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Hand Tips & Tricks: Relative Motion Extension Orthosis for Extensor Tendon Injuries

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Introduction

Extensor tendons of the fingers can suffer various injuries over the dorsum of the hand, leading to loss of active extension of the metacarpophalangeal joint (MPJ). The sagittal band can rupture acutely after blunt trauma (Figure 1), or can gradually attenuate idiopathically or in patients with rheumatoid arthritis, leading to extensor tendon subluxation at the MPJ. Occasionally, acute ruptures can be treated with immediate immobilization; however, most patients with symptomatic extensor subluxation require surgical centralization of the extensor tendon followed by immobilization. Extensor tendon lacerations in zones V-VII are treated with tendon repair and post-operative immobilization. Traditionally, all of these conditions have been immobilized with MPJ in full extension for a period of four to six weeks, followed by gradual mobilization. This often leads to loss of finger range of motion secondary to joint stiffness and collateral ligament contractures, as well as tendon adhesions.^{1,2} Unlike flexor tendons, extensor tendons pass through interstitial tissue without the protection of synovial sheaths, thus making

them susceptible to post traumatic edema and fibrin tethering.³

Previous early motion programs utilized high profile dynamic extension orthoses that are time consuming to fabricate and bulky for the patient. These programs integrate gradual range of motion often requiring diligence of the patient, frequent hand therapy visits, and a guided home therapy program.

A more functional protocol, first described by Merritt et al. two decades ago and used at the University of Pennsylvania over the last ten years, was developed to overcome the problems and complications of these other approaches.⁴ The Immediate Active Range of Motion (ICAM) program utilizes the low profile relative motion extension orthosis (RMEO) and early, controlled active motion of the fingers, requiring fewer therapy visits and yielding excellent results.⁵

How it works

An RMEO (also referred to as a yoke splint) is often made of thermoplast material and places the injured finger in relative 15 to 20 degrees of extension at the metacarpophalangeal joint compared to adjacent fingers sharing the same common extensor muscle belly (Figure 2).^{1,4}



Figure 1. (A) Coronal and (B) axial MRI images demonstrate ulnar subluxation of the extensor tendon following closed blunt trauma to the middle finger MPJ.



Figure 2. Relative motion extension splint (RMEO) positioning the injured middle finger in 15-20 degrees in relative extension compared to adjacent digits.

When the finger is restricted in relatively less flexion than its neighboring fingers, less force is exerted on the repaired tendon compared to adjacent tendons, with decreased tendon excursion of approximately 5 mm.⁶ This design allows for safe, near full, digital motion without stress that would result in rupture of the repaired tendon.

Additionally, the wrist can be splinted in slight extension to further protect the extensor tendons and suture line from increased passive tension. Both orthoses are worn fulltime, and the patient is encouraged to move the fingers within the confines of the orthoses. At 3 weeks the wrist orthosis is weaned, with continued use of the RMEO until 6-8 weeks postoperatively. It is important to note that these therapy programs are often tailored to individual patients and their progress.^{5,7}

Merritt et al. first described this protocol after extensor tendon repairs and for sagittal band injuries.⁴ Catalano et al. subsequently reported using a similar relative motion orthosis in slightly more extension (25 to 35 degrees) for nonsurgical treatment of acute sagittal band injuries that result in extensor tendon subluxation and dysfunction.² Sagittal bands are primary restraints to radial and ulnar deviation of the extensor tendon at the MCP joint, and injury to the sagittal band results in subluxation of the extensor tendon. The RMEO can be used in nonsurgical management of such injuries or for postoperative protection of surgical repair during rehabilitation.

Benefits

Range of motion

The primary benefit derived from the relative motion extension orthosis is improved passive and active range of motion after extensor tendon injury and repair by preventing joint stiffness and adhesions. Merritt et al. reported near full recovery of full flexion: 98.5% of flexion compared to

the contralateral hand at 6 weeks and 96.2% of total active motion.¹

Therapy duration

Another benefit of relative motion splinting is to allow patients more functional active range of motion of the hand during recovery, with fewer therapy visits required to address the negative effects of prolonged immobilization, with less need for strict supervision from in-person hand therapy. Merritt et al. reported an average of 8 therapy visits during recovery, and a return to work of at an average of 18 days.¹ Howell et al reported that the average discharge from therapy was 7 weeks after surgery.⁵ After initial therapy and guidance, the orthosis is typically worn for another 6 to 8 weeks with fewer therapy visits.

Return to work

Immediate controlled active range of motion of the hand allows patients to return to work earlier than with static immobilization. Hirth et al. compared outcomes of relative motion orthosis with immobilization and found that the average number of weeks before return to work was 3.3 weeks compared to 9.4 weeks in the immobilized group.⁷ two-way mixed ANOVA

Immediate Active Range of Motion (ICAM) Protocol adopted by Penn Hand Service 5

Phase 1: Postoperative Weeks 1-3

Relative motion extension orthosis is created to hold the involved digit in 15-25 degrees of relative extension (Figure 2). In addition, the patient is placed in a volar wrist orthosis with the wrist in 20-25 degrees of extension. The patient wears both splints at all times and is allowed active range of motion

within the confines of both orthoses. They are restricted from heavy activity or strengthening.

Phase II: Postoperative Weeks 4-5

To progress to phase II, the patient must have full digit active range of motion within the confines of the orthoses. The patient is weaned out of the wrist orthosis for light activity and instructed to continue exercises within the confines of the RMEO. For sleep and medium/heavy activity, the patient should continue to wear both orthoses.

Phase III: Postoperative Weeks 6-8

The patient is weaned out of the wrist orthosis completely. The relative motion extension orthosis is continued, except when performing therapy exercises which include active range of motion out of all orthoses. Once the patient is able to achieve full range of motion of the wrist and digits, the RMEO is discontinued and patient is discharged from therapy with no restrictions.

Conclusion

Relative motion extension orthoses allow for immediate active range of motion of the digits following extensor tendon repair or closed or open treatment of sagittal band injuries.

The Penn Hand Service has been using relative motion extension orthoses for both extensor tendon injuries and sagittal band injuries with very good outcomes. Combined with a progressive rehabilitation protocol, these lower profile, functional orthoses offer patients a more comfortable method to preserve range of motion of the digits after these injuries.

References

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