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Literature Abstract

Relative motion orthoses in the management of various hand conditions: A scoping review

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ABSTRACT

Study Design: Scoping review.

Introduction: The relative motion (RM) concept and immediate controlled active motion (ICAM) program, originally applied after zones IV-VII extensor tendon repairs, have been modified and extended to a variety of hand conditions, such as sagittal band injury, boutonniere deformity, and extensor lag.

Purpose of the Study: To scope the published and unpublished literature to review ICAM modifications, hand conditions for which the RM concept is used, and describe the preferred degree of relative metacarpophalangeal joint extension/flexion reported and spectrum of orthosis design.

Methods: Electronic and manual searches of scientific and gray literature and expert consultation were conducted. Documents with quantitative data were assessed with Oxford Levels of Evidence and the Structured Effectiveness Quality Evaluation Scale.

Results: Fifteen references met the inclusion criteria; 1 was level III evidence, and others were level IV evidence. RM-ICAM modifications, preferred degree of relative extension/flexion, orthotic design, management of other hand conditions and knowledge gaps were identified.

Conclusion: RM orthoses may improve outcomes in a variety of hand conditions; however, high-quality studies that contribute to the evidence base for its use are needed.

Level of Evidence: Not applicable.

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Background

The concept of relative motion (RM) for the management of zones V-VI extensor tendon (ET) repairs was first studied in cadavers in the 1970s¹ and introduced in clinical practice in 1981² by the hand surgeon Wyndell H. Merritt and his therapy colleagues, Maureen Hardy and Sandra Robinson. Historically, the idea of moving ET repairs in zones V-VI evolved from observing complications such as stiffness and adhesions caused by prolonged immobilization of the wrist and fingers after tendon repair. The original RM orthosis consisted of separate but connected wrist and finger components.³ The wrist was positioned in 25°–30° extension; the finger interphalangeal joints were held in an extension

gutter, and the metacarpophalangeal joint (MCPJ) of the injured digit was positioned in 25°–30° more extension relative to the noninjured MCPJs (Fig. 1).³

The original concept of RM theorized that multiple tendons originating from one muscle, such as the common extensors, could be positioned in such a way as to protect or unload the injured/ repaired tendons, while also limiting the excursion of the injured tendons.⁴ Cadaver and biomechanical evidence supports the RM proof of concept. In addition to the cadaver study undertaken by Dr Merritt et al^{3,5} to develop the theoretical concept, 2 further cadaver studies investigated the biomechanics of RM orthoses, for zone VI ET⁶ and zone III flexor tendon repairs.⁷ Sharma et al⁶ noted decreased strain on intact and repaired tendons when tested in the RM orthoses. Although the common extensor muscle belly is thought to be an important factor in limiting force applied to the tenorrhaphy,⁸ the role of the juncturae tendinum (JT) on repairs proximal to zone V warrants further investigation.⁶

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Fig. 1. Original relative motion extension orthosis. Photo courtesy of Sandy Robinson.

During the 40-year history of RM, the concept has evolved with elimination of the finger gutter and linking strap,³ a reduction in the degree of relative extension,³ and elimination of the wrist orthosis in ETs in zones V and VI.^{9–11} Use has also expanded to include extensor repairs in zones IV³ and VII^{3,12} and sagittal band (SB) injury¹³ or repair.¹² Most recently, the RM concept has been applied to manage acute and chronic boutonniere deformity^{8,14} and to decrease hand pain (personal communication between MH and Dr Donald Lalonde and personal communication between MH and Amanda Higgins). The versatility of the RM orthosis for various neurologic and/or orthopedic problems affecting MCPJ alignment, balance, or range of motion (ROM) has also been documented.¹⁵ The RM concept has since been expanded to the management of postoperative tendon transfers, flexor tendon and digital nerve repairs,¹ interosseous muscle tears,¹⁴ and as a therapeutic technique to address joint stiffness⁸ and extensor lag.¹⁴ Supporters claim advantages, such as its small size,⁹ low-profile design,^{3,10,13} simple and inexpensive fabrication,^{9,10,16} and the benefits of decreased rehabilitation time,^{3,4,11,12} early functional hand use,^{3,9,11,12} early return to work (RTW),^{9,12} improved patient adherence,^{9,16} and less financial investment for the patient or compensation carrier.⁴

Nomenclature

The RM orthosis as it is known today has had many different names. In honor of Dr Merritt, it has been called the Merritt splint^{17–19} and the Wyndell Merritt splint.¹⁰ In 2005, Howell et al³ changed the name to the acronym ICAM (immediate controlled active motion) to emphasize that it was not the usual dynamically assisted extension orthosis but immediate and active mobilization, for ET repairs. The orthosis has also been referred to as a yoke,^{19,20} a border digit splint,²¹ and an SB bridge splint.^{13,22} Most recently, to minimize confusion concerning the name of the concept and orthosis, Merritt¹ and Lalonde suggested use of the terms, relative motion *extensor* and relative motion *flexor*, dependent on the relative position of the injured digit MCPJs to the neighboring uninjured digit MCPJs.

It is important for us to point out that the terms relative motion extension (RME) and relative motion flexion (RMF) used throughout this article refer to the relative position of the injured digit rather than to a flexor or ET injury. We have also used the terms orthosis and orthoses rather than splint and splints in accordance with the current preferred nomenclature.^{23,24} Thus, we have the following terms: RME orthosis/orthoses and RMF orthosis/orthoses.

Despite widespread use, there is very limited evidence for the therapeutic efficacy of RM. Most studies consist of either single-center case series or technical articles.

Purpose of the study

The purpose of this scoping review is to gather, synthesize, and critically examine the scope of evidence supporting the RM concept in the management of hand and finger conditions and to answer the following questions:

1. For which conditions can RME and RMF orthoses be used, and what evidence exists to support their use for each condition?
2. What degree of relative flexion or extension of the MCPJs is indicated for use in each condition?
3. For each condition, what is the preferred RM orthotic design?

The summary of parameters for this scoping review is outlined in Table 1.

Methods

Because the RM literature is scarce, a scoping review permitted us to adequately address our research questions and identify knowledge gaps through scoping the field of both published and unpublished studies and reviews.^{25,26}

We used the 5-stage framework of Arksey and O'Malley²⁵ for review of the available literature and presentations. The framework requires (1) identifying the research questions; (2) identifying relevant studies; (3) study selection; (4) charting the data; and (5) collating, summarizing, and reporting the results.²⁵ The optional sixth stage of Arksey and O'Malley²⁵ was also selected; consultation with experts in the field. Including stage 6 enabled us to take in supplementary references suggested by the experts and document their insights beyond those cited in the literature.^{25,27}

Table 1
Scoping review parameters

Scoping review parameters	
Participants	Adults who have had a RM orthosis applied in the management of a hand injury or condition
Exclusion criteria	<ul style="list-style-type: none"> ■ The content of the document was duplicated in another source (eg, multiple conference presentations given on the same topic, or a conference presentation given on published studies, with priority given to published studies) ■ If the study or presentation was given in a language other than English
Interventions	Application of either a RME orthosis or a RMF orthosis
Outcomes reported	Motion/strength <ul style="list-style-type: none"> ■ Active finger ROM ■ Active wrist ROM ■ Grip strength Tendon subluxation Pain Number of therapy sessions RTW Function <ul style="list-style-type: none"> ■ Patient self-report: standardized and nonstandardized Therapy attendance Adverse events <ul style="list-style-type: none"> ■ Complications ■ Pain and subluxation
Search terms used	PubMed search terms with similar terms for MEDLINE, EMBASE, and CINAHL: (hand injur* OR tendon injur* OR tendon) AND (splint OR splints OR relative motion OR yoke OR bridge splint OR Merritt OR immediate controlled active motion OR orthotic OR orthoses)

RM = relative motion; RME = relative motion extension; RMF = relative motion flexion; ROM = range of motion; RTW = return to work.

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