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Rigid versus semi-rigid orthotic use following TMC arthroplasty: A randomized controlled trial

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ABSTRACT

Introduction: The trapeziometacarpal (TMC) joint of the human thumb is the second most common joint in the hand affected by osteoarthritis. TMC arthroplasty is a common procedure used to alleviate symptoms. No randomized controlled trials have been published on the efficacy of different post-operative orthotic regimes.
Method: Fifty six participants who underwent TMC arthroplasty were allocated to either rigid orthotic or semi-rigid orthotic groups. Both groups started an identical exercise program at two weeks following surgery. Outcome measures were assessed by an assessor blinded to group allocation. The primary outcome was the Patient Rated Wrist and Hand Evaluation (PRWHE) and secondary outcomes included the Michigan Hand Questionnaire (MHQ), thumb palmar abduction, first metacarpophalangeal extension and three point pinch grip. Measures were taken pre-operatively, at six weeks, three months and one year post-operatively. Between-group differences were analyzed with linear regression.
Results: Both groups performed equally well. There was no significant between-group difference for PRWHE scores (0.47, CI −11.5 to 12.4), including subscales for pain and function, or for any of the secondary outcomes at one year follow-up.
Conclusion: We found no difference in outcomes between using a rigid or semi-rigid orthosis after TMC arthroplasty. Patient comfort, cost and availability may determine choice between orthoses in clinical practice.
Level of evidence: 1b RCT.

Introduction

The trapeziometacarpal (TMC) joint of the thumb is the second most common joint in the hand affected by osteoarthritis.[1] This condition is both painful and produces significant disability.[2–5] It may affect hand activities in all aspects of life.[3,6–8] While some patients improve with conservative management, a substantial proportion proceed to surgical treatment in the form of arthroplasty.[8]

Post-operative rehabilitation is an important component of surgical management and is likely to significantly impact on the success, or otherwise, of the procedure.[9] The usual post-operative management after arthroplasty is a period of complete or relative immobilization. This immobilization period is designed to protect the surgery and allow the joint to heal in a stable position. Some authors advocate cast immobilization for four weeks[10,11] then wearing an orthosis (splint) for another four weeks.[12,13] Others report complete immobilization using a forearm-based rigid orthosis for four to six weeks.[14–17] Anecdotal experience suggests that while some patients suffer post immobilization stiffness of the wrist and thumb following casting or orthotic wear, others benefit from immobilization in terms of increased comfort with minimal stiffness. Complications such as radial neuritis and complex regional pain syndrome (CRPS)[18,19] have also been attributed, at least in part, to casting or rigid orthotic use.

Only one published randomized controlled trial has reported on the impact of post-operative care following TMC arthroplasty. Evaluating different periods of post-operative mobilization in 39 patients at 6 months follow-up, Horlock and Belcher[14] reported no significant difference between commencing thumb exercises and light activity with intermittent rigid orthotic use at one week compared to commencing the exercises at four weeks. Horlock and

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Belcher's study emphasizes the need to further investigate the optimal duration and nature of immobilization in patients following arthroplasty. This study endeavors to follow this philosophy of early mobilization in the form of an orthosis that permits some early motion.

While casting and rigid orthotic use do not allow wrist, thumb TMC and metacarpophalangeal motion, a semi-rigid orthosis allows limited wrist and thumb motion. Semi-rigid orthoses have been perceived as more comfortable[20,21] and may be cost effective as the rigid thermoplastic piece can be removed transforming it to a soft orthosis for the remainder of the post-operative period. The efficacy of immobilization, casting or orthotic use in terms of rigid or semi-rigid orthosis is yet to be determined. No randomized controlled trials have evaluated the efficacy of different orthoses following TMC arthroplasty. This study aimed to examine the effectiveness of semi-rigid orthotic use compared with standard rigid orthotic use following TMC arthroplasty on short to medium term outcomes of self-reported pain, range, strength and function.

Method

A randomized controlled trial was conducted comparing post-operative rigid orthotic use with semi-rigid orthotic use, for 56 patients undergoing TMC arthroplasty.

Setting and participants

Consecutive patients presenting to three hand surgery practices for arthroplasty of the TMC joint were screened for eligibility. Included were patients with osteoarthritis of the TMC joint who were scheduled for arthroplasty using one of two common techniques (trapeziectomy with Ligament Reconstruction Tendon Interposition (LRTI) or simple trapeziectomy). Potential participants were excluded if they had rheumatoid arthritis or if they were having surgery to other digits or the wrist that would require other forms of orthotic intervention. Informed consent was obtained from all participants prior to the surgery. Ethical approval for the study was obtained from the University of Sydney Human Ethics Committee.

Pre-operative data were recorded after consent was given at one to four weeks prior to surgery.

Group treatment

Following surgery, a dorsal plaster backslab was applied to immobilize the wrist and thumb of all participants. Immediately following surgery the surgeon advised the patient to move the fingers (composite extension and flexion) and thumb interphalangeal joint (extension and flexion) within the confines of the backslab. At 10–14 days following TMC arthroplasty the surgeon removed the sutures. The participants were referred to hand therapy, at this time they were randomly allocated into either the rigid orthotic or semi-rigid orthotic group. The randomization schedule was generated by an independent person using a computer generated random numbers table. Group allocations were placed in sealed opaque envelopes and sequentially allocated to each participant.

Both orthoses were custom made for each participant. The semi-rigid orthosis was fabricated from neoprene with a bonded thermoplastic piece. The neoprene of the semi-rigid orthosis extended from the thumb interphalangeal joint to include the distal two thirds of the forearm. A thermoplastic piece on the radial aspect of the thumb extending from mid proximal phalanx to just below the wrist was bonded to the neoprene with the thumb in maximal comfortable palmar abduction (Fig. 1a). The rigid orthosis immobilized the thumb from the interphalangeal joint to include the distal two thirds of the forearm. The rigid orthosis was fabricated from 2.4 mm thermoplastic and included the thumb metacarpophalangeal (MCP) and TMC joints (the interphalangeal joint was left free) as well as the wrist. The thumb was in a palmar abducted position and wrist in approximately 30° extension (Fig. 1b). The rigid orthosis does not allow wrist or thumb TMC and MCP joint motion, the semi-rigid orthosis allows limited wrist (approximately 60–70% of active range of extension and flexion) and thumb (approximately 5–25 degrees of MCP flexion, approximately 45–55 degrees of TMC palmar abduction and opposition to all finger tips) active motion. All patients were instructed to wear the orthotic full time (24 h per day) for 4 weeks except for exercises.

Fig. 1. Custom-made orthoses. a) Semi-rigid orthosis – Dashed line represents the extent of the thermoplastic material. b) Rigid orthosis.

When the backslab was removed and the orthosis applied (week two) an exercise program was commenced. All patients underwent the same active exercise program regardless of group allocation. All patients were instructed to complete each exercise ten times, four times a day. At week two, thumb interphalangeal flexion and extension in the orthosis and wrist flexion and extension out of the orthosis was commenced. At week three, participants commenced isolated active first MCP joint flexion and extension to neutral only (0°) out of the orthosis. Emphasis was placed on flexion. Patients were instructed not to hyperextend the MCP joint, and at week four TMC active palmar abduction was commenced out of the orthosis. No formal opposition exercises were given. All patients were advised to use their hand for light painfree activities (opposition/pinch activity) with the orthosis on as tolerated. Light activities were defined as turning pages of a book or newspaper, lifting light objects approximately 100 gms, folding light weight clothing, using the hand as an assist hand in dressing and washing provided it was painfree and did not feel stressful to the patient.

At six weeks, a weaning period from the orthosis was commenced for both groups. This included hand use for light activities without the orthosis, passive exercises as assessed necessary by the hand therapist and a graded strengthening program for grip and pinch. Scar management techniques were commenced when wound healing was complete; massage and silicone products were used to soften and mobilize the scar. The exercise program and scar management were the same for both groups. All patients were encouraged to perform light activities with their hands in the orthoses as tolerated. This activity level was upgraded as tolerated from light activity at 6 weeks to moderate to heavy activity at 12