1. Good soft tissue skills & knowledge of anatomy
2. Understanding of hand incisions
3. Rehabilitation
4. Motion within 2-3 days after surgery
5. Protection
6. Edema management and wound care
Closed Reduction Internal Fixation
Closed Reduction External Fixation

**CRIF/CREF Coaption**

- Approximates fracture ends
- Has some wiggle
- K Wires, Pins, External Fixation
- Splinting/casting

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**Immobilization Position**

- MP ligaments are taut in flexion
- IPs are tight in extension
- "Safe" position prevents contractures is MP flexion, IP extension

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**Video: Abduction with and without MP Flexion**
How Fractures Heal

**Primary**
- No callus
- Open reduction
- No motion at the fracture
- Fracture ends in contact

**Secondary**
- Callus
  - Callus formation, Splinting, Wires/Pins
  - Stress-strain at fracture site
  - Plastic
  - Soft callus assembly
Secondary Bone Healing

- PAIN & SWELLING before callus formation
- Less painful after SOFT CALLUS forms (cartilage)
- HARD CALLUS (cartilage turns to bone)
- Calcification & remodeling

Wolff's Law of Bone Remodeling

Results From Stress & Strain

Therapy Basics
Edema Control

• Prevents throbbing
• Improves active motion
• Ultimately less scar tissue

Physiological Goals:
Increase tissue hydrostatic pressure
Reduce the intravascular pressure
Support lymphatic return

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1. Compression
Very effective with early low-protein edema

PRECAUTION: VASCULAR COMPROMISE, LACK OF SENSATION, GRAFTS AND WOUNDS, CIRCUMFERENTIAL OR TOO TIGHT BANDAGES CAUSE TOURNIQUET; NEED TO WAIT UNTIL AROM PERMITTED TO DON GLOVE

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2. Elevation "On the shoulder, the sofa, the pillow"
Increases intravascular pressure, reduces capillary filtration pressure because peripheral arterial and venous pressures are affected by gravity.

3. Light cardiovascular exercise
Increased diaphragm activity & compression of interstitial spaces, veins, lymphatic vessels, create increased lymphatic activity.

4. Active motion when permitted
Soft tissue motion, compression of interstitial spaces, counter pressure of compressive dressing or glove/stocking, increase lymphatic return.
Kinesiotape

- “Lifts” epidermis
- Opens lymph channels
- Effective on the back of the hand (metacarpal fractures)
- Creates motion between tissue layers

PRECAUTION: MAY OPEN INCISIONS IF NOT COMPLETELY HEALED, CAN TEAR or CONTUSE

Making Motion: AROM & PROM

Active Motion

- 3-4 days after ORIF
- 2-4 weeks for closed reduction
- Balance tendon forces to prevent deformity
- TENDON MOBILITY prevent adhesion between tissue layers
Active Motion

- Blocking
  - Flexor Digitorum Profundus
  - Flexor Digitorum Superficialis
  - Flexor Pollicis Longus
- Tendon Gilding
  - Fist
  - Hook Fist
  - Straight Fist
- Reverse Blocking

Video: AROM

Passive Motion

Fracture stability first, in 4-6 weeks with X-ray evidence of bone healing.

Low-Load Prolonged Stress Heat

Joint mobility
1. Elastic loops: 10 minutes
   4x/day
2. Tape: Can be used with heat
3. LMB: 10-15 minutes
   4x/day
4. SPLINTING
Passive Motion

**Splinting**
30 minutes
4 times per day
1. Static
2. Dynamic
3. Static Progressive

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**Video: PROM**

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**Strengthening**
- Putty & light resistive exercise
- Begin after 6-8 weeks if healing
  1. Grip
  2. Pinch
  3. Opposition
  4. Finger & thumb extension
  5. Abduction/Adduction
Video: Strengthening

Phalange Fractures "P1, P2, P3"

Distal Phalange Fractures

Tuft
- Nailbed injury
- Sensitivity

Shaft

Base
- FDP Avulsion
- Bony Mallet
Distal Phalanx

- Insertion of FDP palmar base
- Insertion of extensors by terminal tendon dorsal base
- Germinal matrix & nail bed

Distal Phalanx Shaft & Tuft Fractures

- Immobilize IP joints straight "mallet splint" that includes the DIP but not the PIP
- 2-3 weeks before active motion

DESENSITIZATION

- AROM
- FDP Blocking
- FDP Gliding
- Vibration
- Rice bucket
- Massage
  10 minutes 2-4x/day
  Works within 2 weeks
Distal Phalanx Base Fractures

Are TENDON INJURIES

**FDP AVULSION**

- “Jersey finger”
- Wire to stabilize & dorsal button
- Zone 1 Flexor Tendon Repair: follow Modified Duran flexor tendon repair program

**BONY MALLET**

- “Baseball fracture”
- Immobilized 6 weeks, then at night and heavy activity
- Active fisting ex program
- No DIP BLOCKING
- (causes extension lag)

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Distal Phalanx Fracture

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Middle Phalanx Fractures

- Condyles and lateral ligaments for stability with DIP joint
- Special Considerations
  - Volar plate injury
  - Insertion of FDS at the base

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Middle Phalanx Fractures “P2”

- IP Gutter
- Extension gutter or buddy tapes if shaft fracture
- Slight flexion of PIP for 6 weeks if a dorsal dislocation with volar plate injury or articular fracture ORIF

Active Motion
Middle Phalanx Fractures

1. FDS blocking
2. Reverse blocking
3. Tendon gliding
   - Fist
   - Hook
   - Straight fist

Middle Phalanx Fracture
Proximal Phalanx Fractures
Base, Shaft, Head

- NO complicating tendon insertions
- Immobilization in MP flexion where collateral ligaments are elongated
- Intrinsics flex proximal piece; extensors extend distal piece

Splinting Proximal Phalanx Fractures “P1”

- Forearm based radial gutter / ulnar gutter
- Include neighboring digit for stability
- SAFE Position
  MP Flexion
  IP Extension
Thumb Fractures

- Proximal and distal phalanx (P1, P2)
- Tendon insertions: EPB, APB, EPL, FPL
- Fractures displaced by tendon pull, pinch/grip

Metacarpal Fractures

Special problems
1. angulation
2. malrotation
3. shortening
Metacarpal Malunion

1. Angulation
   - Apex dorsal because of pull of interossei
   - 30° tolerated in small finger, 20° ring
2. Shortening
   - Relative lengthening of the common finger extensors.
   - 2mm of metacarpal shortening = 7° extensor lag at the MP joint
3. Malrotation
   - 5° at the shaft creates 1.5 cm of overlap of the digit during fisting
   - Buddy tape while immobilized to prevent malrotation

Boxer’s Fracture

Special fracture of the 5th metacarpal
Usual mechanism of injury: hitting a wall or other hard object
Thumb Metacarpal Fractures

Thumb Fractures

- Tendon adherence FPL/EPL
- Loss of web space
- Loss of pinch strength

Rolyan Wrist and Thumb Immobilizer

Metacarpal Neck Fracture
Bennett’s First Metacarpal Fracture

- Partial articular fracture dislocation at the base of the first metacarpal
- Mechanism: Axial load on a flexed first CMC joint, FOOSH
- Causes OA

Bennett’s Fracture

Palmar oblique ligament
Thumb extensors
Adductor pollicis longus
Abductor pollicis longus

Bennett’s Fracture “Before”
Bennett’s Fracture

Rolando’s First Metacarpal Fractures

- 3 piece intra-articular fracture at the base of the first metacarpal
- "T" or "Y" shaped
- Complete articular fracture

Rolando’s Fracture
Scaphoid Fracture

- Men 15-29 years old
- Most common carpal fracture in kids
- 80% of the scaphoid are articular surfaces
- Onset: FOOSH, MVA, direct blow to radial wrist

Scaphoid Fracture

- Blood flow from distal to proximal
- Healing 8-24 weeks
- Return to sport/activity 10-12 weeks after cast removed

1. Palpation in the anatomic snuffbox with ulnar deviation, or
2. Transverse wrist crease
3. 2% don't appear on initial X-ray
Trapezium Fracture
- 1-5% of carpal fractures
- Chip fractures are not treated
- Axial force of the 1st MC causes *splaying* of waist fractures
- Palpation: base of the 1st metacarpal in small finger opposition

Hamate Fracture
- Injury by compression (bat swing is classic), treated with wire, excision, or cast
- Fracture becomes displaced by ligaments
- Ulnar nerve sensitivity

Capitate Fracture
- 6 weeks casted before beginning AROM
- 1% carpal fractures
- ORIF: Mobilize scar, Continuous US with steroid

Retrieved 3/25/15 orthopedicsone.com
Retrieved 4/2/14 http://www.thefemalecelebrity.info/Fractured-Scaphoid-Treatment.html
Pisiform Fracture

- Caused by a direct blow, maybe repetitive stress
- Excision common (nonunion)
- Scar sensitivity & grip weakness

Triquetrum Fracture

- Second most common carpal fracture
- 4 weeks in cast
- Complaints of ulnar wrist pain, local tenderness
- Pisiform lies on top

Lunate Fracture

- Caused by impact with wrist extension
- Casted 6-8 weeks
- Associated with ligament injuries “It’s Complicated”
- Keinbock’s = avascular necrosis of the lunate
- May lose wrist ROM
Hand Physeal Closure Ages

- Open physis is weaker than surrounding bone
- Differential growth of the physis can correct for some malalignment of the fracture site
- Physeal arrest from mishandling

Middle and Distal Phalanges: 14-16 years
Proximal Phalanges: 14-16 years
Metacarpal Head: 14-16 years

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Salter-Harris

Salter-Harris classification of physeal fractures

- Normal
- Type I
- Type II
- Type III
- Type IV
- Type V

Salter-Harris classification of physeal fractures

- Normal
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- Type IV
- Type V

HAND PHYSSES
Special Pediatric Fractures

1. Seymour fracture
   • Fracture of the physis of the distal phalanx
   • Results in infection, growth arrest, mallet deformity

2. Tuft fracture
   • 2-3 year olds
   • Very painful—needs cushioning and protection (tip protector)

Osteoporotic Fractures

1. Age
2. Post-menopausal female
3. Glucocorticoids
4. Smoking
5. Alcoholism
6. High protein diet
7. Balance deficit
8. Failure of fixation

Biophosphonates—Treatment for osteoporosis, slows osteoclast activity; also slows fracture healing; half life in bone is 1.5-10 years, shows a higher rate of non-union

Fracture Complications

• Nonunion, delayed union, malunion, avascular necrosis, osteomyelitis, amputation, stiffness/motion loss, instability, laxity, poor durability, lack of coverage, contracture, tendon adhesions, motion lag, numbness, hypersensitivity, pain, CRPS, ischemia, venous congestion, sensitivity, joint laxity

STIFFNESS
Hand Compartment Syndrome

- Pressure in enclosed space
- Soft tissue injury from crush, burn, tight bandaging

References

23. Watson HK, Weinzweig , eds. The Wrist. 2001, Lippincot Williams & Wilkins, Philadelphia PA.

Questions? Answers? Pearls?