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# Understanding Multi-Trauma Hand and Upper Extremity Injuries

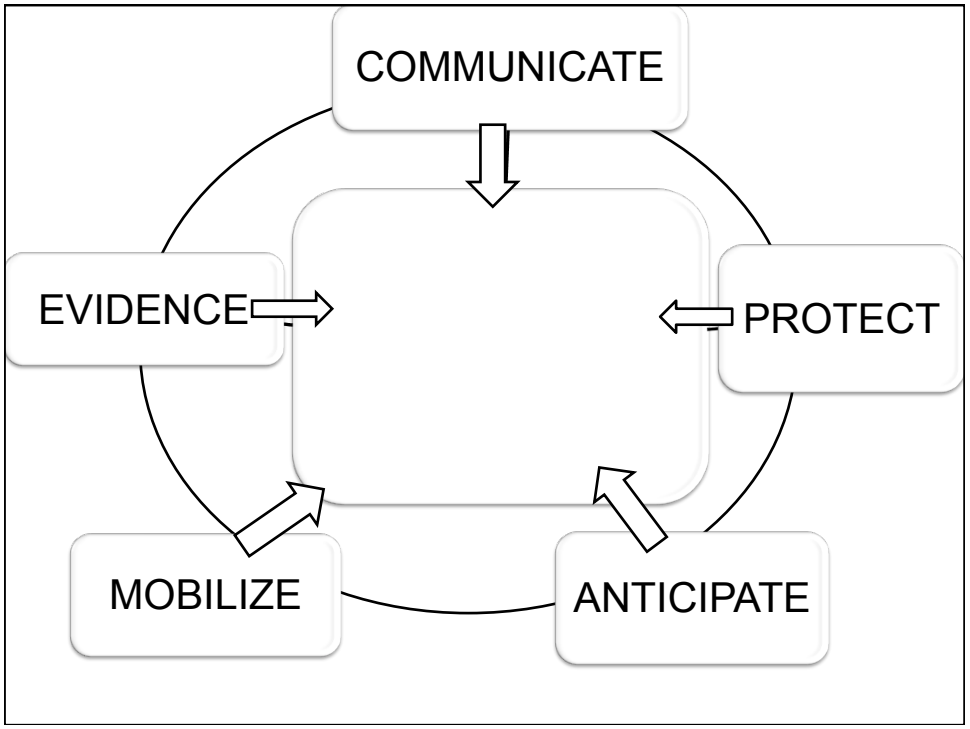
Carol Recor, OTR/L, CHT

## Learning Objectives

After this course, participants will be able to:

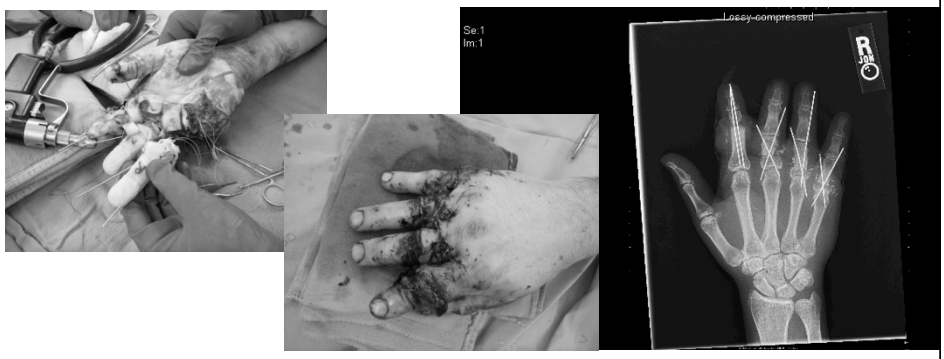
- Recognize the appropriate algorithm or protocol for soft tissue and bony injuries.
- Identify proper orthosis positioning for multi-trauma hand injuries.
- Identify precautions for multi-trauma injuries.

# Algorithm vs. Protocol

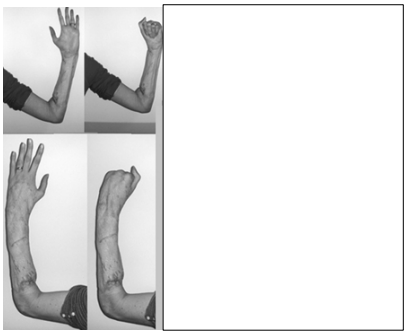


# My Primary Goals:

1. Don't screw up the surgery
2. Regain as much passive motion as possible, as quickly as possible

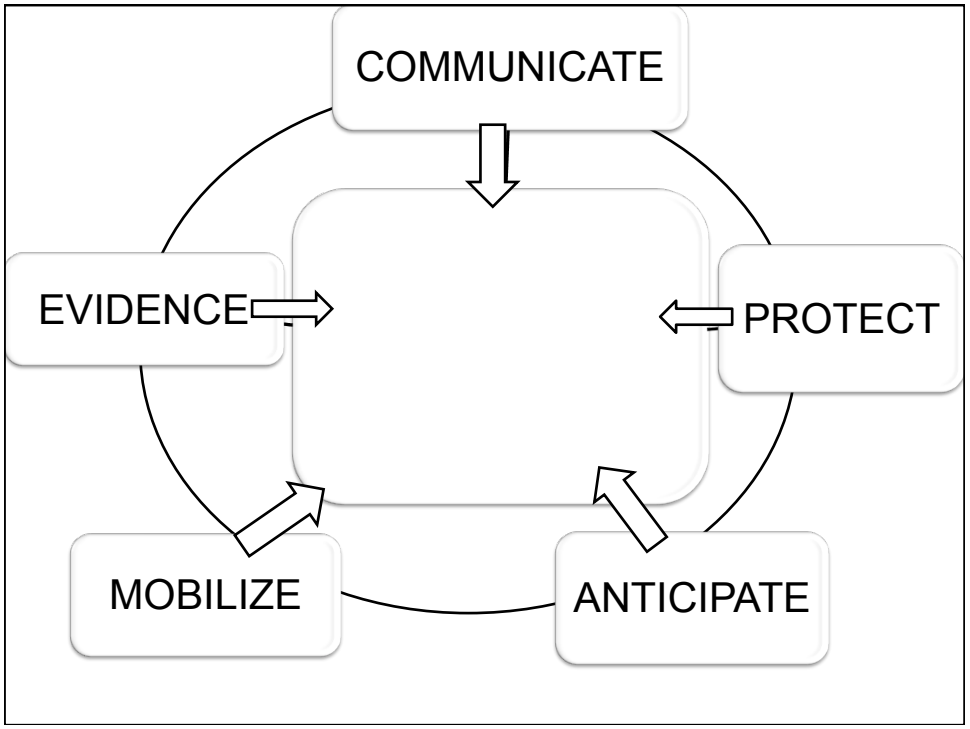



Every degree of motion that we can regain, without sacrificing nerve or vascular function, moves this patient closer to having a functional hand.



"To someone who has nothing, a little is a lot."

Sterling Bunnell



# COMMUNICATE

- Operative Reports
- X-Rays




OPERATIVE REPORT

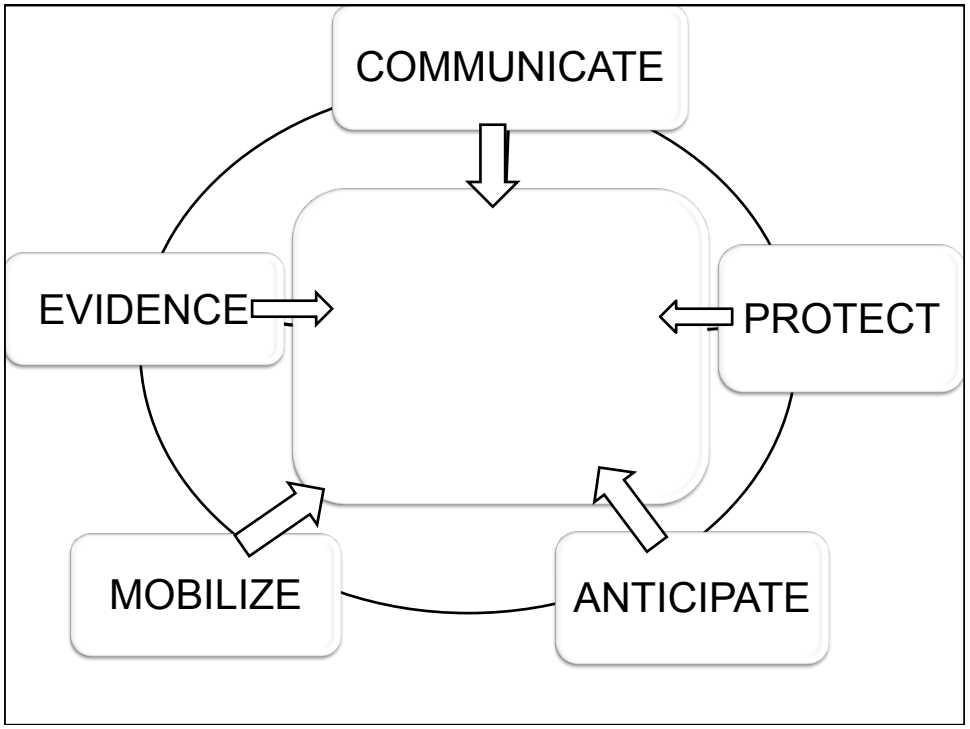
PREOPERATIVE DIAGNOSIS:
Machete wound to right hand.

POSTOPERATIVE DIAGNOSES:
1. Median nerve laceration of the wrist.
2. Flexor digitorum profundus and flexor digitorum superficialis laceration, index finger, zone IV.
3. Flexor digitorum profundus and flexor digitorum superficialis laceration, middle finger, zone IV.
4. Flexor digitorum superficialis and Flexor digitorum profundus laceration, ring fingers, zone II.
5. Ring finger P1 open fracture.
6. Scapholunate dissociation.
7. Capitohamate dissociation with open capitate fracture
8. 3rd carpometacarpal fracture dislocation.
9. Flexor pollicis longus laceration, zone IV.
10. Ring finger metacarpophalangeal joint with associated zone V extensor tendon laceration.

PROCEDURES PERFORMED:
1. Irrigation and debridement of skin, subcutaneous tissue, tendon, fascia, and bone.
2. Repair of flexor digitorum profundus tendons to index and middle fingers, zone IV.
3. Flexor digitorum superficialis repair, index and middle fingers, zone IV.
4. Repair of flexor digitorum profundus and flexor digitorum superficialis tendons to ring finger in zone II.
5. Flexor pollicis longus tendon repair in zone IV.
6. Median nerve repair at the wrist.
7. Open reduction and internal fixation of scapholunate dissociation with ligament reconstruction.
8. Open reduction, internal fixation of capitate fracture.
9. Open reduction, internal fixation of ring finger P1 fracture.
10. Open reduction internal fixation of 3rd carpometacarpal fracture dislocation.

- Stability of fixation
- Tendons, nerves or vessels repaired under tension?
  - Confidence of viability?
- Structures absent?

Photos courtesy of: Stephen Kennedy, M.D



# PROTECT

## Where to Start?

- Ask yourself the right questions:
  - What structures MUST be protected?
    - Including flaps or skin grafts
      - Avoid tight circumferential dressings!
  - What structures are safe to move?

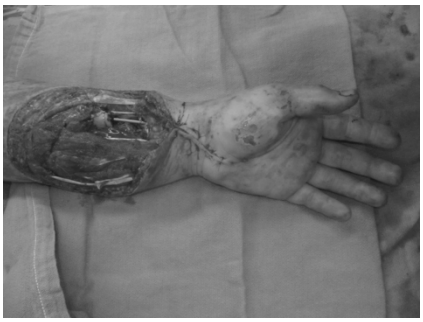


Photo courtesy: Doug Hanel, M.D.

# Where to Start?

- Ask yourself the right questions:
  - What structures MUST be protected?
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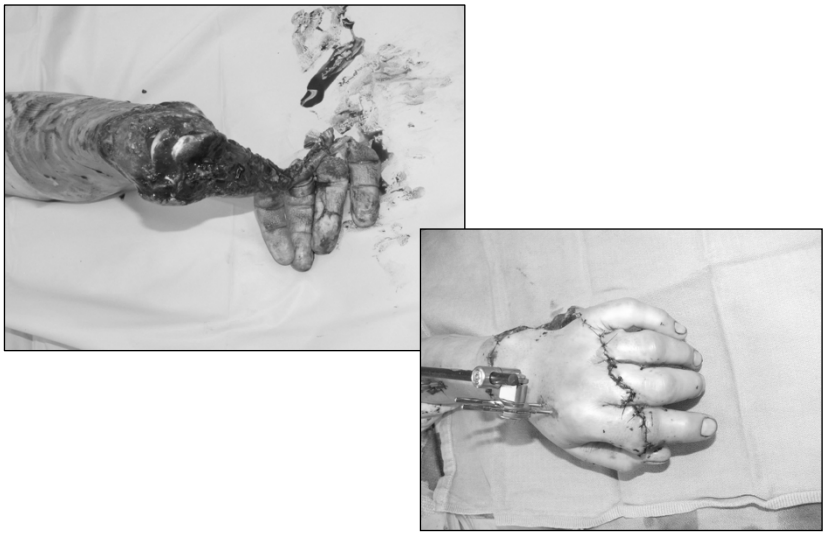
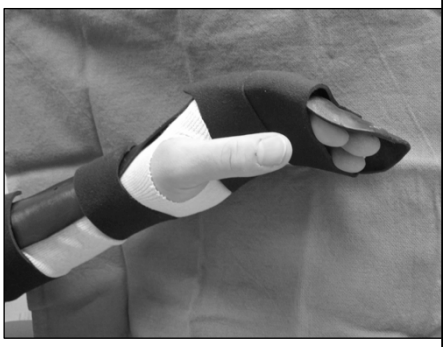
## Where to start?

| | Wrist | Thumb | Index | Middle | Ring | Small |
|---|---|---|---|---|---|---|
| Fracture or Fusion | Radius Ulna Carpals | MP IP | MP PIP DIP | MP PIP DIP | MP PIP DIP | MP PIP DIP |
| Flexor tendons | | | ✔ | | | |
| Extensor tendons | | | ✔ | | | |
| Revasc. | | | | | | |
| Nerves – Digital or Periph. | | | | | | |
| Wounds/ flaps/ grafts | | | | | | |



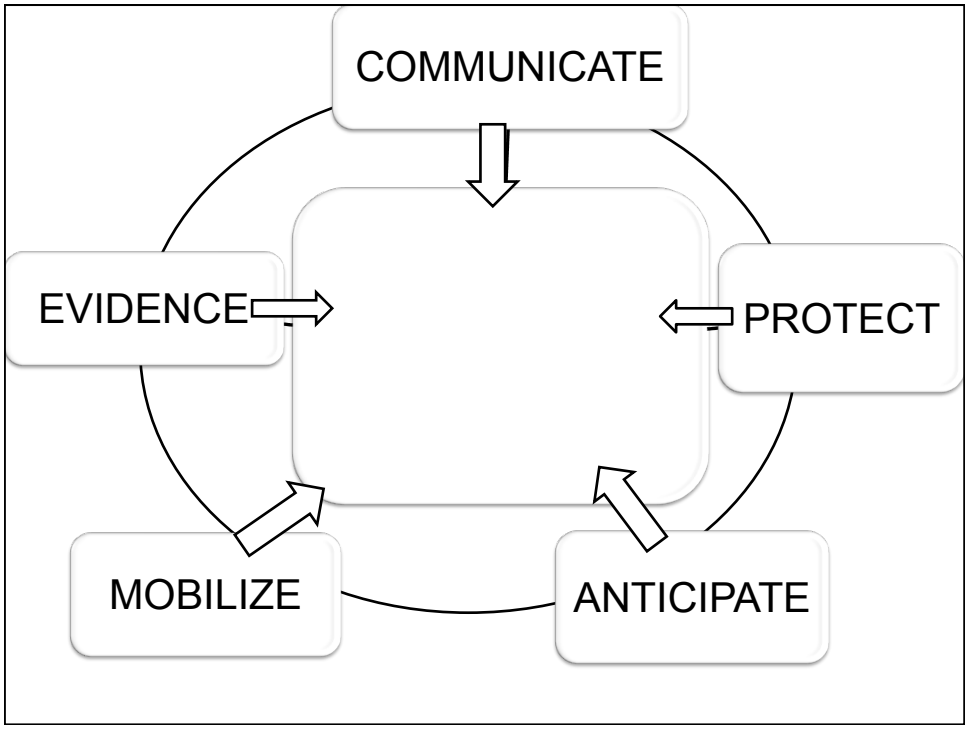
Photos courtesy of: Jeff Friedrich, M.D.

# Orthosis Position

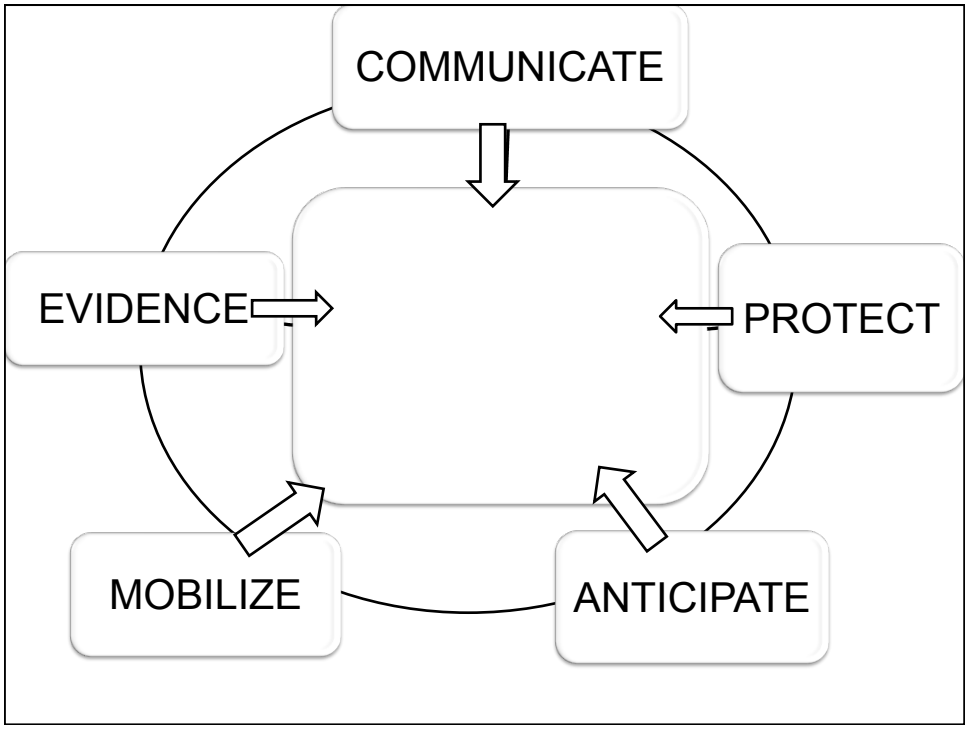


# Orthosis Position

- Protect fracture/fixation
- No tension on tendon, nerve or vascular repair
- Ligaments on stretch, if possible
- Neutral wrist, with digits in resting position is safest for multi-trauma



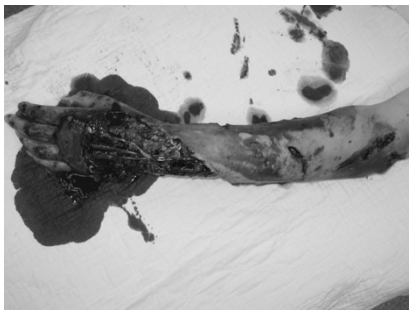

# ANTICIPATE




# MOBILIZE

# EVIDENCE

- Glasgow et al. Mobilizing the stiff hand: combining theory and evidence to improve clinical outcomes. JHT 2010.



# WHEN?
## ~Flexor Tendons~

- Halikis MN et al. Effect of immobilization, immediate mobilization, and delayed mobilization on the resistance to digital flexion using tendon injury model. JHS 1997.
- Zhao C, et al. Digit resistance and tendon strength during the first week after flexor digitorum profundus tendon repair in a canine model *in vivo*. JBJS 2004

# When?

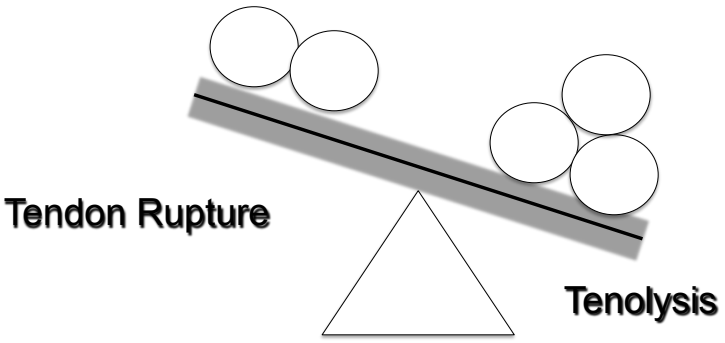
- Day 1: Too soon
  - edematous
- Day 7: Too late
  - Early scar adhesions

- Cao Y et al. Investigation of resistance of digital subcutaneous edema to gliding of the flexor tendon: an in vitro study. JHS 2005.
- Buonocore S et al. The effects of edema and self-adherent wrap on the work of flexion in a cadaveric hand. JHS 2012

# HOW MUCH?

- Groth G. Pyramid of progressive force exercises to the injured flexor tendon. JHT 2004
- Wu YF, Tang JB. Tendon healing, edema, and resistance to flexor tendon gliding: clinical implications. Hand Clin 2013

# Force and Excursion



# Replantation

- Both flexor and extensor tendons:
  - PASSIVE MOTION ONLY!

# Replantation

- Silverman et al. Hand Clinics. 1996
  - EPM I & II

- EPM I: Tenodesis Pattern
- EPM II: Finger "tenodesis"
  - Passive MP joint flexion with IP's maintained in full extension
  - Passive isolated PIP or DIP joint flexion with MP's in full extension
- Use tissue tension as guide for passive motion

# CLINICAL PEARLS

**Immobilize the joints that DO move, to transfer forces to the joints that don't.**

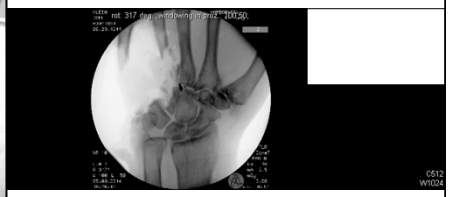
Correct maladaptive motor patterns

- **Langer N, et al. Effects of limb immobilization on brain plasticity. Neurology 2012**

# Case Study

# Case Study

- 68 y/o right hand dominant male
- Accidental self-inflicted GSW
  - Bone loss
  - Vascular injuries
  - Flexor and extensor tendon injuries
  - Intrinsic muscles gone



## Case Study

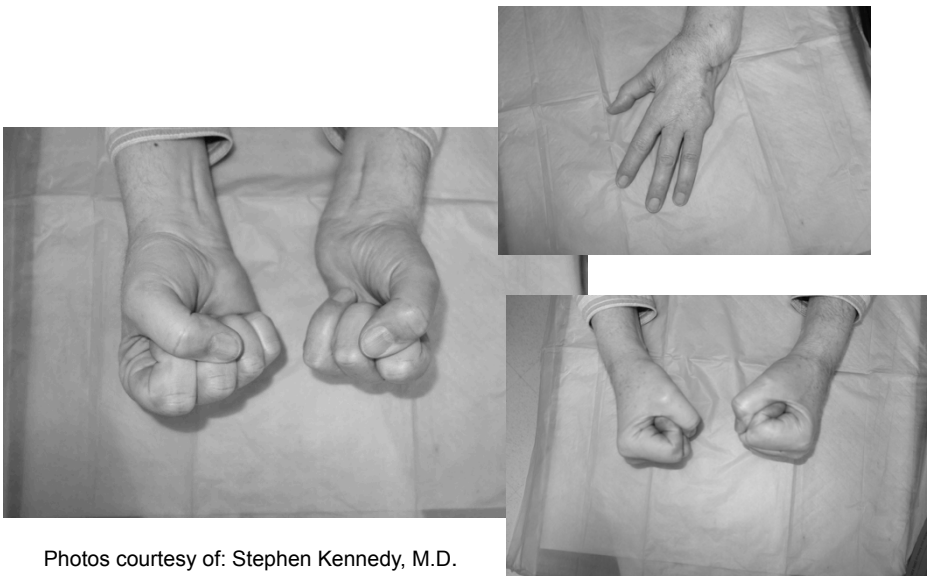
- 5th ray amputation
- Bone grafting and rigid fixation 4th MC fx
- Tendon graft
- Revascularization
- Secondary wound closure

## Case Study

- Resting dorsal blocking orthosis
- Early protected motion of digits
- Wound care

# Case Study

- Scar management
- Modalities
- Tendon glide
- Strengthening



Photos courtesy of: Stephen Kennedy, M.D.

# Thank you

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