



Contents lists available at ScienceDirect

Journal of Hand Surgery Global Online

journal homepage: [www.JHSGO.org](http://www.JHSGO.org)

Original Research

## Immobilization and Hand Therapy After Carpometacarpal Arthroplasty: A Systematic Review



Patrick C. Barrett, BA, \* Darren T. Hackley, MA, † Linsen T. Samuel, MD, MBA, † Peter J. Apel, MD, PhD †

\* Virginia Tech Carilion School of Medicine, Roanoke, VA

† Department of Orthopaedic Surgery, Carilion Clinic Institute for Orthopaedics and Neurosciences, Roanoke, VA

## ARTICLE INFO

*Article history:*

Received for publication February 8, 2022

Accepted in revised form May 25, 2022

Available online July 7, 2022

*Key words:*

Carpometacarpal joint

CMC arthroplasty

Hand therapy

Immobilization timeframe

Systematic review

**Purpose:** We provide a systematic review of the current literature regarding best practices in postoperative care following carpometacarpal arthroplasty, and compare these findings to current practices via reported survey data.

**Methods:** The PubMed, Cochrane, Cumulative Index to Nursing and Allied Health Literature, Science Direct, and Google Scholar databases were searched for relevant studies. English-language articles were included that assessed any aspect of postoperative care, including the immobilization time or rehabilitation strategy. In addition, studies were included that surveyed surgeons and hand therapists on current practices regarding this topic. Reporting followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020.

**Results:** The initial search yielded 3,899 hits. Two systematic reviews were found, along with 5 studies that specifically tested the desired variables of the immobilization duration and type following carpometacarpal arthroplasty. Three relevant surveys were also found. Using the Oxford Centre for Evidence-Based Medicine Level of Evidence guidelines, we found moderate-quality evidence that (1) there is no additional benefit for extended cast immobilization (>6 weeks); and (2) a semirigid orthosis performs as well as a rigid orthosis. We found a lack of evidence regarding formal therapy versus no therapy, and a lack of evidence comparing therapy regimens. When analyzing the survey data, we found wide variation in practices among surgeons and therapists.

**Conclusions:** Longer immobilization times (>6 weeks) and rigid orthotic devices provide no additional benefit over earlier immobilization and semirigid orthotic devices. There is a lack of evidence for the use of formal hand therapy or any specific rehabilitation protocol. Current practices in these areas vary widely among hand surgeons.

**Clinical relevance:** Practices following carpometacarpal arthroplasty are widely variable, and guidance has previously been lacking. This review compiles the most recent data, as well as identifies gaps in the literature for future studies.

Copyright © 2022, THE AUTHORS. Published by Elsevier Inc. on behalf of The American Society for Surgery of the Hand. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Despite the many studies comparing various surgical techniques of thumb carpometacarpal (CMC) arthroplasty, there is a lack of consensus on protocols for postoperative immobilization practices and hand therapy.<sup>1–3</sup> Specifically, many differences exist in the recommended length of immobilization (range, 2–12 weeks), type

of orthotic device (semirigid, rigid), when to start hand rehabilitation (range, 1–6 weeks), and the use of formal, in-person hand therapy; self-directed therapy; or virtual options.<sup>1,2,4</sup>

A systematic review in 2014 by Wolfe et al<sup>2</sup> sought to identify therapy protocols after surgical procedures for basal joint arthritis, with specific focus on whether the length and type of postoperative immobilization affected clinical results, a comparison of therapy protocols that were prescribed, and an evaluation of whether the time at which patients were released to full activity affected clinical results. They found that no definitive conclusions could be made because of considerable variation in the literature regarding the types and durations of postoperative immobilization, postoperative

**Declaration of interests:** No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

**Corresponding author:** Peter J. Apel, MD, PhD, Department of Orthopaedic Surgery, Carilion Clinic Institute for Orthopaedics and Neurosciences, 2331 Franklin Road Southwest, Roanoke, Virginia, 24014.

E-mail address: [dr.peter.apel@gmail.com](mailto:dr.peter.apel@gmail.com) (P.J. Apel).

<https://doi.org/10.1016/j.jhsg.2022.05.011>

2589-5141/Copyright © 2022, THE AUTHORS. Published by Elsevier Inc. on behalf of The American Society for Surgery of the Hand. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

**Table 1**  
Health-Related Databases, Hits, and Search Terms and Methodology (conducted on July 19, 2021)

Database	Hits	Search Terms and Methodology
PubMed	2,901	((“trapezium bone/surgery”[MeSH Terms] OR “thumb/surgery”[MeSH Terms] OR “carpometacarpal joints/physiopathology”[MeSH Terms] OR “carpometacarpal joints/surgery”[MeSH Terms]) AND “english”[Language]) AND (english[Filter])
Google Scholar	334	allintitle: “TMC arthroplasty” OR trapeziectomy OR “CMC arthroplasty” OR “ligament reconstruction AND tendon interposition” OR “Suture suspension arthroplasty” OR “carpometacarpal arthroplasty”
Cochrane	282	#1 CMC OR carpometacarp OR “basal joint” OR “basilar joint” OR thumb OR CMC-1 OR “thumb base” OR trapez OR trapeziometacarp OR basilar OR “carpometacarpal joint” OR “thumb joint” OR basilar OR TMC #2 MeSH descriptor: [Carpometacarpal Joints] explode all trees #3 arthroplasty OR LRTI or “ligament and reconstruction” OR “ligament reconstruction tendon interposition” OR trapeziectomy OR “hematoma and distraction” OR implant OR pyrocarbon OR arthrodesis #4 MeSH descriptor: [Arthroplasty] explode all trees #5 (#1 OR #2) AND (#3 OR #4)
ScienceDirect	208	(carpometacarp OR thumb OR basilar OR trapez) AND (arthroplasty OR “ligament AND reconstruction” OR LRTI OR trapeziectomy)
Cumulative Index to Nursing and Allied Health Literature (CINAHL)	174	AB (carpometacarp OR thumb OR “thumb base” OR basilar OR basal OR CMC-1 OR CMC OR “basilar joint” OR trapez OR trapeziometacarp) AND AB (arthroplasty OR LRTI OR “ligament AND reconstruction” OR “tendon AND interposition” OR arthrodesis OR trapeziectomy OR pyrocarbon)

AB, abstract; CMC-1, 1st carpometacarpal joint; MeSH, Medical Subject Headings; TMC, trapeziometacarpal.

exercise, therapist referral patterns, and when patients were permitted to return to full activity.<sup>2</sup>

A subsequent systematic review by Wouters et al<sup>1</sup> explored the components and phases of postoperative rehabilitation protocols for patients after CMC arthroplasty. They specifically focused on outcomes of shorter immobilization (4–6 weeks or <4 weeks), range of motion (ROM), and strength exercises with regard to pain intensity, limitations in activities of daily living, grip or pinch strength, and complications. They concluded that early active recovery (short immobilization, early initiation of ROM, and strength exercises) provided positive outcomes for those undergoing CMC arthroplasty. However, they found limitations in the number of high-quality studies included, and could not draw conclusions on the effectiveness of postoperative rehabilitation after CMC arthroplasty because of a lack of comparative studies. Both of these previous reviews retrieved their data primarily from studies that were focused on surgical techniques, with postoperative care regimens extracted secondarily.

This systematic review seeks to build on these findings and provide an update of the most current literature regarding postoperative care after CMC arthroplasty. Specifically, this review will focus on prospective studies that tested a variable pertaining to postoperative care or surveys that asked providers their current practices. We hypothesize that this review will enable many hand surgeons to adjust their postoperative practices in ways that are supported by evidence.

## Materials and Methods

The PubMed, Cochrane, Cumulative Index to Nursing and Allied Health Literature, Science Direct, and Google Scholar databases were searched with a combination of search terms related to CMC arthroplasty (Table 1). Specific terms related to postoperative care were omitted, as these did not increase search results in any of the databases. Search terms differed in individual databases to maximize results and broaden the overall search. Studies written in English before July 2021 were included if they specifically tested an aspect of immobilization or hand therapy regimens following CMC arthroplasty. We defined CMC arthroplasty as partial or complete removal of the trapezium, with or without reconstruction of ligaments. Reports of surveys of providers that were relevant to this topic were also included. Reports that included an abstract only, clinical commentary, or letter to the editor, or that did not have a control group, were excluded.

## Systematic review process

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 flow diagram is shown in Figure 1.<sup>5</sup> The original search (July 14, 2021, through July 15, 2021) produced 3,899 records. Duplicates were removed, as well as 34 records (conference reports, articles not written in English, and broken links) that were marked ineligible by the article reviewers (P.C.B., D.T.H.). This yielded 3,400 records that were subsequently screened for relevance by title and abstract by the reviewers. Of these reports, 320 were sought for retrieval through our institutions (Carilion Clinic Institute of Orthopaedics and Neurosciences), with 5 that were unable to be retrieved. The reports were then assessed for eligibility by 2 authors (P.C.B., D.T.H.; Supplemental Tables 1, 2; available on the Journal’s website at [www.jhsgo.org](http://www.jhsgo.org)). Three reports used in this review were also included in a previous systematic review, and they were excluded in the “new studies” column of the PRISMA table (available on the Journal’s website at [www.jhsgo.org](http://www.jhsgo.org)), as they were already captured in the “previous studies” column. Two previous reviews on this topic analyzed 41 total reports of studies (PRISMA 2020 differentiates between studies and reports of studies, as some studies generate multiple reports).<sup>1,2</sup> Thirty-seven of these reports were excluded, as they did not specifically test a variable related to postoperative care. In total, 8 reports were the focus of this review: 5 clinical trials and 3 surveys.

## Level of evidence

The 5-tier Oxford Centre for Evidence-Based Medicine Level of Evidence for orthopedic literature, shown in Table 2, was used to assess the included studies and assign each a level of evidence.<sup>6</sup>

## Extraction of data

Two reviewers (P.C.B., D.T.H.) extracted data into a Microsoft Excel template that included information found in Tables 3 (for trials) and 4 (for survey data).<sup>7–12</sup> For reports of trials, the authors, year, demographics of subjects, study design, immobilization duration and description, postoperative rehabilitation description, types of measurements taken, time frame of measurements, and outcomes or *P* values were extracted. For survey data, the authors, year, type of the population that was surveyed, total number contacted, number of responses, response percentage, and relevant author’s conclusions were extracted.

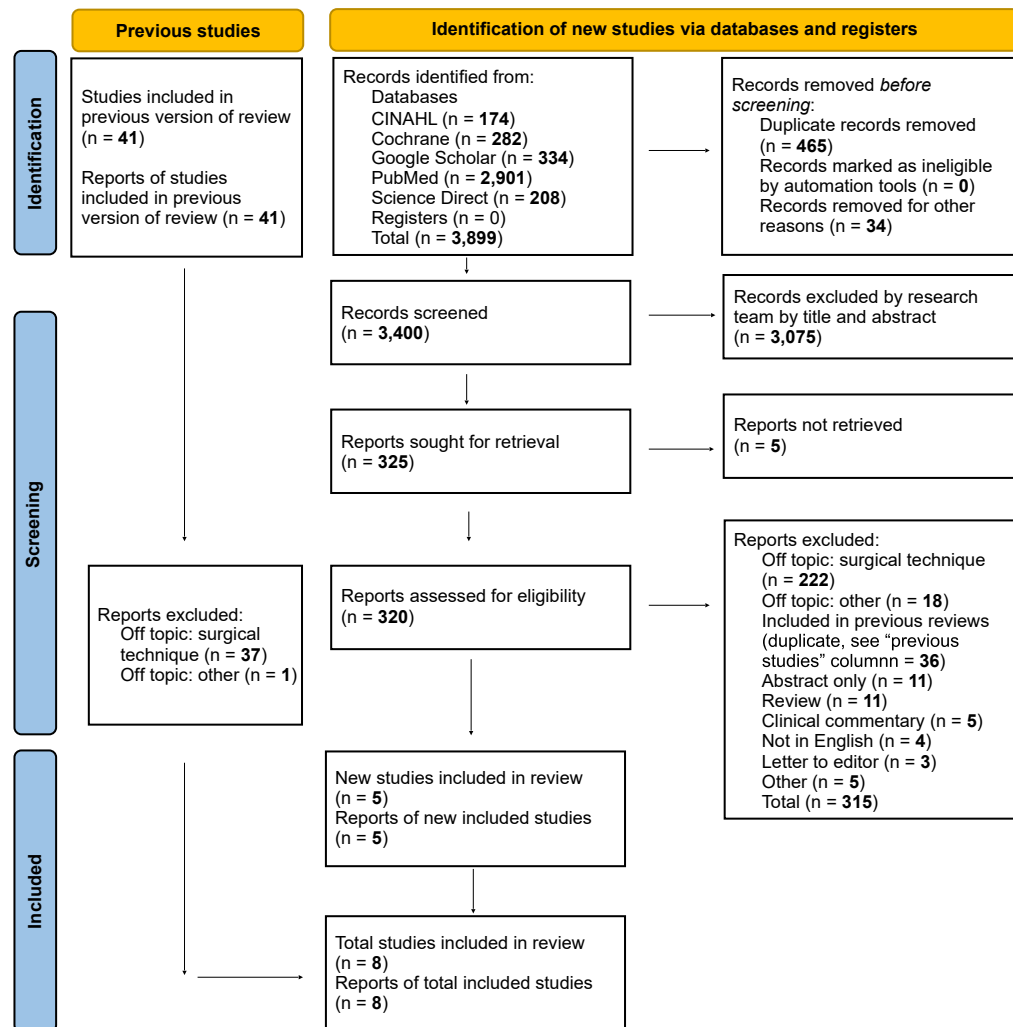


Figure 1. The PRISMA 2020 flow diagram of systematic review process and study selection.

### Risk of bias

The revised Cochrane risk-of-bias tool for randomized controlled trials, the Risk of Bias in Nonrandomized Studies of Interventions tool, and the Joanna Briggs Institute Critical Appraisal Checklist for Analytical, Cross-Sectional Studies were used to effectively assess the risks of bias among the included studies (Figs. 2, 3).<sup>13–15</sup> The Cochrane risk-of-bias visualization (robvis) tool was used to construct the traffic-light plot figures.<sup>16</sup> Initially, the Effective Public Health Practice Project quality assessment tool was used to assess the risks of bias of the included studies. After receiving feedback during the peer review, the contributing authors determined the Cochrane risk-of-bias tool for randomized controlled trials, Risk of Bias in Nonrandomized Studies of Interventions tool, and Joanna Briggs Institute Critical Appraisal Checklist would best establish the transparency of the evidence synthesis of results and findings. Methodologic quality was assessed by 2 reviewers (P.C.B., D.T.H.). It was planned that any disagreements would be resolved by consulting the senior author (P.J.A.). However, a high level of consistency in agreement was present during the quality assessment, and consensus discussions were not necessary.

### Results

#### Length of immobilization

Three studies were identified that tested the length of immobilization in a randomized controlled trial.<sup>7–9</sup> Hutchinson et al<sup>8</sup> found no significant differences in patient-reported outcome measures (PROMs) or pinch strength in patients assigned to a shorter immobilization period (thermoplastic splint until week 4, with orthosis fabrication until week 8) versus a longer immobilization period (plaster cast until week 6, with orthosis fabrication until week 12) ( $P > .05$ ). The former started active ROM (AROM) at 4 weeks, while the latter started AROM at 6 weeks.<sup>8</sup>

Tsehaie et al<sup>7</sup> tested immobilization times following trapeziectomy with suspensionplasty (Weilby procedure) while keeping rehabilitation constant. No differences were found in complication rates or PROMs in participants assigned to a "shorter" immobilization period of 3–5 days in a plaster cast, followed by a thumb-spica orthosis until week 4, versus a "longer" immobilization period of 10–14 days in a plaster cast, with a thumb spica until week 6. The AROM exercises began at 2 weeks.

**Table 2**  
Oxford Centre for Evidence-Based Medicine Levels of Evidence

Level	Description
I	High-quality RCTs or systematic review of level-I RCTs
II	Prospective cohort studies or systematic review of level-II studies
III	Case-control study, retrospective study, or systematic review of level-III studies
IV	Case series or case report
V	Expert opinion or survey

RCT, randomized controlled trial.

Horlock and Belcher<sup>10</sup> mobilized participants even earlier following a simple trapeziectomy. One group was fully immobilized for 1 week, followed by use of a periodic, protective orthosis that was removed during the day for light activities and ROM exercises until week 6. The longer immobilization group switched to the protective orthosis and ROM exercises at week 4 and finished at week 6. No significant differences were found in PROMs at follow-up (6–8 months); however, the early mobilization group found treatment to be more convenient than did the late mobilization group, as measured by a postoperative Likert scale ( $P < .05$ ).<sup>10</sup> Data from these studies is reported in [Table 1](#).

#### Type of immobilization

A study by Prosser et al<sup>4</sup> compared the use of a rigid orthotic device versus a semirigid orthotic device following CMC arthroplasty. Following 10–14 days in a dorsal plaster back slab, participants were randomized into 1 of 2 categories. The rigid-device group received a thermoplastic orthosis that did not allow for wrist or thumb CMC or metacarpophalangeal movement. The semirigid-device group received a neoprene orthosis that allowed for wrist extension and flexion (60% to 70% of full ROM), limited thumb metacarpophalangeal flexion, and limited CMC palmar abduction or opposition. Examples of these orthotic devices are included in [Supplemental Figures 1 to 3](#) (available on the Journal's website at [www.jhsgo.org](http://www.jhsgo.org)). Both groups were advised to wear the orthosis for 4 weeks, for 24 hours per day except for during exercises. No significant differences were found in any of the outcome metrics at any of the time points ([Table 1](#)).<sup>4</sup>

#### Home exercise program

A pilot study by Poole et al<sup>9</sup> investigated the use of a home exercise program following CMC arthroplasty. Subjects were randomized into 1 of 2 groups. One group completed 4 in-person sessions with an hand therapist, whereas the other group completed a home exercise program. Both groups began their respective programs at 4 weeks after surgery. No notable differences were found between groups in ROM, strength, dexterity, or PROMs after surgery.<sup>9</sup>

#### Current practices: survey results

Three surveys were identified relevant to this topic. Brunton and Wilgis<sup>12</sup> found that the most common length of full immobilization among members of the American Society for Surgery of the Hand (ASSH) was 4 weeks (36%), with 76% of respondents reporting immobilizing patients between 4 and 6 weeks and 23% reporting immobilizing patients for  $\leq 3$  weeks. Deutch et al<sup>11</sup> also surveyed the ASSH, and found that 45% of respondents fully immobilize

patients between 4 and 6 weeks, 32% between 2 and 4 weeks, and 19% for  $< 2$  weeks. There were 2% of respondents that did not require any immobilization after surgery. In a survey of hand therapists, Siegel et al<sup>3</sup> found that 53% respondents indicated either a plaster cast or rigid orthosis was used in their practice for 22–28 days.

Regarding the use of postoperative therapy, Deutch et al<sup>11</sup> found that 79% of ASSH members reported recommending postoperative hand therapy, whereas 18% did not. Of surgeons with 0–5 years of experience, 90% recommended therapy, while only 67% of surgeons with  $> 25$  years of experience did.<sup>11</sup>

## Discussion

### Length and type of immobilization

When deciding the duration of immobilization for patients undergoing CMC arthroplasty, surgeons must balance the risk of injury and protection of the arthroplasty with patient discomfort, inconvenience, and stiffness. Currently, the most commonly reported length of full immobilization is 4 weeks, as found by 3 different surveys.<sup>3,11,12</sup> This is the duration of cast immobilization cited by Burton and Pellegrini,<sup>17</sup> who originally described a trapeziectomy with ligament reconstruction and tendon interposition (LRTI) in 1986. Horlock and Belcher<sup>10</sup> found that 4 weeks was significantly less convenient for patients, as measured by a simple Likert scale, and had no added benefit over the “early” mobilization group, who switched to a orthosis at 1 week and began mobilization. Although this study involved a simple trapeziectomy, Tsehaie et al<sup>7</sup> found similar immobilization durations (3–5 days in a plaster cast, followed by a thumb-spica orthosis until week 4) to be safe and effective in those undergoing trapeziectomy with LRTI. Longer immobilization times of 6 weeks were found to add no benefit; however, Brunton and Wilgis<sup>12</sup> found that 27% of hand surgeons use at least this duration.<sup>8</sup>

Additionally, a semirigid orthosis was found to perform as well as a rigid orthosis.<sup>4</sup> Prosser et al<sup>4</sup> speculated this may provide better comfort to the patient, although this was not measured qualitatively. Either shortening the length of cast immobilization or using a semirigid orthosis has the potential to make postoperative recovery less burdensome for patients.<sup>4</sup>

Additional studies are needed to determine the minimum amount of time patients need to be fully immobilized after trapeziectomy with LRTI, as currently no study has tested use of at least a semirigid forearm orthosis for  $< 4$  weeks compared with a more conservative time frame. The type of orthosis is also a potential area of interest. Prosser et al<sup>4</sup> suggested investigating whether it is necessary to immobilize the wrist and thumb apart from the CMC joint. For example, could a short thumb-spica orthosis be used as the primary immobilization? It is also possible that using fewer types of orthoses during rehabilitation could be more cost effective.

### Formal hand therapy and rehabilitation exercises

Overall, there is little research on either the ideal start time of rehabilitation exercises or the use of formal hand therapy after CMC arthroplasty. A study by Poole et al<sup>9</sup> randomized participants to either 4 postoperative visits with an hand therapist or a home therapy program without the use of an hand therapist. This study only contained 9 patients, but found no differences between the 2 groups.<sup>9</sup> A properly powered, non-inferiority study of this nature would enable hand surgeons to

**Table 3**  
Characteristics of Included Randomized and Nonrandomized Studies

Author (Y)	LOE	Sample Size & Demographics	Study Design	Surgical Intervention	Immobilization Duration	Postoperative Rehabilitation	Outcome Metrics and Timelines	Outcomes & P Values
Tsehaie et al <sup>7</sup> (2019)	III	Group A: n = 131; 74% female; mean age, 60. Group B: n = 131; 70% female; mean age, 60	Prospective cohort study with propensity score matching	Weilby procedure (shorter vs longer immobilization)	Group A: 0–3 to 5 days: plaster cast; 5 days to 4 wks: thumb-spica orthosis with wrist immobilization; 4–8 wks: thumb butterfly orthosis; 8–10 wks: orthosis phased out; 10 wks: orthosis discontinued. Group B: 0–10 to 14 days: plaster cast; 2–6 wks: thumb-spica orthosis with wrist immobilization; 6–8 wks: thumb butterfly orthosis; 8 wks to 3 mos: orthosis phased out; 3 mos: orthosis discontinued	Directly postop: tendon-gliding exercises of the fingers and thumb IP joint; 10–14 days: sutures removed; 2–6 wks: hand therapy and home exercises focusing on active wrist flexion/extension, CMC-1 palmar/radial abduction, MCP-1 flexion (with support of thumb), scar management. No flexion/adduction and thumb opposition allowed; 6 wks to 3 mos: initiation of static pinch, then increased grip and pinch exercises	Palmar abduction, radial abduction, MCP extension, MCP flexion; t0 = preop; t1 = 3 mos	Palmar abduction, group A: t0, 46°; t1, 44°; group B: t0, 46°; t1, 45°; radial abduction (A): t0, 53°; t1, 44°; (B): t0, 47°; t1, 47°; MCP extension (A): t0, -16°; t1, -8°; (B): t0, -16°; t1, -10°; MCP flexion (A): t0, 64°; t1, 61°; (B): t0, 64°; t1, 60°
Hutchinson et al <sup>8</sup> (2018)	II	n = 223; t = 238. Group A: n = 80; 62 F/18 M; 42 dom involved; 12 bilateral. Group B: n = 89; 70 F/19 M; 49 dom involved; 12 bilateral	Randomized controlled trial	Trapeziectomy with LRTI using FCR (rigid orthotic device vs semirigid orthotic device)	Group A: 0–7 days: forearm-based thumb-spica plaster orthosis; 1–6 wks: forearm-based thumb-spica cast; 6–12 wks: forearm-based thermoplastic thumb-spica orthosis; 12 wks: immobilization discontinued. Group B: 0–7 days: forearm-based thumb-spica orthosis; 1–4 wks: forearm-based thermoplastic thumb-spica orthosis; 4–8 wks: hand-based thumb-spica orthosis; 8 wks: immobilization discontinued	1-wk office visit: ice, elastic garments, electrical stimulation (on occasion) as needed for edema control. Group A: 6 wks: AROM; 12 wks: resistive wrist strengthening, thumb strengthening with putty. Group B: 4 wks: AROM; 8 wks: resistive wrist strengthening, thumb strengthening with putty	DASH, 9-hole peg test, VAS pain, VAS satisfaction, ROM wrist and thumb, grip strength, 2-point pinch, 3-point pinch, lateral pinch; preoperative, 6 wks, 12 wks, 26 wks, 52 wks, 104 wks.	No significant differences were found in DASH, VAS pain, or VAS satisfaction scores between any groups at any time point. All 3 measurements improved in both groups after surgery. No significant differences in pinch strength between groups at any time point. At 6 weeks postop, group B (early immobilization group) demonstrated better 9-hole peg test, thumb ROM, and wrist ROM than group A but these metrics, including grip strength, did not differ between groups at any other time point
Prosser et al <sup>4</sup> (2014)	I	n = 56; t = 56; 45 F/11 M; age mean = 67.8; dominant thumb 27/56	Randomized controlled trial	Trapeziectomy & LRTI using FCR (rigid vs semirigid immobilization)	0 to 10–14 days: dorsal plaster backslab immobilizing wrist and thumb; 10–14 days to 6 wks. Group A: semirigid neoprene with bonded thermoplastic orthosis. Neoprene extended from thumb IP joint to distal two-thirds of forearm. Thermoplastic piece on radial aspect of thumb extended from midproximal phalanx to just below wrist, with thumb in maximal comfortable palmar abduction. Orthosis allowed approximately 60% to 70% of wrist extension/flexion, 5° to 25° MCP flexion, and 45° to 55° CMC palmar abduction and opposition to all fingertips. Group B: rigid, thermoplastic orthosis from thumb IP joint to distal two-thirds of the forearm, immobilizing MCP, CMC joints, and wrist (IP joint left free). Thumb in palmar abducted position and wrist in 30° extension. Allowed for no thumb MCP, CMC, or wrist joint motion. 6 wks: orthosis discontinued	10–14 days: 10 repetitions, 4 times daily out of orthosis. Thumb IP flexion/extension, wrist flexion/extension. Wk 3: isolated thumb MCP flexion, extension to neutral only, instructed not to hyperextend MCP joint. Wk 4: CMC active palmar abduction. Light activity as tolerated, (lifting objects approximately 100 g). Wk 6: light activity without orthosis, scar management/massage; Wk 12: moderate to heavy activity. Hand therapy, monitored exercise weekly for first 4 weeks, then every other week for next 6 weeks.	PRWHE (total, pain, function), MHQ total, CMC palmar abduction, MCP extension, 3-point pinch; t0 = preop; t1 = 6 wks; t2 = 3 mos; t3 = 1 yr	PRWHE total, group A: t0, 67.7; group B: t0, 58.6; t1, -0.8; t2, 1.0, t3, 0.5; PRWHE pain (A) t0, 37.0; (B) t0, 32.0; t1, 1.2; t2, 0.6; t3, -0.4; PRWHE function (A) t0, 30.7; (B) t0, 26.6; t1, -2.0; t2, 0.6; t3, 1.0; MHQ total (A) t0, 50.3%; (B) t0, 48.2%; t1, 0.2%; t2, 0.2%; t3, 0.1%; Thumb CMC palmar abduction (A) t0, 45.6°; (B) t0, 43.9°; t1, -0.5°; t2, -1.9°; t3, -1.1°; MP extension (A) t0, 11.3°; (B) t0, 13.6°; t1, -0.3°; t2, -3.2°; t3, -2.5°; 3 point pinch (A) t0, 5.1 kg; (B) t0, 3.9 kg; t1, 0.2 kg; t2, 0.6 kg; t3, -0.4 kg

(continued on next page)

Table 3 (continued)

Author (Y)	LOE	Sample Size & Demographics	Study Design	Surgical Intervention	Immobilization Duration	Postoperative Rehabilitation	Outcome Metrics and Timelines	Outcomes & P Values
Poole et al <sup>9</sup> (2011)	II	n = 9; t = 9; 8 F/1 M; mean age, 58.0 (range, 49–68); 4 dom/5 non	Randomized controlled trial	Partial trapeziectomy with suture suspensionplasty using PL and K-wire distraction	0 to 10–14 days: bulky dressing and orthosis. 10–14 days: sutures removed; 3–4 wks: K-wires removed; 4 wks: thumb-spica or c-bar orthosis	Group A: 4 wks: OT visit, received home program consisting of information regarding orthosis wear, edema control methods, AROM, massage of the hand. Group B: 4 wks: OT for 1 hr, 1 time/week for 4 wks consisting of reduction of edema, instruction of ROM and strength exercises, and ADL.	CMC flexion, abduction, MCP flexion, grip strength (kgs), 2-point pinch (kgs), 3-point pinch (kgs), pegboard (s), Jebson total (s), AHFT applied dexterity (s), FSS, SSS, AIMS: hand and finger, arm, work, overall impact, total function; t0 = preop; t1 = 6 months	CMC flexion, group A: t0, 4.8, t1, 15.2; group B: t0, 10; t1, 16.25; Abduction (A): t0, 50; t1, 52; (B): t0, 48.75; t1, 44.5; MCP flexion (A): t0, 54; t1, 55; (B): t0, 47; t1, 46; Grip strength (A): t0, 24.9 kgs; t1, 22.9 kgs; (B): t0, 26.0 kgs; t1, 29.3 kgs; 2-point pinch (A): t0, 3.9 kgs; t1, 5.2 kgs; (B): t0, 3.7 kgs; t1, 5.2 kgs; 3-point pinch (A): t0, 5.6 kgs; t1, 5.3 kgs; (B): t0, 4.9 kgs; t1, 6.3 kgs; pegboard (A): t0, 20.0 s; t1, 19.7 s; (B): t0, 21.8 s; t1, 22.5 s; Jebson total (A): t0, 64.2 S; t1, 64.9 S; (B): t0, 68.4 S; t1, 59.5 S; AHFT applied dexterity (A): t0, 116 s; t1, 118.2 s; (B): t0, 122.6 s; t1, 121.5 s; FSS (A): t0, 2.9; t1, 1.7; (B): t0, 2.8; t1, 1.6; SSS (A): t0, 3.2; t1, 1.7; (B): t0, 3.3; t1, 1.5; AIMS hand and finger (A): t0, 5.9; t1, 1.2; (B): t0, 5.7; t1, 1.5; AIMS arm (A): t0, 2.7; t1, 1.4; (B): t0, 0.8; t1, 1.7; AIMS work (A): t0, 5.1; t1, 0.8; (B): t0, 6.3; t1, 2.1; AIMS overall impact (A): t0, 2; t1, 1; (B): t0, 2.5; t1, 0; AIMS total function (A): t0, 13.9; t1, 2.1; (B): t0, 14.6; t1, 5.3
Horlock & Belcher <sup>10</sup> (2002)	III	Group A: t = 20; 14 F/6 M; mean age, 58; 11 R/9 L; 9 dom/11 non. Group B: t = 20; 16 F/4 M; mean age, 59; 9 R/11 L; 11 dom/9 non	Prospective, randomized	Simple trapeziectomy (late vs early immobilization)	Group A: 0–1 wk: palmer scotchcast plus slab with wrist in slight extension and thumb in slight abduction and extension; 1–6 wks: customized orthosis used for heavier activities and at night. Group B: 0–2 wks: same palmer scotchcast plus slab; 2–4 wks: customized orthosis worn continuously; 4–6 wks: allowed out of orthosis	Group A: 1 wk: light use of thumb and exercises taught. Group B: 4 wks: gentle use and mobilization allowed out of the orthosis	IP ROM, MCP ROM, thumb abduction, thumb extension, Kapandji opposition, grip strength, pulp pinch, key pinch, SMD, TMD; VAS function, VAS pain, VAS movement; t0 = preop; t1 = median 6 mos (range, 6–8 mos)	IP ROM, group A: t0, 86; t1, 90; group B: t0, 82; t1, 86; MCP ROM (A): t0, 61; t1, 56; (B): t0, 66; t1, 57; abduction (A): t0, 4.0 cm; t1, 4.5 cm; (B): t0, 4.0 cm; t1, 4.5 cm; extension (A): t0, 3.5 cm; t1, 4 cm; (B): t0, 3 cm; t1, 4 cm; opposition (A): t0, 9; t1, 9; (B): t0, 9; t1, 9; grip strength movement; t0 = preop; (A): t0, 19 kg; t1, 24 kg; (B): t0, 15 kg; t1, 21 kg; pulp pinch (A): t0, 2.0 kg; t1, 3.1 kg; (B): t0, 1.7 kg; t1, 2.5 kg; key pinch (A): t0, 3.5 kg; t1, 4.3 kg; (B): t0, 3 kg; t1, 3.9 kg; SMD (A): t0, 10 mm; t1, 2 mm; (B): t0, 11 mm; t1, 3 mm; TMD (A): t0, 8 mm; t1, 0 mm; (B): t0, 7 mm; t1, 1 mm; VAS function (A): t0, 45; t1, 21; (B): t0, 44; t1, 25; VAS pain (A): t0, 61; t1, 18; (B): t0, 77; t1, 25; VAS movement (A): t0, 50; t1, 13; (B): t0, 50; t1, 16.

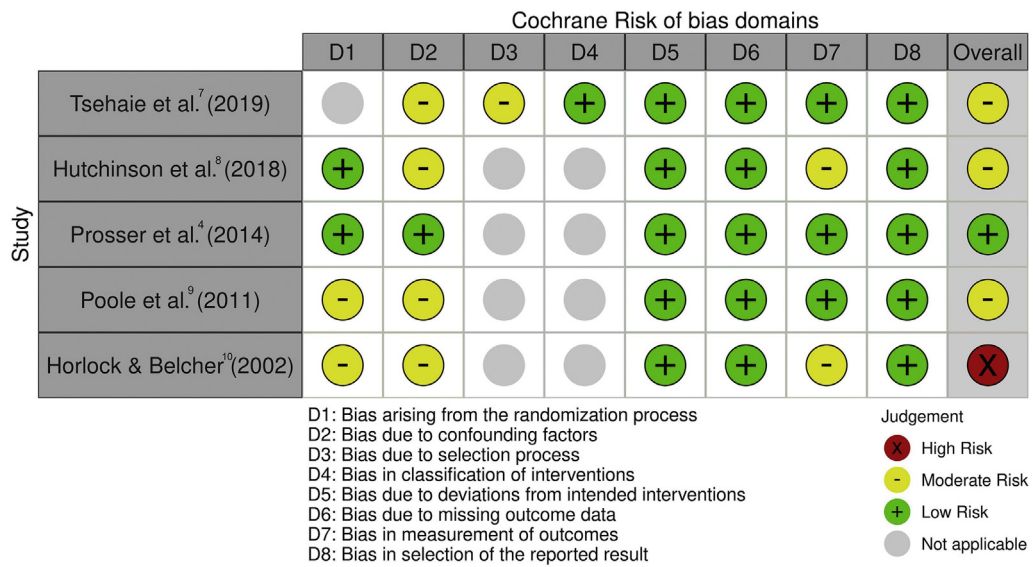
ADL, activities of daily living; AHFT, Arthritis Hand Function Test; AIMS, Arthritis Impact Measurement Scales; CMC-1, 1st carpometacarpal joint; DASH, Disabilities of the Arm, Shoulder, and Hand; dom, dominant; FCR, flexor carpi radialis; FSS, Functional Status Scale; IP, interphalangeal; LOE, level of evidence; MCP, metacarpophalangeal; MCP-1, 1st metacarpophalangeal joint; MHQ, Michigan Hand Questionnaire; non, nondominant; OT, occupational therapy; PL, Palmaris Longus; postop, postoperative; preop, preoperative; PRWHE, Patient Rated Wrist/Hand Evaluation; SMD, minimum distance between the base of the thumb metacarpal and distal end of the scaphoid; SSS, Symptom Severity Scale; t, number of thumbs; TMD, minimum distance between the base of the thumb metacarpal and the radial border of the trapezoid; VAS, visual analog scale.

\* All scores for t1, t2, and t3 represent group A (semirigid) compared to group B (rigid). Negative scores indicate that group A performed worse than group B.

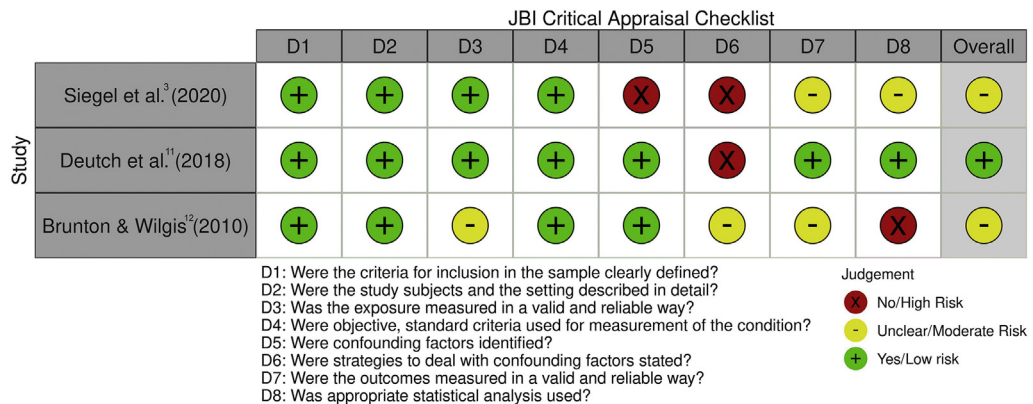
**Table 4**  
Characteristics of Included Cross-Sectional Survey Studies

Author (Year)	Level of Evidence	Survey Type	Sample Size; Response Rate	Response Representation
Siegel et al. <sup>3</sup> (2020)	V	ASHT survey	3,221; 19%	Nonresponse bias and inability to reach those therapists who treat postoperative CMC arthroplasty but are not CHTs or ASHT members.
Deutch et al. <sup>11</sup> (2018)	V	ASSH survey	3,354; 25%	Possibility of recall bias and that it does not represent actual population, especially for international surgeons.
Brunton & Wilgis <sup>12</sup> (2010)	V	ASSH survey	2,536; 40%	Nonresponse bias and spam filters. Largest response rate of ASSH surveys at the time; however, unable to differentiate those still in training.

ASHT, American Society for Hand Therapists; CHT, Certified Hand Therapist.



**Figure 2.** Revised Cochrane risk-of-bias tool for randomized trials and the Risk of Bias in Nonrandomized Studies of Interventions assessment tool.



**Figure 3.** Joanna Briggs Institute Critical Appraisal Checklist for Analytical, Cross-Sectional Studies. JBI, Joanna Briggs Institute.

comfortably prescribe home exercises as the primary rehabilitation and would significantly lower the burden of postoperative care for patients.

Three of the studies referenced with regards to immobilization times also tested the start time of ROM exercises after surgery, with no differences found in groups that began at 1 versus 4 weeks or 4

versus 6 weeks.<sup>8,10</sup> These results are difficult to compare, as both immobilization and mobilization start times were varied simultaneously.

Consistent with the previous systematic reviews on this topic, most of the descriptions of specific rehabilitation regimens were found in studies that tested the surgical technique of CMC arthroplasty.<sup>1,2</sup> The majority of these studies supplied little information on specifics of what the postoperative rehabilitation regimen entailed. For this review, this information was compiled but ultimately left out for brevity (101 studies in total). However, several studies found in our search were notable for their depth of description of postoperative protocols.<sup>7,17–21</sup> The PROMs included in this review varied considerably from study to study, and more consistent use of a standard set of outcome metrics would make future meta-analyses possible. Future studies may consider International Consortium for Healthcare Measurements recommendations for PROMs of hand and wrist conditions for this purpose.

Future potential areas of investigation include earlier mobilization (<4 weeks) or comparing in-person therapy after CMC arthroplasty to a virtual or self-directed therapy program. The safety and efficacy of these options are yet to be determined in a properly powered clinical trial, but have the potential to benefit patients with regards to reduced pain and cost, and earlier return of function or return to work.

### Limitations

Major limitations of this review were the search strategy and lack of registration prior to beginning. The search terms were created by the research team without the assistance of a librarian or a systematic review guideline, such as the Cochrane Handbook for Systematic Reviews of Interventions. Additionally, the search terms differed between individual databases. This was done to broaden the overall scope of the search; however, it may have produced unintended biases that left certain areas of the literature unexplored. A full list of these search terms is included in Table 1. The lack of registration of this review has the potential to create unintended duplicate reviews, as well as decreased transparency in the overall systematic review process.

This review was also limited by the lack of appropriately powered, prospective, randomized controlled trials on the variables of interest, immobilization and hand therapy following CMC arthroplasty (Table 3). Although many studies were found that mention postoperative protocols, conclusions about their effectiveness are not possible because of the large variety of outcome metrics and additional variables that were tested. Even the appropriately powered, randomized controlled trials that tested immobilization protocols were confounded by varying exercise times between groups. An additional limitation of the clinical trials analyzed in this review is their use of different versions of CMC arthroplasty. The most commonly performed technique in the United States is currently trapeziectomy with LRTI.<sup>11,12</sup> This was used in Hutchinson et al<sup>8</sup> and Prosser et al.<sup>4</sup> while the Weilby procedure (trapeziectomy with suspensionplasty) was used in Tsehaie et al<sup>7</sup> and simple trapeziectomy was used in Horlock and Belcher.<sup>10</sup> Finally, surveys cited in this review from the ASSH and American Society of Hand Therapists had low response rates (19% to 40%), possibly introducing response bias.

### Acknowledgments

We thank the Health Sciences Libraries at Carilion Clinic and Virginia Tech Carilion School of Medicine for supplying the requested literature to successfully complete this review. We are also grateful to Carilion Clinic Orthopaedic Technician Supervisor, Kim R. Ford; Shirley P. Alleyne, BS-ATC; Heather D. Tipton, OTII; and Occupational Therapist Amy L. Comforti for fabricating the orthotic devices needed for this manuscript.

### References

1. Wouters RM, Tsehaie J, Hovius SER, Dilek B, Selles RW. Postoperative rehabilitation following thumb base surgery: a systematic review of the literature. *Arch Phys Med Rehabil.* 2018;99(6):1177–1212.e2.
2. Wolfe T, Chu JY, Woods T, Lubahn JD. A systematic review of postoperative hand therapy management of basal joint arthritis. *Clin Orthop Relat Res.* 2014;472(4):1190–1197.
3. Siegel P, Jackson D, Baugh C. Practice patterns following carpometacarpal (CMC) arthroplasty. *J Hand Ther.* 2022;35(1):67–73.
4. Prosser R, Hancock MJ, Nicholson L, Merry C, Thorley F, Wheen D. Rigid versus semi-rigid orthotic use following TMC arthroplasty: a randomized controlled trial. *J Hand Ther.* 2014;27(4):265–270; quiz, 271.
5. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ.* 2021;372:n71.
6. Howick J, Chalmers I, Lind J. OCEBM Levels of Evidence. Centre for Evidence-Based Medicine (CEBM), University of Oxford. Accessed January 24, 2022. <https://www.cebm.ox.ac.uk/resources/levels-of-evidence/ocebml-levels-of-evidence>
7. Tsehaie J, Wouters RM, Feitz R, Slijper HP, Hovius SER, Selles RW. Shorter vs longer immobilization after surgery for thumb carpometacarpal osteoarthritis: a propensity score-matched study. *Arch Phys Med Rehabil.* 2019;100(11):2022–2031.e1.
8. Hutchinson DT, Sueoka S, Wang AA, Tyser AR, Papi-Baker K, Kazmers NH. A prospective, randomized trial of mobilization protocols following ligament reconstruction and tendon interposition. *J Bone Joint Surg Am.* 2018;100(15):1275–1280.
9. Poole JL, Walenta MH, Alonzo V, Coe A, Moneim M. A pilot study comparing of two therapy regimens following carpometacarpal joint arthroplasty. *Phys Occup Ther Geriatr.* 2011;29(4):327–336.
10. Horlock N, Belcher HJCR. Early versus late mobilisation after simple excision of the trapezium. *J Bone Joint Surg Br.* 2002;84(8):1111–1115.
11. Deutch Z, Niedermeier SR, Awan HM. Surgeon preference, influence, and treatment of thumb carpometacarpal arthritis. *Hand (N Y).* 2018;13(4):403–411.
12. Brunton LM, Wilgis SEF. A survey to determine current practice patterns in the surgical treatment of advanced thumb carpometacarpal osteoarthritis. *Hand (N Y).* 2010;5(4):415–422.
13. Sterne JAC, Savović J, Page MJ, et al. RoB 2: A revised tool for assessing risk of bias in randomised trials. *BMJ.* 2019;366:l4898.
14. Sterne JA, Hernán MA, Reeves BC, et al. ROBINS-I: A tool for assessing risk of bias in non-randomised studies of interventions. *BMJ.* 2016;355:i4919.
15. Joanna Briggs Institute. Critical Appraisal Checklist for Analytical Cross Sectional Studies. Accessed April 14, 2022. [https://jbi.global/sites/default/files/2021-10/Checklist\\_for\\_Analytical\\_Cross\\_Sectional\\_Studies.docx](https://jbi.global/sites/default/files/2021-10/Checklist_for_Analytical_Cross_Sectional_Studies.docx)
16. McGuinness LA, Higgins JPT. Risk-of-bias visualization (robvis): an R package and shiny web app for visualizing risk-of-bias assessments. *Res Synth Methods.* 2021;12(1):55–61.
17. Burton RI, Pellegrini VD. Surgical management of basal joint arthritis of the thumb. Part II. Ligament reconstruction with tendon interposition arthroplasty. *J Hand Surg Am.* 1986;11(3):324–332.
18. Ataker Y, Gudemez E, Ece SC, Canbulat N, Gulgonen A. Rehabilitation protocol after suspension arthroplasty of thumb carpometacarpal joint osteoarthritis. *J Hand Ther.* 2012;25(4):374–382; quiz 383.
19. Tomaino MM, Pellegrini VD, Burton RI. Arthroplasty of the basal joint of the thumb. Long-term follow-up after ligament reconstruction with tendon interposition. *J Bone Joint Surg Am.* 1995;77(3):346–355.
20. Qadir R, Duncan SFM, Smith AA, Merritt MV, Ivy CC, Iba K. Volar capsulodesis of the thumb metacarpophalangeal joint at the time of basal joint arthroplasty: a surgical technique using suture anchors. *J Hand Surg Am.* 2014;39(10):1999–2004.
21. Henstridge L. Development and implementation of a trapeziectomy rehabilitation protocol. *Hand Ther.* 2017;22(2):64–72.