An Improvised Approach to Relative Motion Extension Splinting in the Emergency Room

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Summary: Lacerations to the dorsum of the hand are frequently complicated by involvement of extensor tendons. Bedside repair of these injuries in the emergency room decreases time to treatment and avoids operating room expenses and anesthetic associated risks. Optimal outcomes require prompt follow-up and initiation of hand therapy to promote tendon gliding and prevent tethering of scar tissue. Here, we present our improvised relative motion extension splint utilized in treatment of zone five and six extensor tendon lacerations. This orthosis is preferred in isolated extensor tendon injuries that are amenable to primary repair at the bedside in the appropriately compliant and motivated patient. Our design is comprised of readily available supplies in the emergency room setting. Our improvised relative motion extension splint is lighter weight versus a traditional plaster orthosis and frees the patient to engage in activities of daily living with the injured hand on day four following tendon repair. With repeated application we have become facile with this design, which also permits flexibility such as placement of a wrist extension splint component if needed. Relative motion extension splinting is an established method of treatment following extensor tendon repair. Here, we present a straightforward method of fabricating such a device in the emergency room without the availability of thermoplastic materials. Future study will be needed to establish the efficacy of this device versus its thermoplastic counterpart.

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INTRODUCTION

Relative motion splinting was introduced by Dr. Merritt and colleagues in 1981. In the setting of extensor tendon and sagittal band injuries, relative motion extension splinting places the involved digit in 15–20 degrees of relative extension versus the adjacent digits. Conversely, relative motion flexion splinting places the involved digit in 15–20 degrees of flexion versus the adjacent digits and may be utilized for flexor tendon injuries or treatment of early Boutonnière deformity. Both arrangements unload strain at the site of tendon repair due to the quadriga effect. Biomechanical studies have validated this reduction in strain on both intact and repaired extensor tendons.

Dr. Merritt’s original design included hand and wrist-based components. Inclusion of a wrist extension splint (20–25 degrees) is supported by intraoperative findings of decreased tension across the extensor tendon repair in this position. Despite this anatomic benefit, later work by Hirth et al demonstrated efficacy of a hand-based orthosis only, with no ruptures or extension lag in their series of 23 patients. The relative motion splint design can therefore be adapted easily depending on the clinical scenario, considering attributes such as the strength of repair and patient adherence.

Lacerations of the dorsal hand frequently involve the extensor mechanism due to minimal soft-tissue coverage in this region. Our understanding of tendon healing underscores the importance of early motion. Animal models have demonstrated decreased adhesions, improved excursion, and higher tensile strength when an active motion protocol is employed. Protected early motion is clinically supported for patients with an isolated extensor tendon injury.

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Isolated extensor tendon lacerations in zones 5 and 6 are often repaired at the bedside at our institution. Doing so expedites treatment while obviating the need for proximal motor blockade, sedation, or use of a painful tourniquet. Primary repair is performed using a running interlocking horizontal mattress technique with 3-0 or 4-0 nonabsorbable braided suture (Ethibond, Ethicon, Somerville, N.J.). Performing the repair under local anesthesia permits the patient to flex and extend and assist the provider in tensioning of the repair. Furthermore, avoidance of sedation facilitates education regarding postoperative management.

Our technique utilizes four components: a tongue depressor, cast padding, laparotomy pads, and self-adhering wrap (Fig. 1). Two laparotomy pads are cut such that the loop is left with a strip of gauze at 90 degrees to it (Fig. 2). The loops are secured to either side of the tongue depressor with lark’s head knots, which is covered with cast padding centrally followed by self-adhering wrap to secure the loops and padding in place. The loops are then pulled over the radial and ulnar aspects of the wrist with the strips of gauze overlying the dorsal and volar wrist (Fig. 3). These are then secured within the desired hand dressing to complete the orthosis (Fig. 4).

The patient is instructed to avoid use of the injured hand for three days following repair, after which the hand may participate in activities of daily living while avoiding lifting over 5 pounds. The hand should be elevated at night on pillows. The patient is referred to hand therapy 1–2 weeks following injury and returns to clinic 2 weeks after repair. In hand therapy, the patient is transitioned to a thermoplastic relative motion extension splint and a formal active motion protocol is initiated.

Our relative motion extension splint includes a finger yoke and soft hand dressing to anchor the yoke and protect the soft-tissue repair (see Video [online], which demonstrates relative motion extension splinting technique). It does not by convention include a static wrist component, although if desired this modification could be made with plaster within the proximal dressings. This device can be efficiently constructed using the method described or by making straightforward substitutions for the items included in our technique (eg, padded aluminum splint in place of a tongue depressor). Of note, treatment of border digits necessitates both are placed in extension to stabilize the device. The improvised relative motion extension splint may require additional patience on the part of the clinician but ultimately provides a streamlined orthosis and flexible rehabilitative course following extensor tendon repair (see Video [online], which demonstrates relative motion extension splinting technique).

**DISCUSSION**

A prior study of extensor tendon repair supports early repair, with superior results within five days of injury. Zone 5 and 6 extensors can be repaired at the time of evaluation in the emergency room. This safely expedites treatment provided the injury is clean and can be approximated without tension. Contamination, poor visualization, complex soft-tissue injury, or etiologic factors such as fight bite should prompt formal exploration in the operating room.
Work-related injuries account for nearly one-quarter of tendon lacerations presenting to the emergency room. Many patients treated at our institution face barriers to care which may delay follow-up, including financial pressures limiting the ability to leave work, or the need to care for dependents at home. Although early participation in a formal hand therapy program is optimal, our approach provides flexibility and facilitates active motion before the first therapy appointment.

A limitation of this innovation is our lack of clinical data to support its equivalence to a thermoplastic relative motion splint. Given the identical finger positioning, we hypothesize that efficacy should be similar provided the finger yoke does not separate from the hand dressing. Appropriate tensioning of the finger yoke to the proximal hand dressing is critical and the most likely point of failure. Future review of our outcomes will be needed to validate these claims.

Our improvised orthosis facilitates early protected motion, potentially improving final range of motion and grip strength. Patients treated for acute extensor tendon injuries are often placed in a volar blocking splint in the emergency department setting. Our method provides a streamlined and lightweight alternative that permits an introductory active range of motion protocol in the appropriately motivated patient with an isolated zone 5 or 6 extensor tendon injury.
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