Hand Therapy Review Course
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Protocols
For Rehabilitation of
Flexor Tendon Zone II
Repairs
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KEYs to Successful Treatment
• Doing the wrong thing can lead to injury
• Not doing enough of the right thing can cause poor outcomes
• Use the following resources
  • mentors
  • surgeons
  • review protocol to understand biomechanics
  • use references

Flexor Tendon Zones

Zone I: FDP ONLY
• From FDS insertion on middle phalanx
• To A5

Zone II:
• From A1 pulley
• To FDS insertion.
• Includes the area of the flexor tendons within the digital pulley system
• FDS and FDP within the sheaths

Zone III:
• From distal edge of transverse carpal ligament
• To proximal edge of A1

Zone IV:
• Carpal Tunnel

Tendon Healing
• Extrinsic Healing
  • Adhesion formation between tendon and surrounding tissue.
  • Potenza and Peacock
    • Tendons healed by fibroblastic response (adhesions)
    • Tendon cells were incapable of proliferating.
    • “One wound” concept = tendon healing though adhesion formation.

Intrinsic Healing
• Tendon’s ability to heal without adhesions
  • Using both intrinsic vascularity and synovial diffusion
  • Fibroblasts needed for healing
    • Supplied by the endotenon and epitenon,
    • Tenocytes appearing at 2-3 weeks.

20, 26, 27, 29
Passive extension weeks 1-5

- **All other joints supported in flexion**
  - Gives flexor tendon slack
  - Prevents gapping or rupture through excessive traction on the tendon.

**Immobilization**

- **Rationale/Used for:**
  - Children (those under age 10-12)
  - Cognitively impaired
  - Non-compliant patients
  - EXTRINSIC HEALING

**Early Stage (0-3 or 4 weeks):**

- Dorsal blocking splint or cast:
  - Wrist 10-30° flexion, MP’s 40-60° flexion, IP’s in extension

- If therapy is provided:
  - Protected PROM flexion of the digits (in therapy only)
  - Mobility of uninvolved joints
  - Wound/skin management.

**Intermediate Stage (3 or 4 weeks to 5 or 6 weeks):**

- Splint changed to wrist neutral. Remove splint for hourly exercises to include:
  - Passive flexion and extension of fingers with wrist in 10° extension.
  - Active flexion – hook, straight, and full fist.
  - Tenodesis
  - **BE GENTLE** - immobilized tendon is generally weaker

**Late Stage (starting at 5 to 6 weeks):**

- D/C dorsal blocking splint.
  - Add serial extension splinting
  - Begin gentle blocking exercises
  - Be cautious with blocking of FDP of LF.

- After 1 week of gentle blocking, may initiate light resistance (putty, light pick ups, etc.).
  - If tendon gliding is good, delay any resistance.

**After 3-4 days, assess tendon gliding.**

- Measure full MP/PIP/DIP flexion passively and actively.
  - If > 50° difference is present, move to the late stage.
  - If < 50° difference noted, continue with intermediate phase of the program until 6 weeks post op.
Early Controlled Passive Mobilization

**Rationale:**
- Promoting synovial diffusion for healing
- Inhibit dense adhesion formation
- Facilitate a stronger repair at an earlier stage.
- Must be limited to a motivated, compliant patient.
- Two main types of passive flexion protocols exist, based on initial work by
  - Duran and Houser
  - Kleinert

Original: Duran and Houser Protocol

- 0-4 ½ Weeks
  - Splint: Dorsal blocking splint with wrist 20° flexion, and MP’s in a relaxed state of flexion:
  - Splint ends at PIP joints to allow full IP extension.
  - Rubber band traction to the injured finger (loosely) during the day.
  - Between exercises stockinet is applied over the fingers, and pinned to forearm
  - All fingers resting in flexion within stockinet to prevent impulsive grasping.

Duran and Houser Protocol

- Exercises: 6-8 repetitions, 2x/day within splint that blocks MP in flexion,
  - Passively extend DIP while PIP is held passively in flexion
- Passively extend PIP while DIP rests in flexion

Duran and Houser Protocol

- At 4 ½ Weeks
  - Splint: replace dorsal blocking splint with a wrist band with rubber band traction.
- Exercises: 10 repetitions every 2 hours as previously
  - Add gentle active extension against the rubberband traction.

Duran and Houser Protocol

- 5 ½ Weeks:
  - Hourly exercises 10-12 repetitions
  - Remove wrist band and nail suture for rubber band attachment.
  - Active flexion is initiated: gentle blocking, FDS gliding, and fisting.
  - Passive flexion of all joints, and IP passive extension with MP flexed.

Duran and Houser Protocol

- 6 Weeks
  - Begin gentle PIP extension dynamic splinting if needed.
- 7 ½ Weeks
  - Initiate gentle resistance, starting with a rubber sponge advancing to putty. No strong resistance to the tendon for another 2-4 weeks.
“Modified Duran Protocol”

- Eliminate the rubber-band traction
- Extend the DBS hood to the fingertips
- Strap the fingers in IP extension at night.

Exercises:
1) Passive flexion to individual joints and compositely
2) Active IP extension exercises
3) Passive exercises described in the original protocol for the early stage
4) Protected tenodesis in therapy if appropriate

Modified Kleinert Protocol

Original Protocol not used much

- **Splint:** DBS
  - Wrist in 45° flexion
  - MP’s 40° flexion
  - IP’s allowed full extension
  - Volarly applied PFT (postoperative flexor tendon)

Modified Kleinert Protocol

- Exercises: 20 repetitions per hour
  - 0-4/6 weeks
    - Active IP extension against rubber bands
  - 3-6 weeks
    - Remove splint for wrist motion at 4 weeks.
    - Begin gentle active flexion

- 6 weeks
  - Discontinue splint.
  - Add differential tendon gliding exercises.
  - 6-8 weeks
  - Begin gentle resistance.

Protected Passive Tenodesis

Passive composite flex with wrist extension 20-30 degrees followed by passive wrist flexion, fingers extended passively by tenodesis effect.

Modified Kleinert Protocol

- The PFT is a prefabricated splint.
  - Rubber band traction runs from the fingernail, under a rolling bar at the palm, to a coiled lever at the forearm.
  - Coiled lever and rolling bar on the PFT
  - Designed to minimize resistance within the rubber band during IP extension

Washington Regimen

- **Splint:** DBS
  - Wrist at 20-45° flexion
  - MP’s at 40-60° flexion
  - IP’s allowing full extension.
  - A safety pin is applied to the palmar strap at the distal palmar crease, and on the forearm strap.
    - A nylon line is run from the fingernail of the injured finger(s) only, under the safety pin at the DPC, attaching to 2 rubber bands
    - One rubber band is cut, so that it is only a single strand. One RB with exercise and 2 RB at rest.
Washington Regimen

• Full finger flexion to the distal palmar crease strap is attempted with singular rubber band traction.

8,9,13

Washington Regimen

• 0-3 weeks
  • Therapist performs protected passive flexion and extension
  • Active extension against traction x10 reps, hourly
  • RB traction on 24 hours/day
• 4 weeks
  • Discontinue rubber band traction
  • Begin active flexion with an active hold in flexion for 10 seconds, passive flexion, and active extension.

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Washington Regimen

• 5 weeks
  • May be allowed out of splint for hygiene and light activity
• 6 weeks
  • Discontinue splint
• 8 weeks
  • Add blocking for differential tendon gliding if needed.
  • Gradual increase in use and resistance. Heavy lifting above 5lbs not allowed until after POW 12. (dovelle)

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• Rationale: Place the repaired FDP tendon in a shortened position (4.5mm proximal to normal resting length)
  • Decrease gap formation
  • Therapy initiated at 24 – 48 hours post op.

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• LEAF Program: Early Stage (0-3 Weeks)
  • Splint: DBS
    • Wrist at 30-40° flexion
    • MP’s at 30° flexion
    • Full IP extension allowed.
    • A separate finger based dorsal gutter is taped on with the DIP joint at 40-45° flexion.

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Early Controlled Active Motion Protocols

• Minimal Active Muscle Tendon Tension (MAMTT):
  • Minimal tension required to overcome the viscoelastic resistance of the antagonistic muscle-tendon unit.
  • MAMTT not a protocol but a concept used to guide therapy in addition to early passive protocol

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MAMTT

Evans uses the concept of MAMTT to apply a safe amount of tension to the repaired tendon as follows:

- Placing the wrist
  - Optimal position to minimize tension on repair during active flexion.
- Preparing the injured digit
  - Passive motion and edema control techniques
- Using a Haldex Guage
  - Measure the external force applied by the finger during an active contraction.

MAMTT

- Used with any surgical repair technique including simple and complex Zone II or proximal injuries
- Safer for the typical 2 Strand repairs such as the modified Kessler with circumferential suture for FDP and Kessler for FDS, but not for a mattress suture alone for FDS.

MAMTT

- MAMTT used in conjunction with early passive protocol
- Splint
  - DBS with Rubber band traction bringing digits into flexion
  - Apply rubber band traction to all 4 fingers, with monofilament and rubber band attachment running under a palmar pulley, attached to a proximal forearm strap.

MAMTT

- Exercises:
  - 10-20 reps of passive finger flexion to distal palmar crease
  - 10-20 reps of active IP extension with the other hand holding the MP joints at 90° flexion to attain full IP extension
  - At night, detach rubber band traction and strap fingers into IP extension to dorsal hood of splint

MAMTT

- PERFORMED IN THERAPY ONLY and begun 1-3 days post repair:
  - Slow, repetitive PROM to composite flexion
    - Reduce resistance to less than 300 gm.
  - Active hold component: Therapist places all 4 fingers of the injured hand in the following position:
    - Wrist extended to 20-30°
    - MP flexion to 80°
    - PIP flexion to 75°
    - DIP flexion to 30-40°
    - Patient holds this position

- Calibrated Haldex pinchmeter (<150 gm) is used to measure the force of flexion.
- The patient is allowed to apply 15-20 gm of force as measured by the pinchmeter during the active hold component.
MAMTT

- Wrist tenodesis exercises: Passive
  - Therapist passively flexes fingers into palm and extends the wrist to 30-40°
  - Then, passive wrist flexion to approximately 60° while the fingers are allowed to relax in extension through natural tenodesis action.
- 3 weeks
  - Pt is allowed to perform the active hold exercises at home.
  - Therapy then proceeds according to the usual flexor tendon protocols.

Indiana Early Motion Flexor Tendon Protocol

- Repair Technique: Tajima core suture plus horizontal mattress-
  - Equal to 4 strand repair plus epitendinous suture.
- Criteria:
  - Motivated, understanding patients
  - Minimal to moderate edema which does not restrict passive flexion
  - Minimal wound complications.

Indiana Early Motion Protocol

- Protocol: Patients begun on 400 mg Ibuprofen TID for edema control
- Week 0-4
  - Splinting
    - Dorsal blocking splint (wrist 20° flexion, MP’s 50° flexion, IP’s straight)
    - Wear dorsal blocking splint continuously
      - Except 1x/hr, remove and apply hinged wrist splint
      - Immediately reapply dorsal blocking splint after exercises.

- Exercises, (Week 0 to 4):
  - First Passive:
    - 15 reps of passive flexion/extension to the PIP joint, then the DIP joint, then entire digit.
  - Apply Tenodesis splint for 25 reps of Place and Hold:
    - Passively flex fingers & simultaneously extend wrist.
    - Gently/lightly contract the digits for place and hold held 5 seconds
    - Relax fingers and allow wrist to drop into flexion, and resultant finger extension

Indiana Early Motion Protocol

- Week 4:
  - Splinting:
    - D/C wrist hinge splint
    - Continue using DBS except for tenodesis exercises until POW 6.
  - Exercises- 25 reps every 2 hours w/o splint
    - Passively flex fingers and extend wrist. Hold for 5 seconds then relax into wrist flexion. x 25
    - Add light active finger flexion and extension avoiding combined finger and wrist extension. x25
Indiana Early Motion Protocol

- Week 5
  - Splinting: Same as week 4
  - Exercises: Continue week 4 exercises
    - 50 reps every 2 hours
    - Add tendon gliding; hook fisting
- Week 6
  - Splinting: Discontinue dorsal blocking splint
  - Exercises: Continue previous exercises
  - Add blocking exercises if finger flexion lacks more than 3 cm from DPC.
  - Do not perform blocking exercises to the small finger FDP

Pyramid of progressive force exercises

- Level 1: Passive
  - Protected Digital Extension
  - Passive tenodesis out of splint

References

References