JOURNAL OF PLASTIC SURGERY AND HAND SURGERY
2021, VOL. 55, NO. 2, 105–110
https://doi.org/10.1080/2000656X.2020.1830101

ARTICLE

Patient-reported outcomes following interposition arthroplasty of the basal joint of the thumb

Rasmus Wejnold Jørgensen[a], Anders Odgaard[b], Frederik Flensted[b], Henrik Daugaard[a] and Claus Hjorth Jensen[a]

[a]Department of Orthopedics, Hand Clinic, Herlev-Gentofte University Hospital of Copenhagen, Copenhagen, Denmark; [b]Department of Orthopedics, Herlev-Gentofte University Hospital of Copenhagen, Copenhagen, Denmark

ABSTRACT

The purpose of this study was (1) to evaluate the results following thumb carpometacarpal (CMC) interposition arthroplasties with patient-reported outcomes (PRO) in a large prospective series, (2) to evaluate the correlation between PRO and patient satisfaction following surgery, (3) to evaluate if age, gender, occupational status, sports activities or operative technique correlate with the PRO following surgery. Quick-DASH ranges from 0 to 100 with 100 being the worst score. The mean preoperative Quick-DASH was 49.9. The mean 6 months postoperative Quick-DASH was 25.4 showing an average improvement of 24.6 points. Mixed model analysis revealed a further improvement in Quick-DASH and pain after 6 months. Satisfied patients had significantly lower pain scores and lower Quick-DASH at follow up as compared to dissatisfied patients. Age, gender, hobby activities, occupational status and operative technique do not seem to influence PRO after CMC interposition arthroplasty of the thumb.
Level of evidence: II – prospective cohort.

Abbreviations: AUSCAN: Australian/Canadian osteoarthritis hand index; CMC: carpometacarpal; FCR: flexor carpi radialis tendon; LRTI: ligament reconstruction and tendon interposition; PRO: patient reported outcomes; PRWE: patient-rated wrist hand evaluation; Quick: DASH: quick disability of the arm, shoulder, and hand questionnaire; STT: scaphotrapeziotrapezoid

ARTICLE HISTORY
Received 8 June 2020
Accepted 25 September 2020

KEYWORDS
Hand; finger; patient reported outcomes; interposition arthroplasty

Introduction

Osteoarthritis of the carpometacarpal (CMC) joint of the thumb is common and is mostly seen in postmenopausal women. The prevalence is increasing with age and The Copenhagen City Hearth Study describes a prevalence of up to 23% in men over the age of 80 and up to 33% in women over the age of 80 [1]. With an increasing prevalence in the population surgical treatment options have been studied for many years. Previous studies have reported intermediate or long term postoperative measures such as the Disability of the Arm, Shoulder and Hand Questionnaire (DASH) [2–6]. However, most studies have a limited number of patients and systematic reviews call for more research in the area [7,8].

The purpose of this study was (1) to evaluate the results following thumb CMC interposition arthroplasties with patient-reported outcomes (PRO) in a large prospective series (2), to evaluate the correlation between PRO and patient satisfaction following surgery (3), to evaluate if age, gender, occupational status, sports activities or operative technique correlate with the PRO following surgery.

Methods

Demographics

A prospective database of the outcomes following surgical treatment of thumb CMC osteoarthritis was initiated September 2013. The indication for surgical intervention was failure of conservative treatment of idiopathic degenerative osteoarthritis. More women than men were treated, and the mean age was 62 years. The women were younger and had worse PRO scores before surgery and higher pain scores. Demographics are shown in Table 1.

Surgical techniques

Thirteen experienced surgeons performed the operations with their individually preferred technique. 180 patients were operated with trapeziectomy and FCR tendon interposition as described by Burton and Pellegrini [9]. One hundred and ten patients were operated with the technique described by Weilby [10] and the remaining 67 patients were operated with trapeziectomy and capsuloplasty [11].

Patient-reported outcomes

Patients were followed with PRO measures as well as questions about satisfaction. The validated Danish Quick-DASH questionnaire was used [12,13]. The Quick-DASH is valid in the assessment of outcome following surgical treatment of the thumb CMC joint [14]. It includes 11 questions concerning disability and symptoms and an optional section regarding music/sport. The Quick-DASH is designed to evaluate physical function and symptoms in patients with musculoskeletal disorders of the upper limb. The Quick-DASH score is converted to a score from 0 to 100, where 0 is no disability and 100 is extreme disability. Pain was evaluated from the Quick-DASH questionnaire no. 9 with the subject of arm,

CONTACT Rasmus Wejnold Jørgensen rasmus.wejnold.joergensen@regionh.dk Department of Orthopedics, Hand Clinic, Herlev-Gentofte University Hospital of Copenhagen, Copenhagen, Denmark

Table 1. Demographics of patients before surgery.

	All operated	Men	Women	*p*
N	357	82 (23%)	275 (77%)	
Age, mean (SD, range)	62.5 (8.8, 40–84)	65 (8, 40–84)	61.5 (8.9, 42–83)	**.003**
QDASH, mean (SD, range)	49.60 (15.91, 13.64–97.73)	40.9 (13.5, 15.9–75)	52.05 (15.3, 13.6–97.7)	**<.001**
Pain[a], median, mean (Q1, Q3, range)	3.68 (0.71, 1–5)	3, 3.45 (3, 4, 1–5)	4, 3.75 (3, 4, 2–5)	**.003**
Occupational status – working, %	40.4	35.2	41.8	.34
Participating in sports, %	33.9	26.8	35.9	.16

QDASH: Quick Disability of the Arm, Shoulder and Hand, scores from 0 to 100 points (with 100 points being worse).
[a]Pain scale (1: no pain; 2: mild pain; 3: moderate pain; 4: severe pain; 5: extreme pain).
In bold: Statistically significant differences.

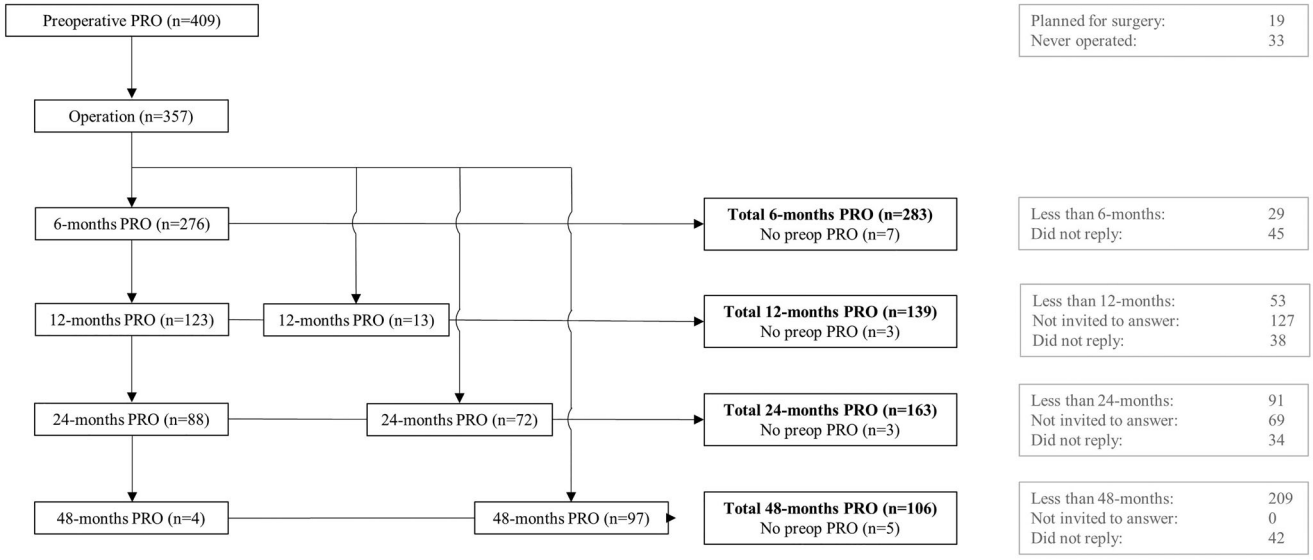

Figure 1. Study flowchart diagram. PRO: patient-reported outcomes. Missing data consist of 'Did not reply': patients that were asked to reply at follow up but did not reply, 'Less than': patients that were operated on but had not reached the follow up time yet, 'Not invited to answer': patients that reached the follow up point but did not receive a follow up questionnaire due to the study design.

shoulder or hand pain, quantified on a scale of one to five, five being extreme pain. The patients were asked if they were satisfied with the result following surgery (yes/no) and will be referred to as satisfied or dissatisfied. Patients were asked about their occupational status (working/not working) and about their participation in sports activities (yes/no).

Sequence

The preoperative Quick-DASH was obtained at the pre-assessment clinic. Patients prospectively answered Quick-DASH questionnaire six months postoperatively following trapeziectomy or interposition arthroplasty of the basal joint of the thumb from 2013 to 2016. From 2016, the database further collected 12, 24 and 48 months postoperative values. Patients that had already passed the 12 and 24 months follow up point by 2016 were not invited to answer at these follow up times. In total, 357 patients were operated by January 2020. The study flowchart diagram is shown in Figure 1.

Complications

Complications following surgery were investigated in a chart review of 250 patients after approval from the National Patient Safety Authority. Persistent pain was included as a complication if the patient returned to the outpatient clinic because of pain more often than the normal postoperative schedule.

Statistics

A mixed model for repeated measures was used in the evaluation of Quick-DASH outcome to accommodate missing values. Pain was analyzed as numerical data for two reasons: (1) because patients had the option to point and click off their answer and the options were positioned next to each other and (2) pain scores were normally distributed. Mixed model for repeated measures was used evaluating pain scores. Independent sample *t*-test was used comparing PRO between satisfied and dissatisfied following surgery. The correlations between PRO and preoperative age, gender, occupational status, sports activities and preoperative PRO were investigated using mixed models for repeated measures. Mixed model for repeated measures were conducted using unstructured covariance structure. SPSS v. 24 (SPSS Inc., Chicago, IL) was used. $p<.05$ was considered statistically significant.

Results

The mean preoperative Quick-DASH was 49.94 (SD 16.22). The mean six months postoperative Quick-DASH ($n=276$) was 25.35 (SD 19.95) showing an average improvement in this group of 24.59, $p<.001$. The average 12, 24 and 48 months postoperative Quick-DASH were 22.64 (SD 20.53), 19.53 (SD 19.91) and 18.92 (SD 19.36), respectively. Pairwise comparison and mixed model for repeated measures results are shown in Figure 2. A significant improvement in Quick-DASH was seen from preoperative to 6 months and from 6 months to 12 months.

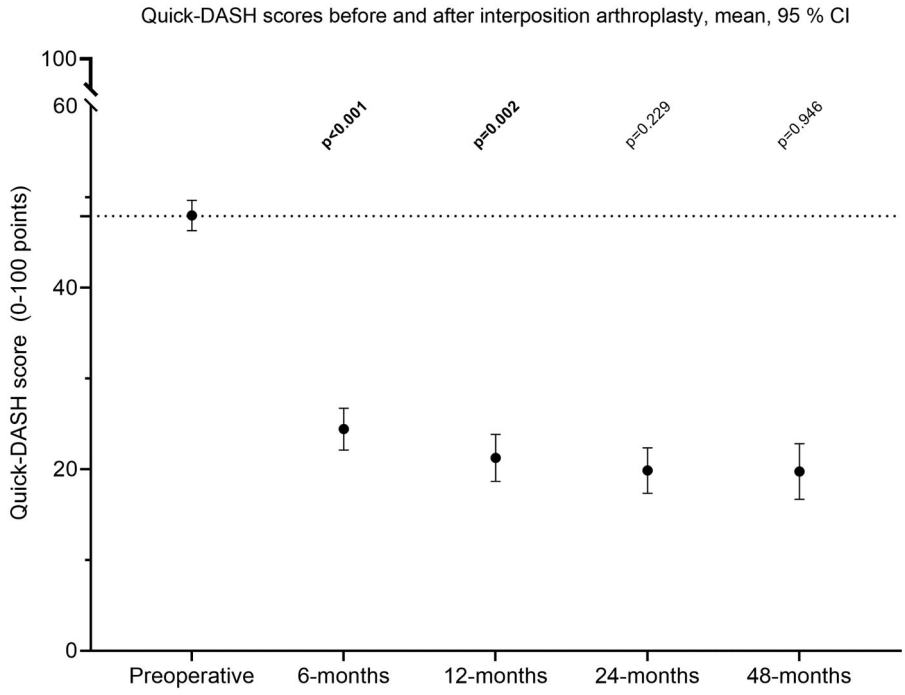

Figure 2. Ticked line representing mean preoperative Quick-DASH from mixed model analysis. *p* Values representing pairwise comparison with the previous value.

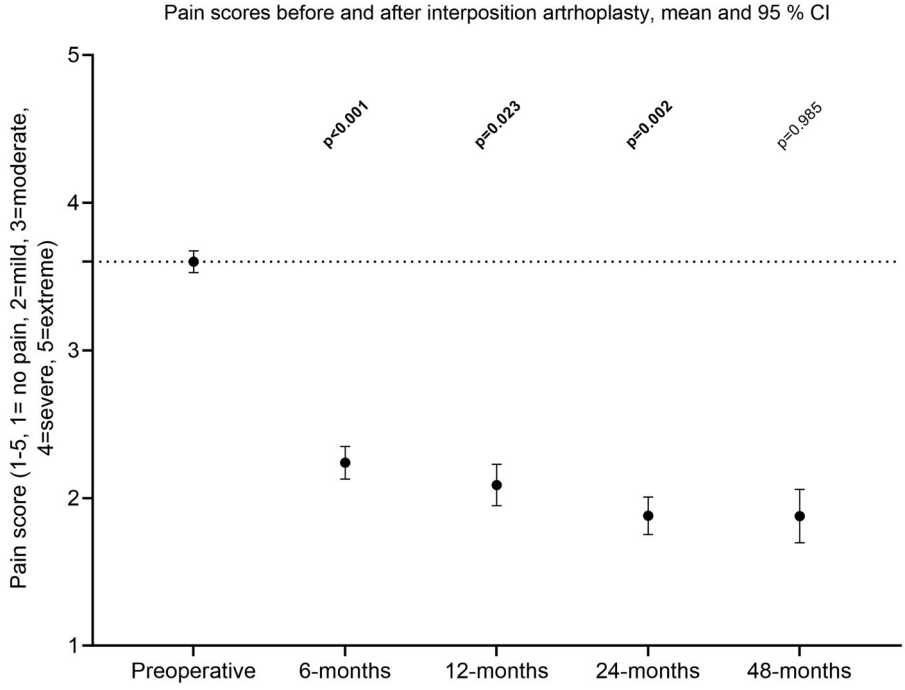

Figure 3. Ticked line representing mean preoperative pain score from mixed model analysis. *p* Values representing pairwise comparison with the previous value.

Preoperative pain was 3.71 (SD 0.73) on a scale from 1 to 5, 5 being extreme pain. Six, 12, 24- and 48-months postoperative mean pain score were 2.26 (SD 0.95), 2.15 (SD 0.98), 1.89 (SD 0.96) and 1.85 (SD 1.02). A significant improvement of 1.45 (SD 1.04) in pain was found from preoperative to 6 months postoperative ($n = 276$, $p < .001$). Pairwise comparison and mixed model for repeated measures results are shown in Figure 3. A significant improvement in pain was seen from preoperative to 6 months, from 6 months to 12 months and from 12 to 24 months.

Seventy-five percent of patients reported that they were satisfied with the result following surgery at six months. Satisfied patients had a significantly larger improvement in pain scores and Quick-DASH scores at 6, 12, 24 and 48 months ($p < .001$ on all parameters) as compared to dissatisfied patients (Figure 4). The same results were seen at all follow up times. As a predictor of outcome; age, gender, occupational status and sports activities did not correlate with satisfaction following surgery. Patients who were satisfied with the results following surgery had lower preoperative Quick-DASH scores (48.8 points, SD 15.8) as compared to patients who were dissatisfied (53.7 points, SD 17.0), $p = .03$.

Age at surgery did not correlate with satisfaction postoperatively, Pearson's correlation −0.08 ($p = .14$). Age did not correlate

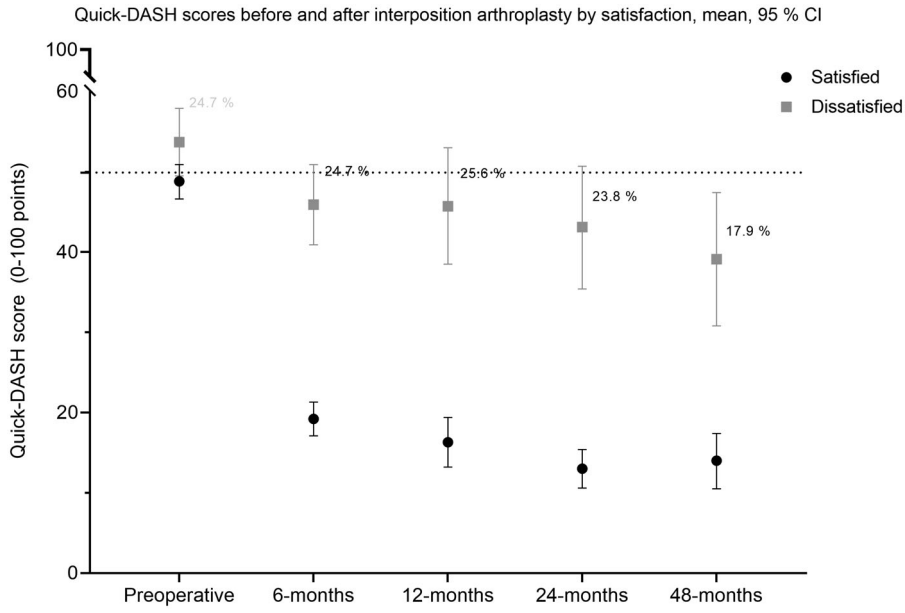

Figure 4. Ticked line representing mean grouped preoperative Quick-DASH score. Preoperative groups based on 6 months satisfaction results. Satisfaction based on the question 'Are you satisfied with the result following the operation, yes/no?'.

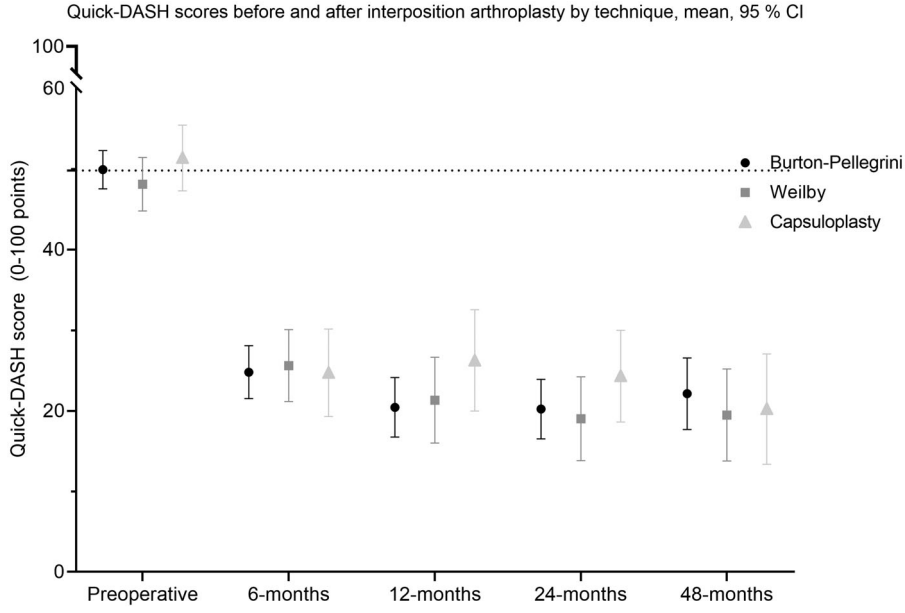

Figure 5. Ticked line representing mean grouped preoperative Quick-DASH score. Pairwise comparison showed no significant difference at any time (mixed effect model, total interaction $p=.30$).

with Quick-DASH results after surgery ($p=.14$, mixed model type III test for fixed effect). Gender, occupational status and patients participating in sports activities did not correlate with postoperative Quick-DASH ($p=.07$, .16, .54, respectively, mixed model type III test for fixed effect). Chi square test showed no difference in satisfaction at 6 months follow up between sexes ($p=.48$), occupational status y/n ($p=.11$) and participation in sports activities y/n ($p=.17$). The same results were found at 12, 24 and 48 months. Operative technique did not correlate with Quick-DASH outcome (fixed effect, $p=.30$), pairwise comparison in Figure 5.

Complications following surgery are as shown in Table 2. FCR rupture and scar tissue formation around the extensor pollicis brevis were only seen in patients operated with Weilby or Burton–Pellegrini technique. There were few major complications but more than 10% returned to the outpatient clinic due to persistent pain. Twelve patients of 250 were revised due to complications. Four received further interposition arthroplasty following capsuloplasty, three received a MiniTight Rope (Arthrex®) suspension due to subsidence, one sensory nerve needed repair, one tendon needed repair, one debridement was performed due to infection, one had additional trapezium bone removed and one had a secondary capsuloplasty performed. Complication of any kind was associated with a mean improvement in Quick-DASH scores of only 13.76 points at six months follow up. Patients who did not have any complications had a mean improvement of 27.82 points ($p<.001$). The same results were seen when comparing the improvement in pain scores ($p<.001$). Complications of any kind were associated with 49% of patients being dissatisfied at 6 months follow up ($p<.001$). Gender was not associated with complications of any kind, but younger age

Table 2. Complications following surgery.

	n/N (%)
Persistent pain[a]	27/250 (10.8)
Scar tissue formation around extensor tendons	7/250 (2.8)
Dysesthesia	5/250 (2.0)
Infection, minor	4/250 (1.6)
Subsidence	3/250 (1.2)
Impingement of residual bone	2/250 (0.8)
FCR rupture	2/250 (0.8)
Mb De Quervain syndrome	2/250 (0.8)
Infection, requiring revision	1/250 (0.4)
ST OA	1/250 (0.4)
Hematoma	1/250 (0.4)
Minor allergic reaction	1/250 (0.4)
CRPS	1/250 (0.4)
DISI configuration	1/250 (0.4)
Dupuytren's contracture	1/250 (0.4)
Ganglion formation	1/250 (0.4)

FCR: flexor carpi radialis tendon; ST OA: osteoarthritis in the remaining joint between the scaphoid and the trapezoid; CRPS: complex regional pain syndrome; DISI: dorsal intercalated segment instability.
[a]Persistent pain was registered when patients were seen in the outpatient clinic more than standard due to persistent postoperative pain.

was associated with a higher risk of complications (Pearson's correlation 0.13, p=.03).

Discussion

The primary outcome of this study shows a significant reduction in pain scores and Quick-DASH scores. A further reduction in pain scores and Quick-DASH scores were seen after 6 months follow up. The improvement in pain scores seen at 6 months further improved marginally but statistically significant at one year follow up. A further improvement might suggest that the full effect of the treatment is seen later than six months following surgery. Werthel et al. showed similar pre- and postoperative DASH values with a mean preoperative value of 49.4 and 22.1 postoperatively in 49 thumbs [15]. These patients were all operated on with ligament reconstruction using the entire flexor carpi radialis tendon. De Smet et al. compared trapeziectomy with or without tendon interposition and found postoperative values of 33 for trapeziectomy in 22 patients and 27 for tendon interposition in 34 patients [4]. One study compared 18 thumb trapeziectomies, 17 trapeziectomies followed by tendon interposition and 28 arthrodesis. Long term postoperative DASH values were 25, 26 and 27, respectively [3]. One randomized single blinded study compared simple trapeziectomy to LRTI suspension and found equal pain scores at follow up but did not report Quick-DASH scores or other PRO [16].

Secondary outcomes of this study suggest that one fourth of patients answer 'no' when asked if they are satisfied with the result of the operation at follow-up. We found a highly significant difference in pain scores and Quick-DASH scores between satisfied and dissatisfied patients at all follow up times. This suggests that patients who are dissatisfied have significantly more pain and less function of their hand following surgery. As seen in Figure 4, dissatisfied patients have postoperative PRO that are almost similar to their preoperative PRO. Preoperative presence of undiagnosed scaphotrapeziotrapezoid (STT) joint osteoarthritis has been postulated as the explanation for the persistence of pain at follow up. Further research regarding the presence of residual ST osteoarthritis in this cohort of patients is warranted. Age and gender did not influence satisfaction at follow up and did not correlate with PRO. Occupational status of the patients as well as if patients participated in hobby activities did not influence satisfaction at follow up and did not correlate with PRO. Higher preoperative Quick-DASH was found to correlate with dissatisfied patients at 6 months follow up, however, the clinical relevance can be discussed. We found no difference between techniques when comparing the improvement in Quick-DASH values or pain scores in line with the current literature. Our results are in line with recent studies and do strengthen our knowledge of CMC osteoarthritis and the operative treatment. Resent systematic review did not find any difference between surgical techniques for thumb CMC arthritis. Further randomized studies are needed to conclude if one surgical procedure is superior [7,8].

Limitations

A prospective series with ongoing follow up will inevitably result in a heterogeneous number of patients at each follow up time. To our knowledge, this is one of the biggest PRO evaluations following interposition arthroplasty of the basal joint of the thumb and publication at this point was assessed as beneficial. Due to a change in database sequence, many patients were not invited to answer PRO at one and two years after surgery. Bias may be introduced when missing values exist. As the treatment has been the same, surgical experience has been the same and patients were not invited solely because of the date of operation, these missing values can be interpreted as MCAR (missing completely at random).

Patients who were invited to answer but never replied could introduce bias to our results. Patients who did not reply at 6 months follow up had a mean age of 65 years vs. 62 years for patients who did reply, p .045. This was the only statistically significant difference between these groups. Preoperative pain and preoperative Quick-DASH were not different for patients that did not reply at 6 months follow up. Patients that did not reply at 12 months, 24 months and 48 months have equal preoperative age, pain scores and Quick-DASH scores.

DASH has been found valid in the assessment of results following interposition arthroplasty of the thumb with construct validity tested against Australian/Canadian Osteoarthritis Hand Index (AUSCAN) and Patient-Rated Wrist Hand Evaluation (PRWHE) [14].

All 13 surgeons were experienced in their operative technique, but their previous training was not necessarily done at the same institute. This strengthens the external validity of the results of this study.

Conclusions

CMC-1 arthroplasty is an effective treatment of thumb CMC osteoarthritis as Quick-DASH scores and pain scores improved significantly postoperatively. Quick-DASH and pain scores further improved suggesting that the full effect of the treatment is seen later than six months following surgery; however, the improvement was small, and the clinical relevance is uncertain. Patients who were satisfied had lower pain scores and lower Quick-DASH scores at follow up compared to patients who were dissatisfied. Age, gender, hobby activities, occupational status and operative technique do not seem to influence PRO after CMC-1 interposition arthroplasty of the thumb.

Acknowledgements

The authors would like to thank Bo Sanderhoff Olsen, Tobias Wirenfeldt Klausen.

Ethical approval

The National Ethical Committee does not require ethical approval for reporting Patient Reported Outcomes. The Danish Patient Safety Authority approved the study: 3-3013-2899/1. Written informed consent was obtained from all subjects before the study.

Author contributions

CHJ conceived the study. AO and BSO were involved in protocol development, database maintenance. RWJ did statistical analysis, drafting of manuscripts, gained approval from the Danish Patient Safety Authority. FF reviewed 250 patient charts for retrospective complication analysis. HD was involved in data collection and maintenance. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

Disclosure statement

The author(s) declare no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

ORCID

Rasmus Wejnold Jørgensen http://orcid.org/0000-0001-5734-9244

References

[1] Sonne-Holm S, Jacobsen S. Osteoarthritis of the first carpometacarpal joint: a study of radiology and clinical epidemiology. Results from the Copenhagen Osteoarthritis Study. Osteoarthritis Cartilage. 2006;14(5):496–500.

[2] Tomaino MM, Pellegrini VD Jr., 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.

[3] Raven EE, Kerkhoffs GM, Rutten S, et al. Long term results of surgical intervention for osteoarthritis of the trapeziometacarpal joint: comparison of resection arthroplasty, trapeziectomy with tendon interposition and trapeziometacarpal arthrodesis. Int Orthop. 2007;31(4):547–554.

[4] De Smet L, Sioen W, Spaepen D, et al. Treatment of basal joint arthritis of the thumb: trapeziectomy with or without tendon interposition/ligament reconstruction. Hand Surg. 2004;9(1):5–9.

[5] Pardini AG Jr., Freitas AD, Chaves AB, et al. Comparative study between trapezium resection and tendon interposition with and without ligamentplasty in the management of carpometacarpal arthrosis of the thumb. J Hand Microsurg. 2009;1(1):7–11.

[6] Gangopadhyay S, McKenna H, Burke FD, et al. Five- to 18-year follow-up for treatment of trapeziometacarpal osteoarthritis: a prospective comparison of excision, tendon interposition, and ligament reconstruction and tendon interposition. J Hand Surg Am. 2012;37(3):411–417.

[7] Huang K, Hollevoet N, Giddins G. Thumb carpometacarpal joint total arthroplasty: a systematic review. J Hand Surg Eur Vol. 2015;40(4):338–350.

[8] Vermeulen GM, Slijper H, Feitz R, et al. Surgical management of primary thumb carpometacarpal osteoarthritis: a systematic review. J Hand Surg Am. 2011;36(1):157–169.

[9] Burton RI, Pellegrini VD Jr. 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.

[10] Weilby A. Surgical treatment of osteoarthritis of the carpometa-carpal joint of the thumb. Acta Orthop Scand. 1971;42(5):439–440.

[11] Gervis WH. Excision of the trapezium for osteoarthritis of the trapezio-metacarpal joint. J Bone Joint Surg Br. 1949;31B(4):537–539.

[12] Herup A, Merser S, Boeckstyns M. Validation of questionnaire for conditions of the upper extremity. Ugeskr Laeg. 2010;172(48):3333–3336.

[13] Health IfWa. Institute for Work and Health; 2020. Available from: http://www.dash.iwh.on.ca/available-translations?-field_language_tid=danish

[14] MacDermid JC, Wessel J, Humphrey R, et al. Validity of self-report measures of pain and disability for persons who have undergone arthroplasty for osteoarthritis of the carpometacarpal joint of the hand. Osteoarthritis Cartilage. 2007;15(5):524–530.

[15] Werthel JD, Dubert T. Use of the entire flexor carpi radialis tendon for basal thumb ligament reconstruction interposition arthroplasty. Hand Surg Rehabil. 2016;35(2):107–113.

[16] Field J, Buchanan D. To suspend or not to suspend: a randomised single blind trial of simple trapeziectomy versus trapeziectomy and flexor carpi radialis suspension. J Hand Surg Eur Vol. 2007;32(4):462–466.