Unplanned Reoperation After Trapeziometacarpal Arthroplasty: Rate, Reasons, and Risk Factors

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Abstract

Background: Trapeziometacarpal (TMC) arthritis is an expected part of ageing to which most patients adapt well. Patients who do not adapt to TMC arthritis may be offered operative treatment. The factors associated with reoperation after TMC arthroplasty are incompletely understood. The purpose of this study was to determine the rate of, the underlying reasons for, and the factors associated with unplanned reoperation after TMC arthroplasty. **Methods:** In this retrospective study, we included all adult patients who had TMC arthroplasty for TMC arthritis at 1 of 3 large urban area hospitals between January 2000 and December 2009. Variables were inserted into a multivariable Cox proportional hazards model to determine factors associated with unplanned reoperation, and the Kaplan-Meier curve was used to estimate and describe the probability of unplanned reoperation over time. **Results:** Among 458 TMC arthroplasties, 19 (4%) had an unplanned reoperation; 16 of 19 (84%) for persistent pain and two-thirds within the first year. The multivariate Cox regression analysis showed that unplanned reoperation was independently associated with younger age, surgeon inexperience, and index procedure type. **Conclusions:** Surgeons should be aware as well as patients should be informed that as many as 4% are offered or request a second surgery, usually for persistent pain and often within the 1-year window when additional improvement is anticipated.

Keywords: arthroplasty, reoperation, risk factors, survival analysis, trapeziometacarpal arthritis

Introduction

Trapeziometacarpal (TMC) arthritis is an expected part of ageing to which most patients adapt well.^{3,10,32} The care a patient receives for hand arthritis seems to depend on the preferences and values of their hand surgeon.^{5,28} Patients who are dissatisfied with nonoperative treatment are usually offered trapeziectomy with or without ligament reconstruction and/or tendon interposition (LRTI). About 80% of patients are satisfied with operative treatment on average.^{2,7,11-16,19,20,22,23,25-27} Evidence to date is not sufficient to establish the value of anything beyond trapeziectomy (ie, interposition, suspensionplasty, LR).^{33,34} The rationale for continuing to perform LRTI is based on the perception that stabilizing the first metacarpal and/or placing a cushion between the metacarpal and the scaphoid will better relieve symptoms and limitations over the long term. However, symptoms do not clearly correlate with radiographic proximity of the metacarpal and scaphoid (often referred to as subsidence).^{1,12,17,18,21,35} The factors associated with reoperation after TMC arthroplasty are incompletely understood and consist largely of speculation based on small case series of patients who had a second surgery.^{8,9,24,31}

The purpose of this study was to determine the rate of, the underlying reasons for, and the factors associated with unplanned reoperation after TMC arthroplasty.

Materials and Methods

Study Population

We identified 473 patients who had TMC arthroplasty at 1 of 3 large urban area hospitals (2 level I trauma centers and 1 community hospital tied to a level I trauma center) between January 2000 and December 2009. We identified all patients who had a procedure coded using one of the following Current Procedural Terminology (CPT) codes:

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25445 for arthroplasty with replacement, 25447 for arthroplasty, interposition, intercarpal, or carpometacarpal joints, and 25210 for carpectomy of one bone. Inclusion criteria were patients 18 years or older who underwent TMC arthroplasty for treatment of TMC arthritis. A total of 440 patients met these inclusion criteria. Twenty patients with rheumatoid or posttraumatic osteoarthritis and 17 patients with history of prior operative treatment elsewhere were excluded, leaving a total of 403 patients for analysis (Online Appendix 1). Both hands were assumed to be independent of each other (but tracked as an explanatory variable), leaving a total of 458 hands for analysis. Our institutional review board approved this retrospective study.

Response and Explanatory Variables

The primary outcome was a second, unplanned reoperation. The justification for repeat surgery was identified from the medical record.

Demographic variables, including age, sex, language, race, marital status, smoking, Charlson Comorbidity Index, and insurance status, were obtained from the hospital database. In addition, we recorded the following variables using record review: affected side, time since onset, other procedures of the thumb at the primary operation, duration of immobilization, surgeon experience (years of practice), and index procedure. Age was dichotomized as either patients younger than 50 years old and patients aged 50 years or older, based on the increasing prevalence of advanced stage TMC arthritis after age 50 years.³ Also, surgeon experience was dichotomized as having either fewer than 12 years or 12 years or more experience in clinical practice.

For the index procedure, TMC arthroplasty, four different surgical techniques were used: (1) resection of part or all of the trapezium alone in 16 patients, (2) resection of part or all of the trapezium with ligament reconstruction (LR) in 11 patients, (3) resection of part or all of the trapezium with interposition (TI) in 96 patients, and (4) resection of part or all of the trapezium with ligament reconstruction and tendon interposition or suspensionplasty (LRTI/S) in 335 patients.

The modified Charlson Comorbidity Index^{29,30} was calculated based on International Classification of Diseases, Ninth Revision (ICD-9) codes, which were available for all patients in the hospital database, and used to obtain the comorbidity status. This index provides a score ranging from 0 to 24 with a higher score representing more severe comorbidity status based on 12 weighted comorbidities. The modified Charlson Comorbidity Index scores were categorized into score 0, score 1, score 2, or score more than 2.

Statistical Analysis

The choice of study period ending on December 31, 2009, allowed for a 5-year period for possible revision surgery within our health system. Variables were inserted into a

Figure 1. Kaplan-Meier survival estimate.

Note. Kaplan-Meier failure plot demonstrating the probability of unplanned reoperation ($1 - \text{probability of survival}$) among all patients who had trapeziometacarpal arthroplasty. The probability only slightly increased with time from 2.8% at 1 year up to 4.3% at 10 years.

multivariable Cox proportional hazards model without any form of selection to determine factors associated with unplanned reoperation. Hazard ratios (HRs) with 95% confidence intervals (CI) were reported. The proportional hazard assumption was found to be valid. A 2-sided P value of $< .05$ was considered statistically significant. The Kaplan-Meier curve was used to estimate and describe the probability of unplanned reoperation over time.

Results

Nineteen of 458 (4%) TMC arthroplasties had an unplanned reoperation an average of 24 months after the index procedure (range, 1-86 months). Thirteen (68%) unplanned reoperations occurred within the first year. The Kaplan-Meier curve demonstrated that most of the unplanned reoperations occurred during the first postoperative year (Figure 1). Based on the Kaplan-Meier estimates, the probability for unplanned reoperation was 2.8% at 1 year, 3.5% at 5 years, and 4.3% at 10 years.

There were two unplanned reoperations for infection and one for an extruded tendon graft that caused protuberance, and the rest (16 of 19; 84%) were for persistent pain (Table 1). Thirty-four of 97 interpositions (35%) without LRs used a bovine collagen graft. Four of 43 bovine collagen grafts (9%) were removed because of a possible inflammatory reaction (Table 1).

The multivariable Cox regression analysis showed that patients younger than 50 years were more likely to have an unplanned reoperation (HR, 0.25; 95% CI, 0.080-0.78, $P = .017$). Patients who had a surgeon with less than 12 years of experience performing the initial TMC arthroplasty were

Table 1. Unplanned Reoperation After Trapeziometacarpal Arthroplasty (n = 19).

Sex, age	Index procedure	Surgeon index procedure	Surgeon reoperation	Reason for reoperation	Reoperation	Months to reoperation
Female, 51	TI	Surgeon 1	Surgeon 1	Extruded tendon graft	Excision tendon graft	2
Female, 49	TI	Surgeon 1	Surgeon 1	Ongoing pain	Revision arthroplasty, removal implant	8
Female, 55	LRTI	Surgeon 1	Surgeon 1	Ongoing pain, deformity	Release flexor contracture, tendon transfer	11
Female, 53	LRTI	Surgeon 1	Surgeon 1	Ongoing pain, deformity	Revision arthroplasty, Removal implant	11
Female, 60	TI	Surgeon 1	Surgeon 1	Ongoing pain, deformity	Revision arthroplasty, Removal implant	12
Female, 50	TI	Surgeon 1	Surgeon 8 ^a	Ongoing pain, subsidence	Revision arthroplasty with LR	80
Female, 62	LRTI	Surgeon 2	Surgeon 2	Infection	Debridement, excision tendon graft	1
Female, 47	LRTI	Surgeon 2	Surgeon 2	Ongoing pain	Neurolysis first dorsal compartment	6
Female, 42	TI	Surgeon 2	Surgeon 2	Ongoing pain	Revision arthroplasty	9
Male, 60	LRTI	Surgeon 2	Surgeon 2	Ongoing pain, subsidence	Tendon transfer, MP elevation	57
Female, 55	LRTI	Surgeon 3	Surgeon 3	Infection	Debridement, excision tendon graft	1
Female, 48	TI	Surgeon 3	Surgeon 3	Ongoing pain	Revision arthroplasty	11
Female, 66	LRTI	Surgeon 3	Surgeon 3	Ongoing pain, deformity	TMC joint fusion	7
Female, 61	LRTI	Surgeon 3	Surgeon 3	Ongoing pain, subsidence	Revision arthroplasty	7
Female, 63	LRTI	Surgeon 4	Surgeon 4	Ongoing pain, subsidence	Revision arthroplasty	86
Female, 60	LRTI	Surgeon 4	Surgeon 4	Ongoing pain, subsidence	Revision arthroplasty	42
Male, 57	LRTI	Surgeon 5 ^b	Surgeon 4	Ongoing pain	Revision arthroplasty	8
Male, 56	TI	Surgeon 6	Surgeon 6	Ongoing pain	Revision arthroplasty	10
Female, 56	TI	Surgeon 7	Surgeon 9 ^c	Ongoing pain, deformity	Revision arthroplasty, Removal implant	80

Note. TI = tendon interposition; LRTI = ligament reconstruction and tendon interposition; LR = ligament reconstruction; MP = metacarpophalangeal; TMC = trapeziometacarpal.

^aFellow performing the unplanned reoperation.

^bFellow performing the index operation.

^cOnly true change in surgeon.

relatively more at risk for unplanned reoperation (HR, 0.31; 95% CI, 0.11-0.84, $P = .022$). We also found that resection of part or all of the trapezium with interposition alone was associated with higher rate of unplanned reoperation (HR, 3.5; 95% CI, 1.3-9.6, $P = .016$) compared with resection of part or all of the trapezium with interposition and ligament reconstruction or suspensionplasty (the other comparisons were underpowered; Table 2).

Discussion

Patients who do not adapt to TMC arthritis may be offered operative treatment. About 20% of patients are unsatisfied with TMC arthroplasty, and some of those patients request a second operation.^{2,7,11-16,19,20,22,23,25-27} We aimed to determine the rate of, the underlying reasons for, and the factors

associated with unplanned reoperation after TMC arthroplasty. We found an unplanned reoperation rate of 4%, 84% for persistent pain and two-thirds within the first year. Unplanned reoperation was independently associated with younger age, surgeon inexperience, and index procedure type.

This study should be interpreted in the light of its limitations. First, we used CPT codes to identify patients who underwent TMC arthroplasty for TMC. Although we have used the most common codes for TMC arthroplasty at the 3 hospitals during the study period, some patients might not have been identified based on these codes. Second, the rate of unplanned reoperation was low, meaning that we might be underpowered to detect small but important differences. Third, patients might have had an unplanned reoperation at a different institution. However, we considered this as a minor limitation as we included multiple centers in our

Table 2. Multivariable Cox Proportional Hazards Model for Unplanned Reoperation After Trapeziometacarpal Arthroplasty (n = 458).

Cox proportional hazards model				
Parameter	Hazard ratio	SE	95% confidence interval	P value
Age				
<50 y	1 [Reference]			
>50 y	0.25	0.15	[0.080, 0.78]	.017
Sex				
Men	1.16	0.78	[0.31, 4.3]	.82
Women	1 [Reference]			
Language				
English	1 [Reference]			
Non-English	3.1	3.2	[0.43, 23]	.26
Race				
White	1.2	0.87	[0.28, 5.0]	.82
Non-white	1 [Reference]			
Marital status				
Married	1 [Reference]			
Single	0.69	0.49	[0.17, 2.8]	.60
Separated or divorced	0.65	0.69	[0.082, 5.2]	.69
Widowed	0.84	0.91	[0.10, 6.9]	.87
Other	^a			
Smoking				
Smoking	0.41	0.43	[0.050, 3.3]	.40
Nonsmoking	1 [Reference]			
Charlson Comorbidity Index				
0	1 [Reference]			
1	1.8	1.3	[0.45, 7.6]	.40
2	1.3	0.99	[0.30, 5.8]	.72
>2	1.4	0.90	[0.41, 4.9]	.58
Affected side				
Right	0.48	0.24	[0.18, 1.3]	.15
Left	1 [Reference]			
Time since onset, per 1-month increase	1.0	0.0054	[0.99, 1.0]	.58
Index procedure				
Resection of part or all of the trapezium	^a			
Resection of part or all of the trapezium with LR	^a			
Resection of part or all of the trapezium with TI	3.5	1.8	[1.3, 9.6]	.016
Resection of part or all of the trapezium with LRTI	1 [Reference]			
Other procedures of the thumb at the primary operation				
Yes	1.2	0.64	[0.39, 3.4]	.79
No	1 [Reference]			
Duration of immobilization, per 1-day increase	0.97	0.037	[0.90, 1.0]	.49
Surgeon experience	0.31	0.16	[0.11, 0.84]	.022
Insurance				
Private	1 [Reference]			
Medicare	0.95	0.61	[0.26, 3.3]	.97
Medicaid	0.78	0.65	[0.094, 6.5]	.88
Self pay	^a			
Unknown	0.31	0.30	[0.034, 2.1]	.29

Note. Bold *P* values represent statistically significant *P* values. LR = ligament reconstruction; TI = tendon interposition; LRTI = ligament reconstruction and tendon interposition.

^aThe hazard ratio could not be calculated due to small number of cases in this category.

region and are aware from prior research that a small numbers of patients change surgeons or hospitals. Even in this study, only 3 patients changed surgeons, all within the same hospital, and all between a hand fellow and a supervising attending. Fourth, both specific procedure and surgeon experience are likely confounded with specific surgeon. Our impression is that some surgeons were more likely to recommend repeat surgery to dissatisfied patients. Fifth, the difficulties with the bovine collagen graft almost certainly influenced our findings. On one hand, this makes it more difficult to study reasons for revision when there are not obvious technical problems. On the other, it points out the limited margin for imperfection with respect to this procedure and all its variations. Finally, this study design is retrospective, and therefore we were not able to include patient reported outcome measures (eg, preoperative duration of symptoms, upper extremity disability, pain intensity, coping strategies, and satisfaction) that may be related to unplanned reoperation.

Our unplanned reoperation rate after TMC arthroplasty for TMC arthritis (4%) is comparable with reoperation rates reported in previous studies (2.8% and 2.9%);^{9,24} however, research on the actual number of patients who request a reoperation is limited. Two other studies also reported the number of unplanned reoperations, but the total number of index procedures was not mentioned and some of the patients had the index procedure at a different institution.^{8,31} Overall, we can assume that the small sample sizes published in all studies, could be explained by the low number of patients requesting operative treatment for TMC arthritis.

It is difficult to make conclusions from this evidence about the relationship between the index procedure and the clinical effectiveness of the procedure. There is an inherent tendency to recommend revision surgery with LR/S if a patient is doing poorly after a trapeziectomy without additional stabilization. For example, if the hypothetical outcomes of trapeziectomy and LRTI are equivalent, dissatisfied patients with trapeziectomy may be more likely to undergo revision as there are more surgical options available for revision (LRTI, abductor pollicis longus [APL] suspensionplasty, or suspensory stabilization) while LRTI patients may be less likely to undergo a revision procedure because there are fewer options for revision (suspensory stabilization only). Second surgery should not be used as a surrogate for clinical effectiveness of a procedure when interpreting these data.

The observation that 16 of 19 reoperations were for persistent pain and more than half within 1 year of the index surgery suggests that the reasons for surgery lie more with patient dissatisfaction than technical problems. Given the evidence that improvements in symptoms and limitations are expected for more than 1 year after injury or surgery, one wonders whether these patients and surgeons might have avoided reoperation had they simply been more

patient. Prior series⁹ also reported pain as the most common reason for reoperation and ascribed all persistent pain to technical deficiencies related to instability or bone impingement, which is dubious based on the evidence that subsidence does not correlate with symptoms.^{1,17,18,21,35}

The independent risk factors for unplanned reoperation after TMC arthroplasty in our study (younger age, surgeon inexperience, and index procedure type) may be confounded with other unmeasured or unstudied factors such as specific surgeon and effective coping strategies. Previous studies report that coping strategies correlate strongly with symptoms and disability.^{4,6} Perhaps patients who request operative treatment at a younger age are less adaptive and, therefore, more likely to request a second surgery. We were unable to study the influence of the specific surgeon (a possible surrogate for surgeon inexperience and surgery type) because two of the 11 surgeons performed 64% of the surgeries and most surgeons performed too few surgeries to allow for statistical comparison. Our observed higher reoperation rate with trapeziectomy and TI without LR/S is likely related to a brief trial of a bovine collagen graft interposition by 1 surgeon for about 4 years, which was abandoned due to a possible inflammatory response. A secondary analysis excluding these patients showed no significant difference between the 2 different operative techniques although we also had reduced power ($P = .15$).

Surgeons should be aware as well as patients should be informed that as many 4% are offered or request a second surgery, usually for persistent pain and often within the 1-year window when additional improvement is anticipated. Future research might address the influence of coping strategies, stress, and distress on dissatisfaction after TMC arthroplasty and patient and surgeon preferences and values on the decision to proceed with a second surgery.

We hypothesize that patients who can be patient with an often prolonged recovery process and those who can accept some residual pain will be less likely to have repeat surgery and that awareness of these variations in recovery will help prepare them. These ideas merit additional study.

Authors' Note

The work was performed at the Department of Orthopedic Surgery, Hand and Upper Extremity Service, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts, USA.

Ethical Approval

This study was approved by our institutional review board under protocol 2009P001019/MGH.

Statement of Human and Animal Rights

All procedures followed were 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 2008.

Statement of Informed Consent

The Institutional Review Board granted a waiver of informed consent.

Declaration of Conflicting Interests

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

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