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A randomized comparative trial: Relative motion vs metacarpophalangeal joint blocking orthoses for trigger finger management

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ABSTRACT

Background: Metacarpophalangeal joint blocking orthoses are used for managing trigger finger, with limited intervention evidence for relative motion orthoses.
Purpose: This 6-week trial evaluated the effectiveness of metacarpophalangeal joint blocking and relative motion orthoses for managing trigger finger severity, function, occupational performance/satisfaction, and orthosis wearability.
Study Design: Randomized comparative trial, ClinicalTrials.gov (NCT05763017).
Methods: Thirty-six participants with no prior trigger finger intervention and ≥ 21 years old were randomly assigned to the relative motion or metacarpophalangeal joint blocking orthosis (neutral metacarpophalangeal joint) groups. The primary author screened for eligibility and fabricated the orthoses. Week-1 and week-6 Therapist A assessed stages of stenosing tenosynovitis, number of triggering events in 10 active fists (NTE), visual analog scales for pain, orthosis comfort and satisfaction (wearability), Disabilities of the Arm, Shoulder and Hand, and Canadian Occupational Performance Measure. Week-3 Therapist B administered orthosis wearability visual analog scales. The relative motion pencil test determined orthosis design, relative motion extension or flexion, and metacarpophalangeal joint differential. Mixed-effects ANOVA was used to compare week-1 and week-6 outcomes. Cohen's *f* was used to measure the effect size.
Results: Thirty-five participants completed this trial. Between week-1 and week-6, both groups demonstrated significant differences with large effect size in stages of stenosing tenosynovitis ($f = 1.21$), NTE ($f = 1.07$), pain *at rest* ($f = 0.36$), pain *during activity* ($f = 0.76$), Disabilities of the Arm, Shoulder and Hand ($f = 1.19$), Canadian Occupational Performance Measure performance ($f = 1.12$) and satisfaction ($f = 1.14$). No superior effect was noted between orthosis groups. Wearability for both groups was 7/10 *at rest* and 4/10 *during activity*. The pencil test yielded 15/18 relative motion extension orthoses and 20-25° metacarpophalangeal differential.
Conclusions: Symptom severity, pain, hand function, and orthosis wearability outcomes support interchangeable use of relative motion and metacarpophalangeal joint blocking orthoses for managing trigger finger.

Introduction

Interventions for trigger finger (TF) can include surgery,[1] corticosteroid injection[2] or orthotics.[3] The most frequent first line of intervention is an orthosis with or without injection.[4] The basis for using an orthosis is to control the extent of flexor tendon excursion within the pulley system of the digit.[5] Various hand-based and

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finger-based orthoses have been described to control flexor tendon excursion through the first annular (A1) pulley of the finger.[6] These orthoses generally control excursion by immobilizing one finger joint, either the metacarpophalangeal (MCPJ), proximal interphalangeal joint (PIPJ), or distal interphalangeal joint (DIPJ).[6] The most described orthosis blocks the MCPJ,[5,7-12] followed by those that block the PIPJ[7,8,13] or the DIPJ.[9,14]

Theoretically and biomechanically, clinician experts have promoted the use of relative motion (RM) finger-based orthoses to manage patients with TF.[15] RM orthoses are a practical option as the small size does not block MCPJ motion. Furthermore, the distinctive 20-25° MCPJ differential can be designed in more extension or greater flexion to control tendon excursion[16,17] and friction within the pulley system.[5] When the MCPJ differential is in more extension or RM extension (RME), there is less passive tension in the extensor system of the affected finger(s), reducing the amount of flexion force during finger flexion[18] as well as friction within the pulley system.[5]

Recently, Yendi et al[19] published a randomized controlled trial (RCT) that compared the efficacy of two different orthotic interventions for TF. This RCT used the Lindner-Tons and Ingell[20] MCPJ blocking orthosis with the MCPJ blocked in 10-20° of flexion and a RME orthosis with a 10-20° MCPJ differential.[19] It is important to note that the MCPJ position of both orthoses is different than originally described. As Lindner-Ton and Ingell[20] showed a fully extended or neutral MCPJ position and the 10-20° of MCPJ differential is less than that described in the RM literature for any application of this orthosis.[15] The purpose of using an orthosis for TF is to "protect" the finger from triggering. With that said, the exact amount of "protective" MCPJ differential required for RM orthoses is unknown when used to manage TF. However, using less than the usual 20-25° MCPJ differential may affect the "protective" role of the RM orthoses. To better inform the evidence, the RM pencil test has been proposed for use as an assessment tool.[21] Since the clinical picture for individuals with TF varies, our opinion is the RM pencil test assessment can determine orthotic design, RME or RM flexion (RMF) and how much MCPJ differential is most effective for each person.

It is our speculation that Yendi et al's[19] use of less MCPJ differential may not have adequately "protected" the affected hand during activity. If pain and/or triggering occurred this may have been what influenced their RME orthosis group score for pain and the Disabilities of the Arm, Shoulder and Hand (DASH). Since the RME group scores did not change significantly while the MCPJ blocking orthosis group scores changed significantly.[19] Thus, leading the authors to conclude that MCPJ blocking orthoses are more effective than RME orthoses in improving function.[19]

Practicality suggests that TF affecting the dominant vs non-dominant hand, will likely affect function more. In other words, individuals wearing a TF orthosis on their dominant hand may be challenged by pain and/or presence of the orthosis during hand use. In Yendi et al's[19] study, the dominant hand of those wearing RME orthoses was affected nearly twice as often as those wearing MCPJ blocking orthoses. This adds to our skepticism regarding their conclusion that RME orthoses are less effective in improving function than MCPJ blocking orthoses.

The intent of this randomized comparative trial is to incorporate a disability and functional approach to compare effectiveness of MCPJ blocking and RM orthoses as an intervention for TF. Our primary objective was to assess the effect of wearing a RM or MCPJ blocking orthoses over 6-week on TF severity. The secondary objective was to compare participant-reports of pain *at rest*, pain *during activity*, hand function, occupational performance, and orthotic comfort and satisfaction. Unique to this trial is assessment using the RM pencil test for determining MCPJ position and the degree of MCPJ differential.

Methods

This single-center, prospective randomized comparative trial was conducted at Hospital Sultan Haji Ahmad Shah, a public hospital in Pahang, Malaysia. Participants were recruited between June 2022 and April 2024 after approval by the Medical Research and Ethics Committee of Ministry of Health (NMRR ID-22-00204-BWM) and the Research Ethics Committee of Universiti Kebangsaan Malaysia (JEP-2022-319). This trial was registered with the ClinicalTrials.gov (NCT05763017) and undertaken according to the Consolidated Standard of Reporting Trials (CONSORT) guidelines. The data collection process involved three occupational therapists with the researcher having 15 years and Therapist A and Therapist B with more than 20 years of professional experience. The research protocol for this study was published previously.[22]

Study participants

Patients diagnosed by an orthopedic surgeon with TF involving the A1 pulley and referred to hand therapy were eligible for this trial. To become a participant, the following criteria had to be met: ≥21 years old; TF involving one or multiple digits TF in one or both hands, and demonstrate full passive MCPJ extension of the affected finger(s). Excluded from the study were those with trigger thumb; prior A1 pulley release or within 6-month steroid injection of the affected finger(s) or a history of affected/adjacent finger(s) fracture, tendon injury, nerve injury, Dupuytren's or other soft tissue hand conditions.

Study process and intervention

After confirming the patient's eligibility and before enrollment, the researcher (primary author, LXL) presented the study details and asked potential participants to sign the informed consent form. Figure 1 outlines the flow of the study and the assignments of the researcher, Therapist A, and Therapist B. Therapists A and B received assessment training prior to the study. Participant allocation to the RM orthosis group or MCPJ blocking orthosis group was done by simple randomization. For this trial, the participant selected a sealed envelope from a group of envelopes presented by the front office staff who also received training prior to the study.

Participants assigned to the RM group had a four-finger RME or RMF orthosis fabricated (Fig. 2). The type of RM orthosis was determined by using the RM pencil test.[23] This involved inserting a pencil between the participant's fingers to position the MCPJ of the affected finger(s) in extension or flexion relative to the other MCPJs (Fig. 3). Participants were then instructed to open and close their fingers several times and compare the effects of the different MCPJ positions on their symptoms.[21] If the participant reported that the RME pencil test lessened his/her pain and/or triggering, then a RME orthosis was fabricated. If the participant answered the other way round, then a RMF orthosis was made. The MCPJ differential angle of 20-25° greater extension or flexion was formed into the four-finger RM orthosis. If the 20-25° MCPJ differential angle failed to lessen the participant's symptoms, the differential angle was increased.

Participants assigned to the MCPJ blocking group wore a thermoplastic custom MCPJ blocking orthosis as described by Lindner-Ton and Ingell[20] (Fig. 4). The "ring" of the orthosis was designed to fit over the affected finger to hold the orthosis securely against the hand and proximal phalanx while positioning the affected finger MCPJ in neutral or 0° of extension.

Both the RM group and MCPJ blocking group received identical instructions from the researcher regarding orthosis wear, activity modification, and precautions (Fig. 1). Participants were instructed to wear the orthosis full-time for 6 weeks to avoid finger movements

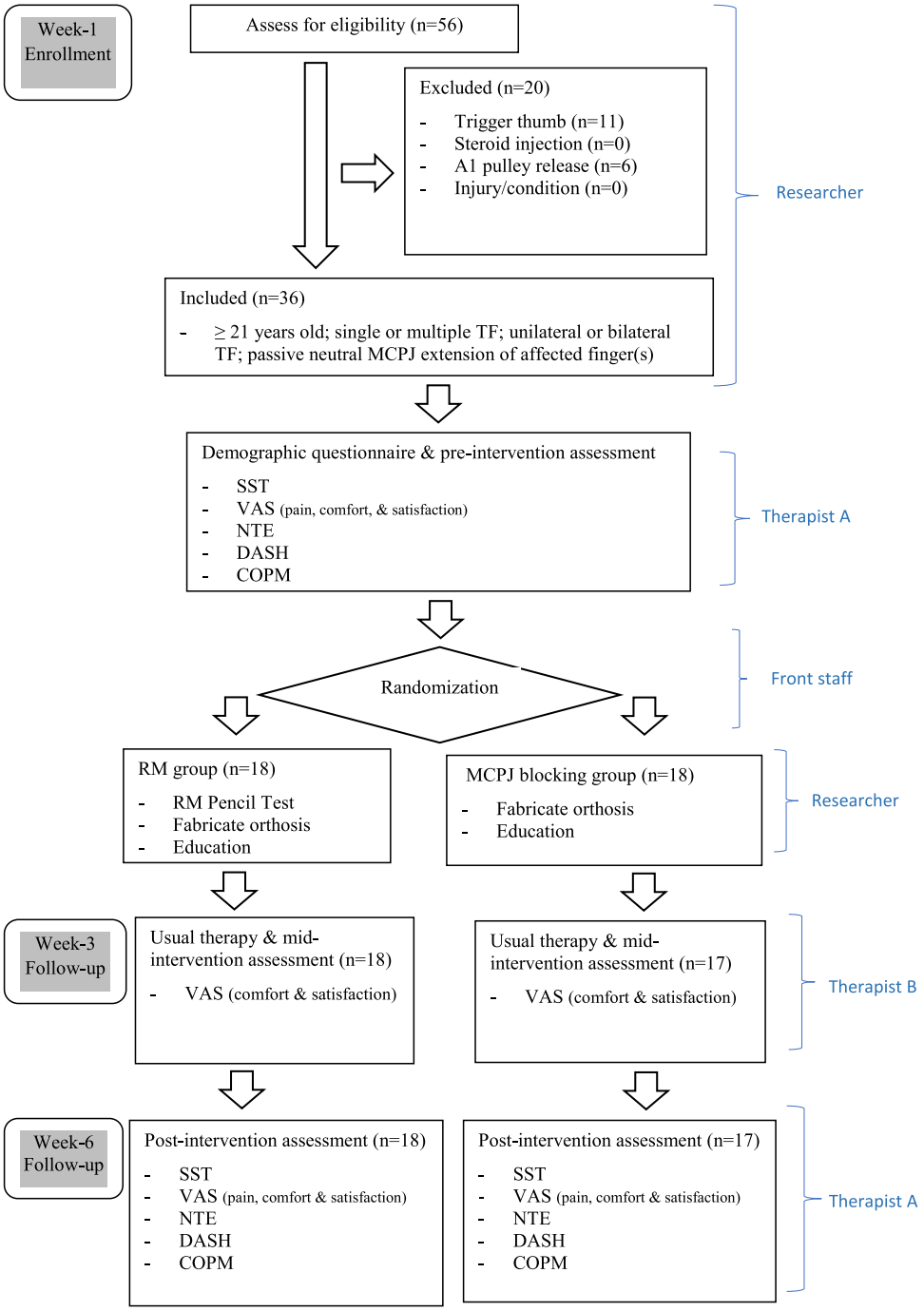

Fig. 1. Flow diagram of the study. TF = trigger finger; MCPJ = metacarpophalangeal joint; SST = stages of stenosing tenosynovitis; VAS = visual analog scale; DASH = Disabilities of the Arm, Shoulder and Hand; COPM = Canadian Occupational Performance Measure; RM = relative motion.

that exacerbated their TF symptoms, and to avoid or modify repetitive tasks and prolonged grasp. The researcher also asked each participant to keep a daily diary for logging hours of orthotic wear and to describe any tasks for which the orthosis was removed. Participants were instructed to immediately contact the researcher if they experienced issues with their orthosis including loss. If necessary, the participant was seen by the researcher.

During the 6-week trial, each participant attended three therapy sessions, starting with the baseline session or week-1 and then follow-up visits during week-3 and week-6. During week-3, Therapist B provided the "usual" therapy, which included home instruction for a 5-minute-deep circular massage over the A1 pulley and oversaw the mid-intervention assessment. During week-6, Therapist A administered the post-intervention assessments (Fig. 1).

Outcome measurements

Outcomes were measured during week-3 and week-6. Because of the conspicuousness of the orthosis, once the participant was assigned to a group it became a practical challenge to blind the participants and assessors. Figure 1 describes the timing and which

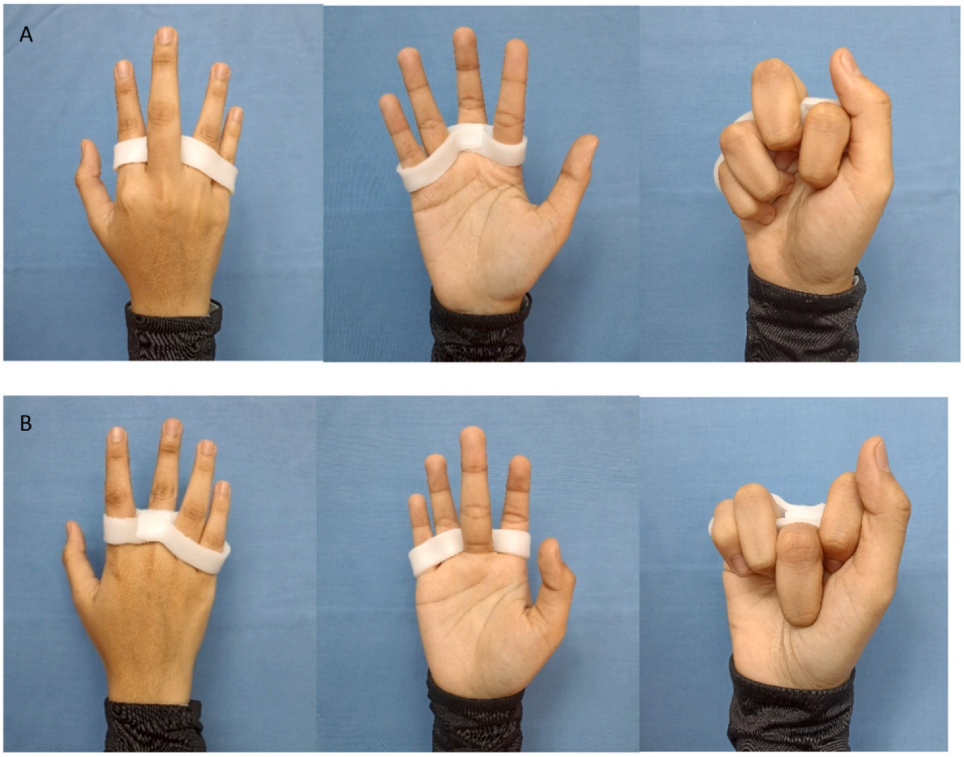

Fig. 2. (**A**) Relative motion extension (RME) and (**B**) relative motion flexion (RMF) orthoses.

outcome measurements were obtained by Therapist A and Therapist B.

Primary outcome

The primary outcome assessed was the Stages of Stenosing Tenosynovitis (SST), a six-stage system used to grade TF severity.[10] Each SST stage is theorized to describe a different mechanical problem with or without pain: stage 1: normal finger movement; stage 2: uneven finger movement; stage 3: triggering, clicking or catching; stage 4: finger locked in flexion or extension that can be unlocked by active finger movement; stage 5: finger locked in flexion or extension that requires passive force to unlock and stage 6: finger locked in flexion or extension.[10]

Secondary outcomes

In this study, pain was assessed using a 10 cm visual analog scale (VAS) and a change of 1.2 cm between measurements was considered to be a minimal clinical important difference (MCID).[24] The VAS was labeled with "no pain" at the left end and "extreme pain" at the right. Both pain *at rest* and *during activity* was measured. The participant's perception of orthosis comfort and satisfaction was assessed using separate VASs. Collectively, comfort and satisfaction are defined as orthosis wearability, and both were measured *at rest* and *during activity*. For comfort, the left end of the VAS was labeled "not at all comfortable" and the right end was labeled "extremely comfortable." For satisfaction, the left end of the VAS was labeled "not at all satisfied" and the right end was labeled "extremely satisfied." For all VASs, the participant was asked to rate their level of pain or comfort or satisfaction by marking the scale. The score being the measured distance between the mark and the left end of the scale.

The frequency of triggering was assessed using the number of triggering events in 10 active fists (NTE).[25] Each participant was asked to actively open and close their fingers fully while being observed by the assessor for signs of triggering, counted and recorded (0-10).[25] During the process of actively opening and closing, if the

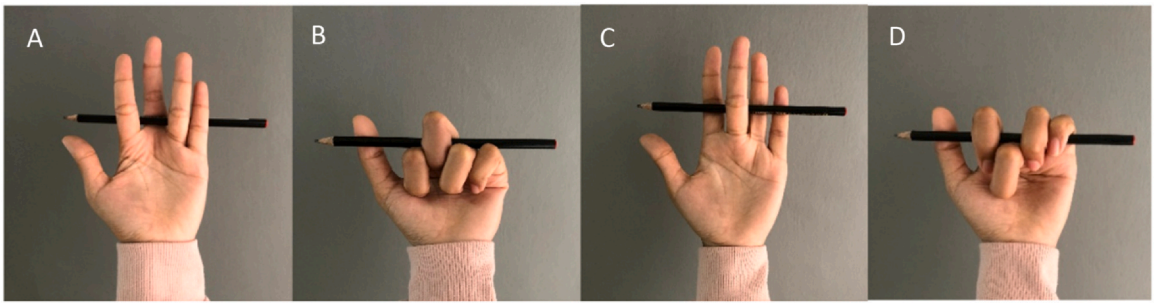

Fig. 3. Relative motion pencil test. (**A**) RM extension (RME) fingers open, (**B**) RME fingers closed, (**C**) RM flexion (RMF) fingers open and (**D**) RMF fingers closed.

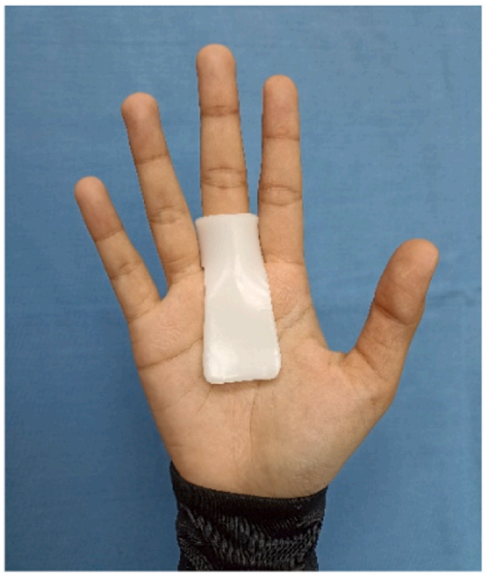

Fig. 4. Metacarpophalangeal joint (MCPJ) blocking orthosis.

finger persistently locked, a score of 10/10 was assigned. If any participant had multiple fingers affected by TF, they were asked to perform 10 repetitions with the result reported on the worst-performing finger.

The Disabilities of the Arm, Shoulder and Hand (DASH) Outcome Measure was used to measure hand function.[26] Participants answered a 30-item questionnaire covering performance of selected activities (21 items), severity of symptoms (five items), and impact on social function, work, sleep and self-image (four items). Two optional modules for work and sports were not used. The DASH score ranges up to 100, with higher scores indicating greater disability or poorer hand function.[26] For this trial, a change in the DASH score of 10.8 points was considered a MCID.[27]

The Canadian Occupational Performance Measure (COPM) was used to measure each participant's occupational performance.[28] The COPM is an interview-based assessment tool where participants reported and prioritized activities they could not accomplish. They also rated their performance and satisfaction with these activities on a 10-point scale, with higher numbers indicating better performance and satisfaction. The MCID for the performance and satisfaction subtests were reported as a change of 0.9 points and 1.9 points, respectively.[29]

Sample size

Sample size calculation using G*Power determined that 32 participants were required. Assuming 10% drop out rate, 36 participants in all were needed with 18 participants each allocated to the RM and MCPJ blocking groups.

Statistical analysis

Descriptive statistics were used to summarize and organize demographic data including age, gender, occupation, hand dominance, finger(s) involved, associated medical conditions, and duration of triggering onset. Data was expressed in total numbers, mean, and the pattern of the data. Descriptive statistics were also used for the primary (SST) and secondary (NTE, VASs, DASH, and COPM) outcome measurements. A mixed-effect analysis of variance (ANOVA) was used to compare week-1 and week-6 SST, NTE, VAS (pain, orthosis comfort and satisfaction), DASH, and COPM. Cohen's f was used to measure the effect size of the orthotic intervention and was reported only for statistically significant effects.

Results

Recruitment, follow-up, and RM pencil test

Figure 1 illustrates the flow of patients beginning with participant inclusion and through the 6-week orthotic trial. Originally, 56 patients were considered for eligibility. Of these, 20 patients were excluded with the diagnosis of trigger thumb (n = 11), prior A1 pulley release (n = 6) or declined to participate (n = 3). The remaining 36 individuals met the inclusion criteria, signed the consent form, and were randomly assigned to the RM group (n = 18) or the MCPJ blocking group (n = 18). After RM pencil test assessment, 15/18 RM group participants chose to wear a RME orthosis and 3/18 chose to wear a RMF orthosis. During week-3, the MCPJ blocking group lost one participant to follow-up. Final outcomes were obtained from the RM group (n = 18) and MCPJ blocking group (n = 17) during week-6.

Participant demographics and trigger finger characteristics

Demographic characteristics of the participants are reported in Table 1. The participant's mean age in both groups was mid to late 50s, with females having a higher incidence of TF than males. For most, metabolic and/or inflammatory disorders were a part of their medical history. The middle finger was involved most often for both groups followed by the ring, index, and little fingers. A total of nine participants had multiple fingers on one-hand, while seven had TF affecting both hands. TF involved the dominant hand in both orthosis groups more often than the non-dominant hand. No statistically significant differences were noted between orthosis group participant or trigger finger characteristics.

Outcome measures

The overall results are shown in Table 2 for the effectiveness of this 6-week trial of wearing RM or MCPJ blocking orthoses for TF. A significant main effect for time was obtained for all outcomes measured including the primary outcome measure for TF severity (SST) and the secondary outcome measures of NTE, VAS pain *at rest*, VAS pain *during activity*, DASH, COPM performance score, and COPM satisfaction score (Table 2). These results indicate that each type of orthosis was effective in reducing the severity of TF and improving hand function and occupational performance. After separately determining the effectiveness of the RM and MCPJ blocking orthoses, these same primary and secondary outcomes were compared between orthosis groups (Table 2). In this comparison, an insignificant main effect resulted, indicating that there were no significant differences between the RM and MCPJ blocking groups. Furthermore, when an interaction effect between time and orthosis group was analyzed for these outcomes, neither orthosis group demonstrated a better effect (Table 2). The effect size of SST, NTE, VAS pain *during activity*, DASH, COPM performance score, and COPM satisfaction score ranged from 0.76 to 1.21, indicating a large effect. The effect size of VAS pain *during rest* (f = 0.36) was found to be approaching the threshold for a large effect (f = 0.40) (Table 2).

There was no significant main effect for time, group and interaction between time and group (Table 3), as participants in both orthosis groups reported similar (wearability) VAS comfort and satisfaction scores. After 6-week of orthotic wear, the mean VAS comfort and satisfaction scores of both groups *at rest* were 7/10. While mean VAS comfort and satisfaction scores for both groups *during activity* were 4/10.

Table 1
Participant and trigger finger characteristics of the relative motion (RM) and metacarpophalangeal joint (MCPJ) blocking orthosis groups

Demographics	RM orthosis RME (15) RMF (3) n = 18	MCPJ blocking orthosis n = 17	p
Age			
Minimum – Maximum	40-86	37-71	
M (SD)	59.4 (11.7)	54.0 (10.2)	0.152
Gender			
Male	5 (27.8%)	2 (11.8%)	
Female	13 (72.2%)	15 (88.2%)	0.237
Associated medical disorder			
Metabolic (Diabetes, hypothyroidism, etc)	7 (38.9%)	7 (41.2%)	
Inflammatory (Inflammatory arthritis, gout, carpal tunnel syndrome, etc)	3 (16.7%)	0 (0%)	
None	8 (44.4%)	10 (58.8%)	0.202
Duration of onset (mo)			
Min-Max	1.0-48.0	0.5-12.0	
M (SD)	9.0 (11.4)	4.7 (4.5)	0.133
Finger(s) involved			
Index	7 (28.0%)	3 (10.7%)	
Middle	10 (40.0%)	15 (53.6%)	
Ring	7 (28.0%)	9 (32.1%)	
Little	1 (4.0%)	1 (3.6%)	0.442
Multiple fingers involved on one hand			
Yes	3 (16.7%) Index and little (1) Index and middle (2)	6 (35.3%) Index and middle (1) Middle and ring (4) Index-middle-ring (1)	
No	15 (83.3%)	11 (64.7%)	0.208
Both hands involved			
Yes	4 (22.2%)	3 (17.6%)	
No	14 (77.8%)	14 (82.4%)	0.735
Dominant hand involved			
Yes	11 (66.7%)	11 (58.8%)	
No	7 (33.3%)	6 (41.2%)	0.826

M(SD) = Mean(standard deviation); RME = relative motion extension; RMF = relative motion flexion; p = p-value.

Although an insignificant interaction between time and orthosis group is observed for orthosis comfort and satisfaction (Table 3), the intersection of lines, as in Figure 5, indicate an interaction for comfort *at rest* (Fig. 5A), comfort *during activity* (Fig. 5B), and satisfaction *during activity* (Fig. 5D) between the orthosis groups during the 6-week trial.

Orthosis wearing hours

The participant-reported their average hours of daily orthotic wear to be 10.7 hours for RM group and 12.9 hours for MCPJ blocking group. No significant difference (p = 0.156) in reported orthotic wear times was noted between the groups.

Discussion

We found no difference in the primary and secondary outcomes measured between the groups that wore RM or MCPJ blocking orthoses for 6-week as an intervention for TF. More precisely, one orthosis was not superior to the other for the outcomes studied. Because our outcomes somewhat conflict with those reported by Yendi et al,[19] discussion will include a comparison between the two reports. A key difference between this RCT and those of others[8,9] including Yendi et al,[19] is that we used comparative statistics that incorporate both main and interaction effects, which we believe to be more appropriate and robust when examining intervention effectiveness.

Our trial aligns with the demographic evidence[8,9,11,13,19] in that TF affects mostly women in their mid to late 50s. In this trial, the dominant hand orthosis wearers in both groups were evenly distributed as opposed to Yendi et al's[19] RME group who had nearly twice the dominant hand wearers as the MCPJ blocking orthosis group. In our view, when TF affects the dominant hand, this could, more than if it were the other hand, have an adverse impact on the wearer's perception of hand function and orthosis wearability.

Both our study and Yendi et al[19] observed more middle finger involvement than ring finger, which differs slightly from a 2019 literature review[3] reporting more involvement of the ring finger. Of interest, and for which we have no explanation was one-third of our participants had TF affecting the index finger. For our trial, we included individuals with multiple TF fingers differing from others[6] including Yendi and colleagues.[19] It is our opinion that including individuals with added health complexities mirrors clinical practice. Interestingly, the three participants in the RM group with multiple TF on one-hand chose RME orthoses. The participants in the MCPJ blocking group with multiple digits required modification of the "ring." We are aware of only Valdes[7] who included patients with multiple TF on one hand but substituted another type of hand-based orthosis for the Lindner-Tons and Ingell[20] MCPJ blocking orthosis.

This study aligns with David et al's[30] report that associated inflammatory and metabolic disorders with TF. In fact, 40% of our participants had metabolic disorders, exceeding the findings of Gil et al[31] who reported the occurrence rate for those with diabetes to be 5%-20% or twice that of the general population. When compared to a contemporary Malaysian hand surgery study,[32] our occurrence rate is similar, as these authors noted diabetes to be present in about 53% of the patients who underwent surgery for TF.

The duration of TF onset is reported in many ways, making comparison across similar studies nearly impossible.[6] Yendi et al[19] for example, used < 3 months (acute), 3-6 months (sub-acute) and > 6 months (chronic), while we reported duration as the mean number of months. Based on this example, we suggest that future researchers consider using number of weeks or months, until there is a better understanding of the impact of symptom duration onset on orthotic intervention for TF.

For the 6-week trial, there was an equal decrease in TF severity (SST) for those wearing RM and MCPJ blocking orthoses. A similar mean reduction from stage 3 (triggering) to stage 2 (uneven movement) was reported by Pataradool and Lertmahandpueti[13] who used PIPJ blocking orthoses for 6-week. A mean decrease of almost three-SST stages with large effect size was described by Valdes[7] for patients with single and multiple TFs who wore MCPJ or PIPJ blocking orthoses for 6-10 weeks. Regrettably, this author pooled the SST data for both orthosis groups, so it is difficult to determine if the 10-week wear time and/or orthosis type were factors. In an updated systematic review, Leong et al[6] reported that direct comparison of TF severity between studies is difficult as researchers have used various classification systems. Unfortunately, Yendi et al[19] added the lesser known Froimson classification to this list, which makes comparison to others as well as the present study impossible. For future consideration, we agree with the consensus statement in the European HANDGUIDE[4] concerning the need to establish a unified system for assessing and managing individuals with TF.

The NTE is commonly used as a measure of triggering frequency.[6] After 6-week of orthosis wear there was a statistically significant decrease in the mean NTE score for both groups. Yet for most, their triggering symptoms were not entirely resolved. We cannot say if the duration of TF onset or the short length of orthosis wear played a

Table 2
Mixed-effect ANOVA applied to assess outcome measurements at baseline and after 6-wk of wearing a relative motion (RM) or metacarpophalangeal joint (MCPJ) blocking orthosis for management of trigger finger

Outcome measures	Group		Time			Group		Time*Group	
	RM M (SD)	MCPJ blocking M (SD)	*p*	Eta	*f*	*p*	Eta	*p*	Eta
SST			< 0.001*	0.593	1.21	0.814	0.002	0.971	0.000
Week-1	3.6 (0.9)	3.5 (1.1)							
Week-6	2.4 (1.4)	2.3 (1.4)							
NTE			< 0.001*	0.538	1.07	0.056	0.106	0.168	0.057
Week-1	9.3 (2.0)	6.0 (5.0)							
Week-6	3.4 (4.7)	2.3 (4.0)							
VAS pain during rest			0.046*	0.115	0.36	0.589	0.009	0.486	0.015
Week-1	1.8 (2.2)	2.4 (2.7)							
Week-6	1.3 (1.7)	1.3 (1.8)							
VAS pain during activity			< 0.001*	0.366	0.76	0.317	0.030	0.966	0.000
Week-1	4.5 (2.1)	5.2 (2.5)							
Week-6	2.8 (2.2)	3.5 (2.0)							
DASH			< 0.001*	0.585	1.19	0.072	0.095	0.415	0.020
Week-1	28.7 (16.0)	39.0 (13.5)							
Week-6	17.6 (14.4)	24.9 (15.8)							
COPM performance score			< 0.001*	0.557	1.12	0.192	0.051	0.735	0.004
Week-1	5.6 (1.3)	4.9 (1.4)							
Week-6	7.1 (1.5)	6.6 (1.6)							
COPM satisfaction score			< 0.001*	0.565	1.14	0.341	0.028	0.282	0.035
Week-1	5.4 (1.6)	4.6 (1.7)							
Week-6	7.0 (1.5)	6.8 (2.2)							

SST = stages of stenosing tenosynovitis; NTE = number of triggering events in 10 active fists; VAS = visual analog scale; DASH = Disabilities of the Arm, Shoulder and Hand outcome measure; COPM = Canadian Occupational Performance Measure; M(SD) = median (standard deviation); *p* = *p*-value; * = significant; Eta = partial eta squared; *f* = Cohen's *f*; Time*Group = interaction effect between time and group.

role. The onset duration for the RM group was about 9-month compared the MCPJ blocking group with roughly 4.5-month duration of onset. Other 6-week orthotic trials[12,13] have reported a similar reduction but not elimination of triggering events using MCPJ or PIPJ blocking orthoses. We suggest that clinicians using orthoses for TF management may want to keep this in mind when informing patients and making clinical decisions about the need to extend the duration of orthosis wear beyond 6-week.

The updated TF systematic review[6] found the most used instruments for self-report of pain to be VAS and numerical pain rating scales. Different from the TF literature[6] and this trial, which used VAS for pain reported as mean and standard deviation. Yendi et al[19] used the numerical pain rating to report their outcomes as the median and interquartile range, which cannot be compared. In this trial, we deviated from the norm by intentionally asking participants to distinguish between pain *at rest* and pain *during activity*. Regardless of the orthosis worn by our participants, VAS MCID was achieved for both groups for pain *during activity*, but not *at rest*. Because this distinction was not made by Yendi et al[19] and others,[7-9,11-13] no comparison to our trial is feasible. Based on our trial, we believe making the distinction between pain *at rest* and pain *during activity* is important when studying TF. As it is the patient's active attempt to glide the flexor tendon through the pulley system that usually prompts their symptoms of triggering and pain.

While there is no instrument to measure function specific to TF, Lundsford et al[3] recommended using functional outcome measures such as the DASH and COPM to gain the patient's perspective regarding orthotic wear; and several studies[8,11,13] subsequently

Table 3
Mixed-effect ANOVA applied to assess orthosis wearability at baseline and after 3 and 6 wk of wearing a relative motion (RM) or metacarpophalangeal joint (MCPJ) blocking orthosis for management of trigger finger

Outcome measures	Group		Time		Group		Time*Group	
	RM M (SD)	MCPJ blocking M (SD)	*p*	Eta	*p*	Eta	*p*	Eta
VAS comfort at rest			0.367	0.030	0.922	0.000	0.390	0.022
Week-1	6.8 (1.8)	7.3 (2.3)						
Week-3	7.5 (1.6)	6.9 (2.0)						
Week-6	7.6 (1.9)	7.4 (2.4)						
VAS comfort during activity			0.203	0.047	0.744	0.003	0.728	0.004
Week-1	4.5 (2.1)	4.5 (1.6)						
Week-3	3.4 (1.5)	4.3 (2.2)						
Week-6	4.5 (2.8)	4.2 (2.7)						
VAS satisfaction at rest			0.180	0.051	0.529	0.012	0.755	0.003
Week-1	7.2 (1.8)	6.9 (2.6)						
Week-3	7.3 (1.9)	6.7 (2.3)						
Week-6	7.6 (1.8)	7.5 (2.0)						
VAS satisfaction during activity			0.463	0.023	0.521	0.013	0.597	0.009
Week-1	4.8 (2.8)	5.3 (2.3)						
Week-3	4.0 (2.3)	4.9 (2.3)						
Week-6	4.8 (2.7)	4.7 (2.7)						

VAS = visual analog scale; M(SD) = median (standard deviation); *p* = *p*-value; Eta = partial eta squared; Time*Group = interaction effect between time and group.

implemented the QuickDASH. Although the DASH was found to have better precision than the QuickDASH,[33] our DASH outcomes are consistent with other QuickDASH TF outcomes.[6]

DASH scores for our 6-week trial decreased for both orthosis groups, the change for the RM group was 11 points and the MCPJ blocking group 14 points, both exceeding MCID threshold. The DASH score outcomes for the RME group reported by Yendi et al[19] were less remarkable, reduced by only 2.5 points as compared to 13 points for the MCPJ blocking group with only the latter group achieving MCID. The exact reason for the disparity in DASH outcome scores between our findings and Yendi et al[19] for RM orthoses is unknown. We speculate it may have to do with methodology. In our study, the RM pencil test was used to determine RME or RMF orthosis design and to verify that the 20-25° MCPJ differential was "protective." While Yendi et al[19] standardly used a 10-20° MCPJ differential. We also included participants with multiple digit involvement and associated health conditions with a more equal distribution of dominant hand involvement. Consequently, our participants may have initially had greater restriction in hand function and therefore, perceived more improvement in DASH scores after wearing the orthosis for 6-week. These differences may also account for Yendi et al's[19] effect size on RME orthosis wearers, which was small (0.15) while we observed a medium (0.73) effect size for our RM orthosis group. In our study and Yendi et al,[19] a large effect size for the MCPJ blocking orthosis was observed, indicating that for this orthosis, the position of the MCPJ may not be important.

Participants used the COPM to report their level of occupational performance and satisfaction. Both the RM and MCPJ blocking orthoses were rated as effective in improving occupational performance and most reported being satisfied. A MCID was achieved in all ratings except the RM group COPM satisfaction score of 1.6/1.9. Tarbhai et al[9] is the only other TF study to report the use of the COPM, however, they did not proceed with the assessment because their adult cohort reported no functional limitations.

Wearability analysis for the RM and MCPJ blocking orthoses demonstrated an insignificant interaction effect between time and group. Stated differently, neither the RM orthosis or the MCPJ blocking orthosis surpassed the other in comfort and satisfaction. Yet, the interaction effect plots shown in Figure 5A, B, and D display non-parallel lines, signaling the potential for an interaction effect. Based on this observation, we propose that had our sample size been larger, a significant interaction effect may have occurred. For almost the entire 6-week trial, the interaction effect plot shown in Figure 5A demonstrates that *at rest*, the RM orthosis was more comfortable than the MCPJ blocking orthosis. Though, the visual trend at week-3 (Fig. 5B) shows that *during activity*, the RM orthosis was less comfortable than the MCPJ blocking orthosis; however, by week-6, the RM orthosis was more comfortable. Orthosis satisfaction *during activity* for week-6 was greater for the RM group than the MCPJ blocking group (Fig. 5D). Interestingly, *during activity* for week-3, in both groups, the orthosis comfort and satisfaction scores decreased. Having interacted with the participants, our suspicion, is that the lower scores at week-3 reflected frustration or difficulty adapting to orthosis wear by some. Had we more closely examined the participant's orthotic comments at week-3 and/or the actual hours the orthosis was worn from the orthotic daily dairy, this observation

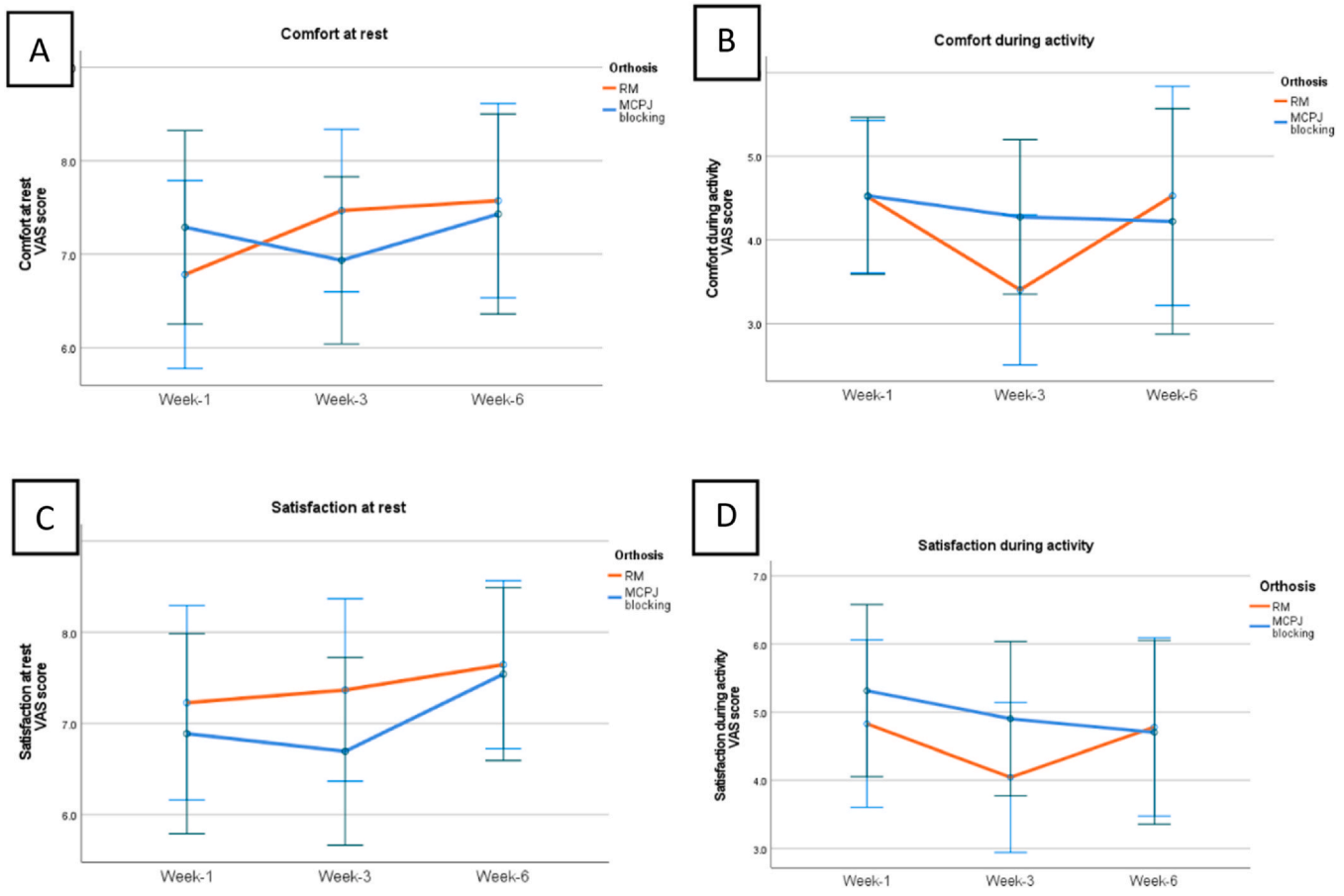

Fig. 5. Interaction effect between time and orthotic groups in (**A**) comfort at rest, (**B**) comfort during activity, (**C**) satisfaction at rest and (**D**) satisfaction during activity. RM = relative motion; MCPJ = metacarpophalangeal joint; VAS = visual analog scale.

might be explainable. Although all participants were instructed to wear the orthosis full time, clearly, they did not as the average wear time per day was between 10-13 hours.

Participant comments aligned with statistical analysis, in that individuals in both groups reported their orthoses to be more comfortable *at rest* than *during activity*. Both groups mentioned that orthosis wear made it more difficult to hold a plate, wash dishes, write, work, and cook. While RM orthosis wearers said they were able to perform light-simple activities because they felt more secure knowing their finger would not trigger. MCPJ blocking orthosis wearers stated that once accustomed to the orthosis, they experienced no difficulty wearing it throughout the day. These participant comments, using the parameters of *at rest* and *during activity*, and our more robust comparative statistical analysis challenges Yendi et al[19] who reported the MCPJ blocking orthosis to be more effective in improving function than a RME orthosis for TF intervention.

Since the differences in VAS measures RM and MCPJ blocking orthosis satisfaction and comfort was statistically no different in this trial, clinicians may want to consider using these orthoses interchangeably should issues of orthosis wearability arise.

We relied on the participant's response to RM pencil testing to determine if a RME or RMF orthosis was fabricated, with most choosing the RME orthosis. Interesting to us, some did elect to wear a RMF orthosis, and several said both the RME and RMF pencil tests were equally effective in lessening pain and/or triggering. It is not surprising that an orthosis blocking the motion of MCPJ flexion at 10-20°[19] or at neutral or 0°[6] effectively decreased flexor tendon excursion through the A1 pulley. Alternatively, since the MCPJ is permitted to move in RM orthoses, the degree of protective MCPJ differential required to reduce flexor tendon excursion through the A1 pulley is unknown. We believe using the RM pencil test for assessment allowed some insight into how much differential is required. For most participants the 20-25° MCPJ differential relieved their TF symptoms, yet there were a few in which the differential had to be increased to achieve the goal. Admittedly, we did not try to lessen the amount of differential because our experience in implementing RM orthoses for this diagnosis advised against a lesser MCPJ differential.

Limitations

To complete this discussion, here a few more considerations.

- Although a power analysis was done, there is a possibility that the participants in this trial do not fully represent the overall population of people with TF.
- We included individuals with co-morbidities such rheumatoid arthritis, diabetes mellitus, and carpal tunnel syndrome, as these co-morbidities, in our experience, resemble the traits of patients referred to hand therapy with TF. The ebb and flow of these metabolic and systemic conditions may or may not have affected the outcomes of the trial. It is our opinion for those living with the fluctuating symptoms of these metabolic and systemic conditions, either orthosis could be used as tools for self-management of TF.[34]
- Considering the study's context and the fact that orthosis wear is visible, we couldn't blind the participants and therapists.
- We had Therapist A conducted the pre-intervention and post-intervention assessments, while Therapist B conducted the mid-intervention assessment. Although Therapist B only assessed the VAS orthosis comfort and satisfaction, potential bias may occur due to the involvement of different assessors.
- We do not know if adding the "usual" deep tissue massage at week-3 was effective or not.
- We did not follow the recommendations for hand and wrist conditions as suggested by the International Consortium for Health Outcomes Measurement (ICHOM),[35] in that outcome measurements were not taken at baseline, 3-month and 6-month intervals. A longer trial period may have been more complete and mirrored practice. Given that our trial was 6-week, we do not know the number of participants who may have later opted for steroid injections and/or surgery.

Conclusion

This randomized comparative trial prospectively used a functional and disability approach to study the effectiveness of RM and MCPJ blocking orthoses as an intervention for TF. The results demonstrated that RME, RMF orthoses with at least a 20-25° MCPJ differential and MCPJ blocking orthoses effectively reduced TF severity and pain, and supported occupational performance and orthosis comfort and satisfaction. Assessment using the RM pencil test defined everyone's responsiveness to the position of RME or RMF and the degree of protective MCPJ differential angle required.

Author contributions

Li Xian Leong: Writing – original draft, Investigation, Formal analysis. **Siaw Chui Chai: Writing – review & editing,** Supervision, Methodology, Conceptualization. **Julianne W. Howell**: Writing – review & editing, Methodology, Conceptualization. **Hanif Farhan Mohd Rasdi**: Supervision, Methodology, Formal analysis. **Nur Rahimawati Abdul Rahman**: Supervision, Methodology.

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Declaration of Competing Interest

No competing interest declared.

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Quiz: # C52

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1 The MCPJ differential was set at about
a. 10-15°
b. 30-45°
c. 20-25°
d. 0-10°

2 #The type of RM orthosis was determined by
a. the RM pencil test
b. videography
c. traditional goniometry
d. AI

3 The MCPJ blocking orthosis was that originally designed by
a. Howell and Powell
b. Bell and Fess
c. Michlovitz and Mackin
d. Linder-Ton and Ingell

4 Assignment to one of the two groups was done by
a. handedness
b. sex
c. random
d. age

5 Neither orthotic was shown to produce superior outcomes over the other
a. not true
b. true

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