

# First carpometacarpal arthroplasty with ligamentous reconstruction: a long-term follow-up

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## Abstract

**Background** The purpose of the present study is to evaluate a single surgeon's short, intermediate, and long-term clinical, functional, and radiographic outcomes with a trapeziectomy with flexor carpi radialis (FCR) suspension arthroplasty without tendon interposition (LRSA).

**Methods** Twenty-one patients underwent 26 FCR suspension arthroplasties without tendon interposition by a single senior surgeon. All patients had Eaton stage III and IV carpometacarpal (CMC) osteoarthritis. The Patient-Rated Wrist and Hand Evaluation (PRWHE) and Quick Disabilities of Arm, Shoulder, and Hand (QuickDASH) were used to evaluate functional outcomes. A comprehensive strength and range of motion evaluation was performed to evaluate clinical outcomes. Plain radiographs at rest and with maximal pinch were performed to evaluate for arthroplasty space subsidence.

**Results** The LRSA exhibited consistent clinical and functional outcomes throughout postoperative follow-up. As the average patient age and time from surgery increased, range of motion (ROM) and PRWHE scores stayed relatively constant, while lateral tip and tip pinch strength deteriorated with time. The LRSA prevented the proximal migration of the first metacarpal in all but one patient. No patients required revision arthroplasty following LRSA.

**Conclusions** This study demonstrates the consistent short, intermediate, and long-term clinical, functional, and radiographic outcomes following a trapeziectomy with FCR suspension arthroplasty.

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## Introduction

Osteoarthritis of the first carpometacarpal joint is a common condition affecting hand function in middle aged and elderly individuals and constitutes the most common site of surgical reconstruction for osteoarthritis in the upper extremity [1].

A variety of surgical techniques for advanced carpometacarpal (CMC) osteoarthritis have been described. While there is abundant literature describing various surgical techniques, few studies provide data regarding the long-term outcomes of the procedures.

The purpose of the present study is to evaluate a single surgeon's intermediate and long-term clinical, functional, and radiographic outcomes with a trapeziectomy with flexor carpi radialis (FCR) suspension arthroplasty without tendon interposition (LRSA). We hypothesize that patients will continue to maintain a satisfactory level of function up to 15 years postoperatively.

## Methods

### Subject Selection

Inclusion criteria included all patients treated by the senior author between 1996 and 2010 who had Eaton stage III and IV [2, 3] CMC osteoarthritis and who underwent LRSA. The surgical technique is a modified Burton-type arthroplasty and has been previously described in detail [4]. Modifications to the Burton arthroplasty in our surgical technique included the use of a mini Mitek suture anchor to secure the slip of FCR

tendon to the first metacarpal and the no use of tendon interposition within the arthroplasty space. Operative reports were used to confirm the specific procedure performed; those patients for whom operative reports were unavailable were excluded. Attempts were made to contact all patients to return for a clinical and radiographic examination. Patients who returned for examination were included in our final analysis. Major complications requiring the need for revision surgery were recorded.

Radiographs were obtained to evaluate the scapho-metacarpal space at rest and with maximal lateral key pinch stress. The scapho-metacarpal space and scapho-metacarpal space index were determined using a previously established methodology [5].

### Patient Examination

All study patients signed informed consent and subsequently received a comprehensive clinical and functional examination by one of two hand therapists. This exam included strength measurements (lateral pinch strength, two-point pinch strength, three-point pinch strength, grip strength), range of motion (ROM) evaluation (metacarpal-phalangeal (MP) extension, MP flexion, thumb palmar/radial abduction), a Kapandji opposition score (ability to complete progressively more difficult thumb movement on a scale from 1 to 10) [6], the completion of functional questionnaires (Patient-Rated Wrist and Hand Evaluation/PRWHE [7], Quick Disabilities of Arm, Shoulder, and Hand/QuickDASH [8]), and an X-ray series (standard posteroanterior and oblique views of hand at rest and with maximal pinch) to evaluate for metacarpal subsidence [4]. The QuickDASH and PRWHE were selected as measures of functional outcome as they have been previously used as comprehensive and specific assessments of thumb CMC joint conditions [9].

Data were abstracted in compliance with HIPAA protocol and compiled. Basic descriptive statistics (means, standard deviations) were used to analyze results. This was an institutional review board (IRB)-approved study. None of the authors had any conflicts of interest related to this study.

## Results

Twenty-eight patients were successfully contacted out of a total of 59 patients identified as potential subjects. Of these 28 patients, seven were unable (six) or unwilling (one) to return for evaluation. Twenty-one final study participants with 26 LRSAs were included in the final analysis. Nineteen participants were women, and two were men. The mean age of subjects at time of follow-up exam was 65.7 years old (SD 8.6) with a mean time since surgery of 7.6 years (SD 4.4).

Subjects were stratified into groups based on time since surgery. Group 1 was defined as 0–5 years since operation, group 2 was defined as 5.01–10 years since operation, and group 3 was defined as greater than 10.01 years since operation. Group 1 included 8 arthroplasties with an average time since operation of 3.2 years (SD 1.2), group 2 included 11 arthroplasties with an average time since operation of 6.8 years (SD 1.3), and group 3 included 7 arthroplasties with an average time since operation of 13.9 years (SD 2.0) (Table 1). None of the study subjects had revision of their arthroplasty in the time since their operation.

### Strength Results

Overall, the average lateral pinch strength was 8.7 lbs (SD 2.5), two-point pinch strength was 6.3 lbs (SD 2.5), three-point pinch strength was 7.1 lbs (SD 2.6), and grip strength was 50.8 lbs (SD 17.1) (Fig. 1).

For group 1, the average lateral pinch strength was 9.9 lbs (SD 2.0), and the average grip strength was 57.2 lbs (13.9). For group 2, the average lateral pinch strength was 8.4 lbs (SD 2.2), and the average grip strength was 53.3 lbs (SD 20.4). For group 3, the average lateral pinch strength was 8.0 lbs (SD 3.3), and the average grip strength was 39.4 lbs (SD 8.9) (Table 1).

### Range of Motion Results

Overall, the mean MP extension ROM was 2.2° (SD 7.3), MP flexion ROM was 27.5° (SD 18.0), radial abduction ROM was 49.4° (SD 10.2), palmar abduction ROM was 50.7° (SD 8.6), and Kapandji opposition score was 8.8 (SD 1.2) (Fig. 2). For groups 1, 2, and 3, the average Kapandji opposition scores were 9 (SD 0.9), 8.6 (SD 1.4), and 9 (SD 0.8) (Table 1).

**Table 1** Summary of results

Time since procedure	Number of procedures	Avg age	Lat pinch (lbs)	Two-point pinch (lbs)	Three-point pinch (lbs)	Grip (lbs)	MP flex ROM (°)	Radial abduct ROM (°)	Palmar abduct ROM (°)	PHWHE total	Quick DASH	Kapandji opp score
All patients	26	65.7	8.7	6.3	7.1	50.8	27.5	49.4	50.7	12.2	14.8	8.8
Group 1	8	58.6	9.9	7.0	7.1	57.2	29	54.1	54.3	10.4	7.7	9
Group 2	11	67.6	8.4	6.0	7.5	53.3	26.6	50.3	50.4	12.6	13.6	8.6
Group 3	7	70.9	8.0	6.0	6.5	39.4	27	42.7	47	13.5	24.9	9

Questionnaire Results

Overall, the average PRWHE score of subjects was 12.2 out of a possible 100 (low scores indicating better functionality). The average QuickDASH score was 14.8 out of a possible 100 (low scores indicating better functionality) (Fig. 3).

The average PRWHE scores for groups 1, 2, and 3 were 10.4, 12.6, and 13.5, respectively. The average QuickDASH scores for groups 1, 2, and 3 were 7.7, 13.6, and 24, respectively (Table 1).

Radiographic Results

Overall, the average scapho-metacarpal distance was 6.2 mm (SD 2). The scapho-metacarpal distance for groups 1, 2, and 3 were 7.1 mm (SD 2), 6.9 mm (SD 1), and 4.2 mm (SD 3), respectively. Radiographs were unavailable for one subject in group 2 (Table 1).

Discussion

At short, intermediate, and long-term follow-up, patients continued to exhibit satisfactory strength, range of motion, and function without the need for surgical revision.

We did note modest declines in strength measures associated with patient age and time from surgery. As the average patient age and time from surgery increased by >10 years (group 1 vs. group 3), lateral pinch deteriorated by 20 %, and tip pinch strength deteriorated 19 %. A previous study of healthy control thumbs from subjects aged 59–71 years showed that lateral pinch strength deteriorates by 7 % and pinch strength deteriorates by 10 % [10], suggesting that perhaps surgically repaired thumbs deteriorate at a faster rate than healthy control thumbs. Compared to healthy age-matched control thumbs [10], the arthroplasties in group 1 were 35 % weaker in lateral pinch and 36 % weaker in tip

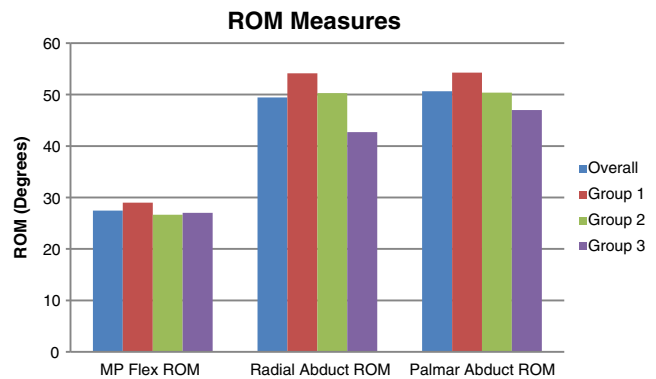


Fig. 2 ROM results

pinch. Grip strength was 9 % stronger in operative hands than in the similarly aged patients in the study by Mathiowetz et al., suggesting that LRSA may have a mixed effect on strength performance.

Range of motion, as measured by the Kapandji opposition score, did not deteriorate between group 1 and group 3, and average scapho-metacarpal joint space was maintained at >4 mm for all groups. Only one thumb was found to have a collapsed joint space (at 16.25 years postsurgery).

Within the literature, there are several short-term studies that included similar clinical and functional detail. At 2 [4], 3 [11], and 4 [12] -year follow-up, respectively, these studies demonstrated clinical and functional results similar to those found in our short-term follow-up group (group 1 with average follow-up of 3.2 years) (Table 2).

Gerwin [4] and Kriegs-Au [12] performed randomized control trials, which demonstrated that results with CMC suspension arthroplasty were as good as those attained with trapeziectomy with FCR ligamentous reconstruction and tendon interposition (LRTI). A study by Brand [13] included patients 1–7 years following a CMC suspension arthroplasty and found that the vast majority of patients (40 of 41) were subjectively satisfied but included no objective measures other than scapho-metacarpal joint space distance. A number of other short-term outcome studies following CMC suspension arthroplasty with the use of FCR [14, 15] or APL [16, 17] also obtained results

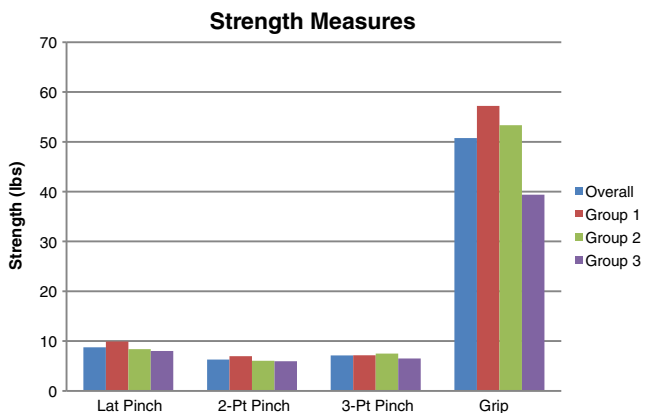


Fig. 1 Strength results

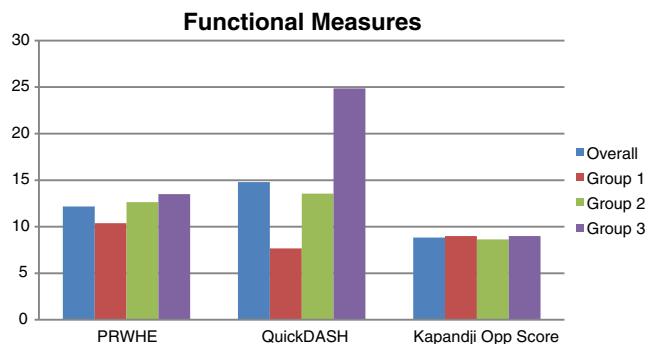


Fig. 3 Functional results

**Table 2** Trapeziectomy with FCR ligamentous reconstruction without tendon interposition (LRSA), trapeziectomy with FCR ligamentous reconstruction and tendon interposition (LRTI), SM distance (scapho-metacarpal distance). CMC arthroplasty short-term follow-up studies

Study	Procedure	Avg follow-up	Lateral (key) pinch (kg)	Two-point pinch (kg)	Three-point pinch (kg)	Grip (kg)	Radial abduction	Palmar abduction	Kapandji score	SM distance (mm)
Present study (group 1)	LRSA	3.2 years	4.5	3.2	3.2	26	54.1	54.3	9	7.1
Kriegs-Au, 2004	LRSA	4 years					39	38		
	LRTI	4 years					43	42		
Gerwin, 1997	LRSA	2 years	5.4	4.1	5.3	27.7	40	44		5.2
	LRTI	2 years	4.8	3.5	4.2	24	42	47		4.5
Soejima, 2006	LRSA with APL	3 years	4			16	56			
Chang, 2008	LRSA with APL	1 year				16.7				
Wysocki, 2010	LRSA	19 months	5	5	6	19	56	55		5.9
Walaszek, 2010	LRSA	14 months							9.5	
Nordback, 2012	LRSA with APL	1 year	4.6						9.1	5.6

similar to those for group 1 (Table 2). Our study reinforces the longevity of these outcomes up to 15 years postoperative.

Although other long-term follow-up studies are lacking for LRSA, they do exist for some other surgical modalities for the treatment of first CMC arthritis. A study by Gangopadhyay et al. reported lateral pinch, tip pinch, and grip strength outcomes for simple trapeziectomy, trapeziectomy with palmaris longus interposition, and LTRI at an average of 6 years postsurgery (range of 5–18 years postsurgery) [18]. Tomaino et al. reported on the same parameters for LRTI at 2, 6, and 9-year follow-up [19]. A study by Gray [20] reported SC distance for trapeziectomy with hematoma arthroplasty at 6.5-year follow-up, and a randomized trial by Hartigan et al. [21] reported lateral pinch strength, grip strength, and palmar/radial abduction ROM measurements for LRTI and arthrodesis 5 years after surgery. Results from all these studies are

similar to our study’s overall results (average follow-up of 7.6 years) with the notable exception of Gray’s scapho-metacarpal distance of just 2 mm at 6.5 years postsurgery (Table 3). Review studies continue to show no difference in outcomes between LRTI and other surgical modalities used to treat thumb CMC arthritis [22–24].

There were several limitations to this study. Recruitment and examination of large numbers of subjects proved difficult, and this resulted in a relatively small number of subjects. Given the strict requirement for procedure performed (trapeziectomy with FCR suspension arthroplasty of first CMC joint without tendinous interposition), the relatively advanced age of patients receiving the procedure (indicated for advanced osteoarthritis of CMC joint), and the length of follow-up (up to 16 years), we believe that the 21 subjects and 26 LRSA attained were satisfactory and similar in study size

**Table 3** Trapeziectomy alone (T), arthrodesis (A), HAD (trapeziectomy w/ hematoma and distraction), trapeziectomy with FCR ligamentous reconstruction without tendon interposition (LRSA), trapeziectomy with FCR ligamentous reconstruction and tendon interposition (LRTI). CMC arthroplasty intermediate and long-term follow-up studies

Study	Procedure	Avg follow-up	Lateral (key) pinch (kg)	Two-point pinch (kg)	Grip (kg)	Radial abduction	Palmar abduction	SC distance (mm)
Present study, 2013	LRSA	7.6 years	4	3.2	23.1	49.4	50.7	6.2
Tomaino, 1995	LRTI	6 years	5.6	3.8	24.4			
	LRTI	9 years	4.9	3.8	24.6			
Gray, 2007	HAD	6.5 years						2
Hartigan, 2011	LRTI	5 years	5		25	45	42	
	A	5 years	4		25	48	47	
Gangopadhyay, 2012	T	6 years	4.1	2.7	20			
	T+PL interposition	6 years	3.4	2.5	18			
	LRTI	6 years	3.6	2.7	20			

to studies of other treatment modalities with similar duration follow-up.

Our focus was strictly on the clinical, functional, and radiographic longevity of this procedure. Consequently, we did not investigate nor did we include baseline clinical and functional data on our patients. Despite all patients having Eaton stage III or IV disease, this is a notable limitation, as we are unable to draw conclusions regarding interval clinical and functional change following this operative intervention. Furthermore, results were not corrected for severity of disease at time of operation, the condition of joints other than the first CMC joint, or strength at baseline. In addition, there may have been minor complications with patients in this series, but none significant enough to require revision arthroplasty surgery.

In order to draw firm conclusions regarding the long-term efficacy of the LRSA, further studies are needed to analyze postprocedural clinical and functional improvement and to directly compare LRSA to other procedures commonly employed to address advanced first CMC arthritis, such as ligamentous reconstruction with tendinous interposition (LTRI), simple trapeziectomy or “hematoma arthroplasty,” and reconstruction techniques utilizing a tendon slip other than the FCR (such as the APL.)

**Conflict of Interest** Mark A. Yaffe, Bennett Butler, James M. Saucedo, and Daniel J. Nagle have no conflicts of interest related to this study.

**Statement of Human and Animal Rights** This study was IRB approved and was conducted in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 and 2008.

**Statement of Informed Consent** All subjects involved in this study understood and signed IRB-approved informed consent forms.

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