

***Early Short Arc Motion
For the Zone III, IV Extensor Injury; 2012
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- I. Historical Perspective
- II. Rationale for Immediate Active Tension
 - A. The effects of immobilization
 - 1. loss of glycosaminoglycan concentration
 - 2. loss of water
 - 3. decreased fibronectin concentration
 - 4. decreased endotenon healing
 - 5. loss of gliding function
 - 6. imposed injury to uninvolved tissues by immobilization
 - B. The effects of controlled stress; biochemical/biomechanical benefits
 - 1. improved tensile strength
 - 2. increased fibronectin concentration/ fibroblast chemotaxis
 - 3. increased repair site DNA
 - 4. improved cellularity with both *motion* and *tension*
 - 6. maintain homeostasis in uninvolved tissues
 - C. The effect of timing
- III. Indications/Contraindications for Active Tension
 - A. Not limited to any specific repair technique
 - B. Appropriate for simple and especially complex injury if associated osseous injury will tolerate controlled motion and if the patient can understand treatment protocols
 - C. Optimum time to start motion: 24-48 hours post-operative
 - D. Caution if patients started late (>10 days)
 - E. Patients need to be monitored in therapy 2/3 times per week for first 3 to 4 weeks
- IV. General Considerations
- V. Guidelines for Treatment Zones III, IV
 - A. Zones III and IV: Open or closed injury to the extensor tendon over the PIP joint or proximal phalanx may result in a boutonniere deformity.
 - 1. Splint position
 - a. Traditional management: uninterrupted splinting of the PIP joint at absolute 0 degrees extension for 4 to 6 weeks with digital cylinder casting or volar thermoplastic splinting
 - b. SAM protocol (see Evans RB. J Hand Surg 19A:991-997, 1994) Volar digital static extension splint for PIP and DIP joints holding both at 0 degrees of extension between exercises

2. Timing: SAM protocol for immediate active *short arc motion* preferably 24 hours post-operative (for open injury and repaired tendon)
3. Exercise: template splint 1 allows 30 degrees PIP flexion and extension (DIP is allowed to flex simultaneously to 25 degrees). Template splint 2 positions the PIP at 0 degrees and is cut away at the DIP level. Full DIP flexion is allowed if the lateral bands were not repaired, but only 25 degrees flexion is allowed if the lateral bands were repaired. *If no lag* develops 40 degrees PIP flexion is allowed by week 3, and 60 to 70 by the end of week 4; 90 by week 6. Exercise position is wrist 30 degrees flexion, MP at 0 degrees to slight flexion and IP joints as described within the template splints. (see: Evans RB, Thompson DE. J Hand Ther 6:4. 266-284, 1993)
4. Clinical results: 64 digits in 55 patients with open and repaired zone III extensor tendon injuries compared as two groups; 76%/77% complex in groups I (3-6 weeks immobilization) and II (immediate active short arc motion) (17). Early motion group (SAM) experienced less extensor lag (-13 vs. -3), improved flexion (PIP and DIP) (110 vs 131), shorter treatment time (76 vs. 51 days to discharge), and no boutonniere deformity.

B. Discussion

1. Problems associated with zones III and IV associated with the often complex nature of the injury, unfavorable ratio of tendon-to-bone interface in zone IV, improper postoperative splinting, and the effect of stress deprivation on associated connective tissue.
2. SAM program allows 4mm of excursion Zones III, IV calculated by radians.
3. Isolated DIP motion creates lateral band excursion
4. Active extension from 30 degrees flexion to 0=300gm internal tendon tension
5. The position of wrist flexion decreases workload of EDC and facilitates interossei which extend the PIP when the wrist is flexed; the position of MP extension transmits force to the EDC in zones III and IV because the sagittal bands glide proximal with MP extension; some active tension desired to create true proximal migration of the repair site and to stimulate cellular events of healing; the position of MP extension reduces the workload of the EDC through the action of the lumbricals and interossei. The lumbricals assist IP extension both directly through the action on the PIP joint, and

indirectly by neutralizing the viscoelastic resistance of the flexor digitorum profundus. The interossei work to assist IP extension with the MP in extension

* It is not necessary to splint more than the PIP and DIP joints

* Early motion at this level is supported by a number of clinical studies



Abbreviated References

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