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What Factors Influence Variability in Thumb Carpometacarpal Arthroplasty Care? A Survey of ASSH Members

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Abstract

Background: The purpose of this study was to gather information regarding current practices in the care of carpometacarpal (CMC) arthroplasty including the use of hand therapy, immobilization, and surgical technique, and to determine which factors influence these patterns. **Methods:** We conducted a survey from February 24, 2022, through March 26, 2022, of 3648 currently practicing members of the American Society for Surgery of the Hand. We developed an 11-item questionnaire that contained questions about surgical technique, immobilization, and postoperative therapy utilization. Results were analyzed using chi-square analysis and a Bonferroni correction was applied to account for multiple comparisons. Statistical significance was set at a *P*-value of less than .05. **Results:** A total of 811 hand surgeons completed the survey (22% response rate). Surgeons who are employed by the same medical center as their hand therapist use more in-person hand therapy than surgeons with other types of business relationships. Surgeons with more than 25 years of experience are less likely to recommend therapy routinely, more likely to use ligament reconstruction and tendon interposition, and less likely to be an employee of the same medical center as their hand therapist. The length of immobilization and the time at which hand therapy began were related to surgical technique. **Conclusions**: Variability in hand therapy usage after CMC arthroplasty is at least partially explained by business relationships with hand therapists and surgeon experience. Variability in the length of immobilization and the beginning of hand therapy postoperatively was more associated with surgical technique.

Keywords: survey, carpometacarpal arthroplasty, immobilization duration, hand therapy, business relationships

Introduction

The postoperative care of patients receiving carpometacarpal (CMC) arthroplasty has received little attention compared to surgical technique.[1] While hundreds of studies examined results of various surgical techniques for CMC arthroplasty, only a small number studied postoperative care[2-5] and these focused on immobilization times and type of orthosis. One pilot study compared in-person occupational therapy versus a patient-directed, home therapy program.[6] Systematic reviews about postoperative practices have found a lack of evidence regarding postoperative immobilization and use of hand therapy.[1,7,8] Thus, decisions that hand surgeons make regarding postoperative care cannot be evidence based, and factors that influence these decisions remain unknown.

A survey of the American Society for Surgery of the Hand (ASSH) in 2010 sought to find practice patterns in the surgical treatment of CMC arthritis.[9] This 12-question survey found that the most common duration of immobilization was 4 weeks (36%) with 23% using a length shorter than this. No statistical analysis was performed to determine which factors influence immobilization. Siegel et al[10] surveyed the American Society of Hand Therapists about length of immobilization and the start of hand exercises after CMC arthroplasty. They found wide variations in practice patterns among hand therapists and reported that very few respondents cited using an evidence-based treatment program to guide therapy.

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A survey of the ASSH conducted in 2017 sought to identify recent changes in treatment of CMC arthritis including surgical technique, postoperative therapy, length of immobilization, and pain medication and to determine if region, practice setting, and experience influence these treatment choices.[11] They found that surgeons who have been in practice for 0 to 5 years are more likely to recommend postoperative hand therapy than those who have been in practice for more than 25 years. It was also reported that trapeziectomy was associated with the longest immobilization times, and that suture suspensionplasty was associated with the shortest.

The purpose of this study was to expand on prior work, quantify the variability in practice patterns, and to understand the reasons for this variability. This includes length of immobilization, the timing and quantity of in-person therapy sessions, and whether certain types of business relationships with hand therapists, surgical technique, or practice demographics influence these patterns.

Materials and Methods

Following institutional review board approval, an 11-item survey was sent to 3648 members of the ASSH. Permission was granted by the ASSH Clinical Research and Grantsmanship Committee to distribute the survey to currently practicing members using an electronic database of e-mail addresses. An initial e-mail was sent with a link to the survey, which was collected and managed using REDCap electronic data capture tools. The survey was multiple choice and contained questions regarding demographics (surgical training, experience, volume, practice setting and type), as well as preferred technique for CMC arthroplasty and postoperative practices (length of immobilization, use of in-person therapy). The exact wording for each question is included in Table 1. The survey opened on February 24, 2022, and was available for 30 days. A follow-up e-mail was sent after 2 weeks to increase the number of responses. Data were received anonymously through REDCap, exported into Microsoft Excel, and then transferred to SAS Enterprise Guide for analysis. One response per e-mail address was permitted to prevent duplicate records. Frequency distributions were calculated for all questions. Chi-square tests were used for multiple variables with significance set to *P*-value less than .05. When statistical significance was found, a post hoc analysis was performed to calculate adjusted residuals for individual comparisons. As multiple comparisons for each survey question were performed, and the specific comparisons between questions were not planned before data analysis, we determined that the odds of a type I error were high, and that a Bonferroni correction was needed to adjust for multiple comparisons. This was performed by dividing the *P*-value (.05) by the number of tests (rows $\times$ columns) for each comparison. An inverse normal distribution calculation was then performed using this new *P*-value to create a new "critical value." Adjusted residuals higher than the absolute value of this critical value were determined to be significant to an alpha of 0.05. This same process was performed for an alpha of 0.01 and significant relationships were noted in the text.

Question 6, which asked preferred technique, contained a free response, "other" answer choice. The responses of those who chose this answer were reviewed and when appropriate, placed into other categories. This led to the creation of 2 answer choices not originally included in the survey, "tightrope" and "trapeziectomy with interposition arthroplasty."

Results were reported in tables using the statistical method described above and all *P*-values reported in the text refer to post hoc analyses. Percentages were used for comparisons of significant findings, but these were not used in statistical tests.

Results

A total of 811 of 3648 hand surgeons completed this survey (22% response rate).

In-person Therapy Recommendations

Whether or not a surgeon recommended in-person therapy regularly to all patients was associated with years of experience as well as the nature of the business relationship with their hand therapist. Of all respondents, 81% indicated that they regularly prescribe hand therapy for all patients (Table 1, question 8, first 2 responses combined). Those with more than 25 years of experience are more likely to say they use no formal therapy but use a handout, video, or other patient-directed method ($P < .01$) and more likely to only recommend therapy to those patients experiencing difficulty ($P < .01$; Table 2). Surgeons with no business relationship with their hand therapist used "a few planned in-person visits with a therapist (less than 6 visits)" less ($P < .01$), while surgeons employed by the same medical center as their hand therapists used this amount of therapy more ($P > .05$; Table 2). The decision to recommend therapy was not influenced by practice setting, surgical volume, surgical technique, or the specialty in which a surgeon trained.

Volume of In-person Therapy Sessions

Most hand surgeons (62%) recommend between 4 and 10 in-person therapy sessions (Table 1). The volume of therapy sessions was influenced by surgeon experience, with surgeons who have more than 25 years of experience recommending zero in-person therapy sessions more often than surgeons with less experience ($P < .01$). The number of in-person therapy sessions was not related to practice setting, surgical technique, or the surgeon's specialty training.

Table 1. Frequency and Percentages of Responses for All Survey Questions.

Survey question	N	%
In what specialty did you train?		
General surgery	26	3.2
Orthopedic surgery	687	84.8
Plastic surgery	97	12.0
Which of the following best describes your practice set-up?		
Privademics	154	19.1
Academic	168	20.8
Military	12	1.5
Private practice	474	58.7
How many years have you been in practice following fellowship?		
0-5	163	20.1
6-15	194	23.9
16-25	186	22.9
>25	268	33.1
Which of the following best describes where the majority of your patients live?		
Rural	90	11.1
Suburban	498	61.4
Urban	223	27.5
How many CMC arthroplasties do you perform per year?		
0-10	119	14.7
11-30	342	42.3
31-50	246	30.4
>50	102	12.6
What best describes your preferred technique for CMC arthroplasty?		
Abductor pollicus longus or suture suspensionplasty	320	39.5
Implant arthroplasty	12	1.5
Tightrope	24	3
Trapeziectomy with interposition arthroplasty	6	0.7
Ligament reconstruction with tendon interposition	406	50.1
Trapeziectomy only with or without pin	33	4.1
Other	10	1.2
How long do you immobilize in a splint or cast after CMC arthroplasty?		
4 wk or less	415	51.1
5 wk	78	9.6
6 wk	277	34.1
7 wk	5	0.6
8 wk or more	36	4.4
Which of the following best describes the therapy you recommend following CMC arthroplasty?		
A few planned in-person visits with a therapist (<6 visits).	221	27.3
A regimented program of in-person therapy (6 or more visits).	436	53.8
No formal therapy, but I use a handout, video, or other patient-directed method.	20	2.5
None. I do not routinely prescribe any therapy after CMC arthroplasty.	36	4.4
Only use therapy as needed for patients having difficulty.	98	12.1
If you prescribe hand therapy following CMC arthroplasty, which week post surgery does it typically start?		
<4 wk after surgery	288	35.6
4 wk after surgery	216	26.7
5 wk after surgery	64	7.9
6 wk after surgery	175	21.6
>6 wk after surgery	17	2.1
Not applicable	50	6.2
How many in-person hand therapy sessions do you typically recommend for patients following CMC arthroplasty?		
0	67	8.3
1-3	123	15.2
4-10	499	61.7
>10	120	14.8
What is your business relationship with your most commonly used therapists?		
They are employees of my practice or group.	234	28.9
They are medical center employees, but I am private practice.	41	5.1
They are part of a separate business and I have no relationship with them.	275	34.0.
We are both employees of our medical center.	260	32.1

Note. CMC = carpometacarpal.

Initiation of Therapy

The week at which surgeons chose to start hand therapy was related to surgical technique. Of all respondents, 36% start hand therapy early (less than 4 weeks postoperatively). Those who use abductor pollicus longus (APL) or suture suspensionplasty were more likely to start therapy early (140/320, 44%, $P < .01$). Surgeons who perform ligament reconstruction and tendon interposition (LRTI) were less likely to start therapy early (110/405, 27%, $P < .01$). Surgeons with 0 to 5 years of experience were also more likely to start therapy early (75/163, 46%). Most surgeons chose to start hand therapy as soon as immobilization ended. The week at which in-person therapy began was not related to surgical volume, business relationship, or surgeon specialty.

Length of Immobilization

The number of weeks a surgeon immobilizes in a splint or cast was found to relate to surgical technique. For all respondents, 51% immobilize for 4 weeks or less, with those performing LRTI more likely to immobilize longer than 4 weeks (233/406, 57%, $P < .01$). The length of immobilization was not influenced by surgical volume or in-person therapy utilization.

Table 2. Frequency Distributions of In-person Therapy Recommendation (Q8) Versus Years in Practice (Q3) and Business Relationship (Q11).

	Q8. Which of the following best describes the therapy you recommend following CMC arthroplasty?					
	A few planned in-person visits with a therapist (<6 visits)	A regimented program of in-person therapy (6 or more visits)	No formal therapy, but I use a handout, video, or other patient-directed method	None. I do not routinely prescribe any therapy after CMC arthroplasty	Only use therapy as needed for patients having difficulty	Total
Q3. Years in practice						
0-5	47 (29%)	104 (64%)	2 (1%)	1 (1%)	9 (6%)	163
6-15	51 (26%)	119 (61%)	2 (1%)	6 (3%)	16 (8%)	194
16-25	54 (29%)	100 (54%)	1 (1%)	9 (5%)	22 (12%)	186
>25	69 (26%)	113 (42%)▼*	15 (6%) ▲*	20 (7%)	51 (19%) ▲*	268
	$P < .001$					811
Q11. Business relationship with therapist						
They are employees of my practice or group	69 (29%)	130 (56%)	5 (2%)	7 (3%)	23 (10%)	234
They are medical center employees, but I am private practice	12 (29%)	16 (29%)	2 (5%)	1 (2%)	10 (24%)	41
They are part of a separate business and I have no relationship with them	49 (18%)▼*	162 (59%)	9 (3%)	19 (7%)	36 (13%)	275
We are both employees of our medical center	91 (35%)▲	128 (49%)	3 (1%)	9 (3%)	29 (11%)	260
	$P < .001$					810

Note. ▲ indicates higher than expected value. ▼ indicates lower than expected value after Bonferroni correction ($P < .05$). CMC = carpometacarpal.
*$P < .01$. *P*-values represent chi-square tests.

Table 3. Frequency Distributions of Business Relationship With Hand Therapists (Q11) Versus Patient Setting (Q4).

	Q11. Business relationship with hand therapist				
	They are employees of my practice or group	They are medical center employees, but I am private practice	They are part of a separate business and I have no relationship with them	We are both employees of our medical center	Total
Q4. Patient setting					
Rural	21 (23%)	5 (6%)	23 (26%)	41 (46%)▲	90
Suburban	163 (33%)▲	25 (5%)	180 (36%)	129 (26%)▼*	497
Urban	50 (22%)	11 (5%)	72 (32%)	90 (40%)▲	223
	$P < .001$				810
Q3. Years in practice					
0-5	43 (26%)	4 (2%)	49 (30%)	67 (41%)	163
6-15	53 (27%)	8 (4%)	51 (26%)	82 (42%)▲*	194
16-25	62 (33%)	6 (3%)	66 (35%)	52 (28%)	186
>25	76 (28%)	23 (9%)▲	109 (41%)	59 (22%)▼*	267
	$P < .001$				810

Note. ▲ indicates higher than expected value. ▼ indicates lower than expected value after Bonferroni correction ($P < .05$).
*$P < .01$. *P*-value represents chi-square tests.

Factors That Influence Procedure Type

Ligament reconstruction and tendon interposition was more common among surgeons with more than 25 years of experience (171/268, 64%, $P < .01$) and less common among those with 0 to 5 years of experience (55/163, 34%, $P < .01$). The reverse trend was true for APL or suture suspensionplasty with those having 0 to 5 years of experience using it more (97/163, 60%, $P < .01$). Ligament reconstruction and tendon interposition was used more in private practice (262/474, 55%) compared with other types of practices (133/304, 43%, $P < .05$).

Factors That Influence Business Relationship

Surgeons who practice in primarily suburban environments were more likely to employ a hand therapist as part of their private practice or group, whereas surgeons with rural and urban patient settings were more likely to be employed by the same medical center as the hand therapist (Table 3). Surgeons with more than 25 years of experience were less likely to be employed by a medical center, and more likely to be in private practice with no business relationship with a hand therapist.

Discussion

Among members of the ASSH, there exists variability in surgical techniques for CMC arthroplasty and postoperative care practices. Although this study is limited in explaining much of the variability, there were notable associations.

Certain business relationships were found to be associated with in-person therapy recommendations. Surgeons who regularly recommend a "few" (<6) in-person therapy visits are more likely to be employed by the same medical center as their hand therapist. Those who have no business relationship with a hand therapist are less likely to recommend this amount. Although the reasons for this association are unclear, the higher reported utilization among medical center employees may represent the influence of access or proximity to hand therapists. Working near hand therapists at a medical center may make scheduling and patient commutes more convenient compared with practices with no relationships to therapists. Financial relationships also exist in medical centers and may play a role in decisions to recommend therapy. However, it was notable that surgeons who directly employ a hand therapist (a seemingly higher level of conflict) were not associated with a significant difference in hand therapy usage.

Surgeon experience may also play a role in therapy recommendations. Deutch et al[11] found that surgeons with more than 25 years of experience were significantly less likely to prescribe hand therapy following CMC arthroplasty, and the present study confirms this finding. This may be due to young surgeons' lack of confidence in the unsupervised recovery of their patients and lack of experience with good outcomes in the absence of therapy. It also may be the case that younger surgeons are more likely to mirror the postoperative practices prescribed in their training, while relying on personal experience further along in practice. This survey also found that more experienced surgeons are less likely to work in the same medical center as their hand therapist and more likely to be in private practice, which may explain the variability in hand therapy recommendations more than simply surgeon experience. There is a lack of evidence regarding the utility of

in-person hand therapy[1,2,8]; however, a semistructured interview study by Stepan et al[12] indicates patients who underwent LRTI find hand therapy important in regaining function and guiding postoperative expectations. Results from this survey suggest that the decision to prescribe therapy after CMC arthroplasty is partially surgeon-driven and not fully patient-driven.

Most hand surgeons begin hand therapy at either 4 weeks postoperative or sooner (62%) and most start hand therapy as soon as patients are out of immobilization. The type of procedure was found to influence this decision, as surgeons who use APL or suture suspensionplasty tend to favor earlier start to hand therapy and a shorter duration of immobilization. We also found that LRTI uses longer immobilization times. This is consistent with Deutch et al[11] who found similar responses, with over half of surgeons who use suture suspensionplasty immobilizing patients for 2 weeks or fewer. Other examples in literature also use this amount of time.[13,14] Early mobilization has been the focus of a handful of prospective clinical trials. Horlock and Belcher prospectively investigated mobilization at 1 versus 4 weeks following trapeziectomy and found no differences in range of motion, strength or pain at 6 months postoperative.[4] Patients did find the early mobilization group significantly more convenient as measured by a Likert scale. Hutchinson et al[3] prospectively investigated mobilization at 4 versus 6 weeks following LRTI and found no differences between groups at 6 months or 1 year postoperative in strength, pain, or function. These results question the utility of prolonged immobilization. Our data found no factors that influence immobilization other than surgical technique.

We found that surgeons with 0 to 5 years of experience are more likely to use suspensionplasty using suture or the APL, consistent with findings by Deutch et al. We also found that more experienced surgeons are more likely to use LRTI. A possible explanation is LRTI's inception in 1986 compared with the newer APL or suture suspensionplasty, which gained prominence around 20 years later.[15] Ligament reconstruction and tendon interposition was also used more frequently by those in private practice. Although the reasons for this are uncertain, it is possible this is due to a common variable of years in practice (Tables 2 and 3).

Several differences exist among hand surgeons who have been in practice for more than 25 years compared with their younger counterparts. These include the use of hand therapy (less likely to use); the type of surgery preferred (LRTI more often); as well as the relationship with hand therapists. It is unclear whether these differences are due to training, experience, and some combination of these factors or are reflective of a more general change in the hand surgery landscape over time.

This survey was limited by a low response rate (22%), similar to a previous survey of currently practicing ASSH members.[11] Demographic data from this study were similar to Deutch et al regarding specialty training, volume of CMC arthroplasties, and practice set-up. The current study had a higher portion of surgeons with more than 25 years of experience following fellowship (33% vs 22%). Without official data that contain accurate demographic information about the makeup of the ASSH, it is difficult to assess the degree of nonresponse bias that exists in this survey; however, it is possible that those who did not respond make up a different demographic and have different practices compared with those who did.

In addition, there may have been respondents who do not perform CMC arthroplasty who completed the survey, as indicated by 15% of respondents who report performing 0 to 10 CMC arthroplasties per year. All questions in this survey were multiple choice, and it is possible that some of the answer choices did not represent the entirety of practices of some hand surgeons. This was especially true for question 6 regarding surgical technique which included an option for free response. While attempts were made to reconcile these responses with existing categories, some techniques may fit into 2 categories, creating an imperfect capture of the data. As the individual chi-square tests were not planned prior to data analysis, it is possible that type I errors still exist despite the use of a statistical correction. Furthermore, some of the significant findings included lack of a clear explanation of their clinical importance, and it is possible they would fail to be replicated in subsequent surveys.

Conclusion

Despite these limitations, this study provides insight into the variability in surgical care for CMC arthroplasty. Although there is not a one-size-fits-all approach to operative and postoperative CMC arthroplasty practices, hand surgeons should be aware of the variability and the possibility of personal biases and conflicts of interest that drive decision-making.

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Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

The participants of this study were surgeon members of the American Society for Surgery of the Hand (ASSH). Their participation required completion of an online survey. No experimental procedures were carried out on the human subjects.

Statement of Informed Consent

Informed consent was obtained from all participants for being included in this study.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: CJB is a reviewer for the American Association for Hand Surgery. The other authors declare no conflicts of interest of any kind.

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References

1. Wouters RM, Tsehaie J, Hovius SER, et al. Postoperative rehabilitation following thumb base surgery: a systematic review of the literature. *Arch Phys Med Rehabil*. 2018;99(6):1177-1212. doi:10.1016/j.apmr.2017.09.114.
2. Tsehaie J, Wouters RM, Feitz R, et al. Shorter vs longer immobilization after surgery for thumb carpometacarpal osteoarthritis: a propensity score-matched study. *Arch Phys Med Rehabil*. 2019;100(11):2022-2031. doi:10.1016/j.apmr.2019.02.016.
3. Hutchinson DT, Sueoka S, Wang AA, et al. A prospective, randomized trial of mobilization protocols following ligament reconstruction and tendon interposition. *J Bone Jt Surg: Am*. 2018;100(15):1275-1280. doi:10.2106/JBJS.17.01157.
4. Horlock N, Belcher HJ. Early versus late mobilisation after simple excision of the trapezium. *J Bone Joint Surg Br*. 2002;84(8):1111-1115. doi:10.1302/0301-620X.84B8.12993.
5. Prosser R, Hancock MJ, Nicholson L, et al. Rigid versus semi-rigid orthotic use following TMC arthroplasty: a randomized controlled trial. *J Hand Ther*. 2014;27(4):265-270; quiz 271. doi:10.1016/j.jht.2014.06.002.
6. Poole JL, Walenta MH, Alonzo V, et al. A pilot study comparing of two therapy regimens following carpometacarpal joint arthroplasty. *Phys Occup Ther Geriatr*. 2011;29(4):327-336. doi:10.3109/02703181.2011.613530.
7. Wolfe T, Chu JY, Woods T, et al. A systematic review of postoperative hand therapy management of basal joint arthritis. *Clin Orthop Relat Res*. 2014;472(4):1190-1197. doi:10.1007/s11999-013-3285-z.
8. Barrett PC, Hackley DT, Samuel LT, et al. Immobilization and hand therapy after carpometacarpal arthroplasty: a systematic review. *J Hand Surg Glob Online*. 2022;4(5):255-262. doi:10.1016/J.JHSG.2022.05.011.
9. Brunton LM, Wilgis EF. A survey to determine current practice patterns in the surgical treatment of advanced thumb carpometacarpal osteoarthrosis. *Hand (N Y)*. 2010;5(4):415-422. doi:10.1007/s11552-010-9275-7.
10. Siegel P, Jackson D, Baugh C. Practice patterns following carpometacarpal (CMC) arthroplasty. *J Hand Ther*. 2022;35(1):67-73. doi:10.1016/j.jht.2020.10.016.
11. Deutch Z, Niedermeier SR, Awan HM. Surgeon preference, influence, and treatment of thumb carpometacarpal arthritis. *Hand (N Y)*. 2018;13(4):403-411. doi:10.1177/1558944717717506.
12. Stepan JG, Rolf L, Zhu E, et al. Patient perspectives after trapeziectomy and ligament reconstruction tendon interposition: a qualitative analysis. *Plast Reconstr Surg*. 2022;150(6):1275E-1282E. doi:10.1097/PRS.0000000000009676.
13. Morais B, Botelho T, Marques N, et al. Trapeziectomy with suture-button suspensionplasty versus ligament reconstruction and tendon interposition: a randomized controlled trial. *Hand Surg Rehabil*. 2022;41(1):59-64. doi:10.1016/j.hansur.2021.10.315.
14. Yao J, Cheah AE. Mean 5-year follow-up for suture button suspensionplasty in the treatment of thumb carpometacarpal joint osteoarthritis. *J Hand Surg Am*. 2017;42(7):569.e1-569.e11. doi:10.1016/j.jhsa.2017.03.011.
15. Tomaino MM. Suspensionplasty for basal joint arthritis: why and how. *Hand Clin*. 2006;22(2):171-175. doi:10.1016/j.hcl.2006.02.009.