Journal of Hand Surgery Global Online 5 (2023) 655–660

Contents lists available at ScienceDirect

Journal of Hand Surgery Global Online

journal homepage: www.JHSGO.org

Original Research

Factors Influencing Surgical Decision Making in Trapeziometacarpal Osteoarthritis

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ARTICLE INFO

Article history:
Received for publication December 29, 2022
Accepted in revised form May 6, 2023
Available online June 15, 2023

Key words:
Arthroplasty
Basal joint
Expectations
Osteoarthritis
Trapeziometacarpal

Purpose: With trapeziometacarpal osteoarthritis (TMC OA), the relationship between disease severity and pretreatment dysfunction, patient expectations, and preferred patient treatment and management remains unclear. This study aimed to assess the association between functional status, pretreatment expectations, and demographic and clinical characteristics of TMC OA patients who decide to undergo operative management.

Methods: Patients diagnosed with TMC OA (n = 96) were administered the Thumb Arthritis Expectations Survey and the Brief Michigan Hand Questionnaire (bMHQ) during their initial office visit. Demographic data (sex, age, race, education level, marital status, comorbidities, and hand dominance) and clinical characteristics (prior injury, and therapeutic interventions including splinting, steroid injections, therapy, and anti-inflammatory medication) were collected. Multiple logistic regression was used to assess the association between surgical treatment and expectation scores.

Results: Our logistic regression model found that lower bMHQ scores, high thumb arthritis expectation survey scores, and prior treatments for TMC OA were associated significantly with the surgical treatment of TMC OA. After controlling for all possible covariates, the odds of having surgery was 3.9 times higher among patients with high expectations (above median) compared to patients with low expectations (adjusted odds ratio [AOR], 3.9; 95% confidence interval [CI], 1.3–11.2). Patients with average function, as measured by bMHQ scores, were 74.5% less likely to elect for surgery than those with the lowest bMHQ (AOR, 0.3; 95% CI, 0.1–0.9). Patients treated previously with steroids were 13 times more likely to elect for surgery than those who were never treated for TMC arthritis (AOR,13.1; 95% CI, 2.2–77.0).

Conclusions: Patients with TMC OA who elect to proceed with surgical management have lower bMHQ (greater perceived dysfunction) and higher expectations, and have had prior treatment. Age was not a significant predictor of surgical management of TMC OA.

Type of study/level of evidence: Prognostic IV.

Patients with trapeziometacarpal (TMC) osteoarthritis (OA) often present with varying degrees of disease severity and symptomatology. Outcomes after nonsurgical and operative treatment for this condition are variable. Among patients with TMC OA and hand OA, individually determined factors, such as the degree of dysfunction, hand dominance, and perceived history of antecedent trauma, have been demonstrated to influence patient's decision to seek treatment and may contribute to greater expectations.[1,2] Factors such as personal needs, aversion to surgery, palatability of treatment options, and surgeon recommendations may affect the decision-making process and influence the character and number of expectations that patients have when deciding to proceed with treatment.[3–6] Understanding and measuring these factors and expectations in similar conditions have been shown to correlate with outcomes after treatment. The goal of this study was to assess

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

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https://doi.org/10.1016/j.jhsg.2023.05.001

factors associated with operative management of TMC OA, including functional status, pretreatment expectations, and demographic and clinical characteristics.

Materials and Methods

From March 2013 through March 2015, 96 patients diagnosed with TMC OA were followed prospectively at a single, orthopedic, tertiary institution. Demographic information (sex, age, race, education level, marital status, comorbidities, and hand dominance), clinical characteristics (prior injury, and therapeutic interventions, including splinting, steroid injections, therapy, and anti-inflammatory medication), the Thumb Arthritis Expectations Survey, and the Brief Michigan Hand Questionnaire (bMHQ) were collected and recorded during their initial visit.

Participants/study subjects

Patients were eligible for this study if they were diagnosed with TMC OA by the participating hand surgeon investigator, and if TMC OA was the primary condition for which patients were seeking evaluation and/or treatment. Diagnosis was based on clinical information including patient's history, symptomatology, physical examination, and plain radiographs.

The timing of initial diagnosis relative to entry into the study varied among patients because entry was contingent on whether the condition was of primary concern among other diagnoses and whether they were seeking treatment. Subsequent treatment included either an injection (with either triamcinolone or betamethasone) or TMC surgery involving trapeziectomy with soft tissue joint reconstruction. Patients were excluded if they were not English-speaking, chose not to participate, were unable to provide informed consent, or had another condition that affected use of the thumb (eg, carpal tunnel syndrome, Dequervain's, trigger thumb) to which the TMC arthritic condition was considered by the patient to be secondary. Only patients who sought initial and subsequent continuity of care with a hand surgeon and who did not transfer their care during the course of their treatment were included. This study was approved by the institutional review board, and all patients provided written informed consent.

No participant was later excluded for reasons attributable to the criteria listed above. Surveys were administered and completed in-person or by telephone communication before receiving any subsequent treatment. All patients completed the surveys <1 month before receiving further treatment. The Expectations Survey, first developed and described by Kang, et al,[1] consists of 19 discrete items representing a range of pain-related, functional, and psychosocial domains, prefaced by the following question: "For each of the following, how much improvement do you expect after treatment for your hand arthritis?" Response options included "Back to normal" (scored as a 4), "A lot of improvement" (scored as a 3), "A moderate amount of improvement" (scored as a 2), "A little improvement" (scored as a 1), and "I do not have this expectation or this expectation does not apply to me" (scored as a zero). Raw overall scores were calculated by summing all responses, and then these scores were transformed by normalizing to 100, with a higher score indicating greater expectations. The bMHQ survey in paper format, its administration, and its scoring methodology adhered to guidelines provided at http://mhq.lab.medicine.umich.edu/brief-mhq.

Variables, outcome measures, data sources, and bias

At the time of in-person or telephone administration of the survey, data on demographic and clinical characteristics were collected and transcribed into a Microsoft Excel database. Information included age, sex, hand dominance, laterality of the condition, work status, level of education, number of comorbidities, history of depression or anxiety, and history of preceding trauma, and prior intervention. This article adhered to the guidelines set forth by the Strengthening the Reporting of Observational Studies in Epidemiology statement.

Table 1
Demographic and Clinical Characteristics of TMC Arthroplasty Patients

Characteristic	N (%)
Age (y); mean (SD)	62.5 (7.9)
Number of comorbidities; mean (SD)	2.3 (2.5)
Expectation score; mean (SD)	67.5 (24.8)
bMHQ score; mean (SD)	56.7 (16.5)
Thumb arthritis expectations survey scores	
Below median (expectations <73.6)	50 (52.1)
Above median (expectations >73.6)	46 (47.9)
Hand function as measured by bMHQ	
Low function (mean bMHQ = 36.7, SD; 8.1)	29 (30.1)
Average function (mean bMHQ = 53.4, SD; 3.8)	31 (32.3)
High function (mean bMHQ = 72.8, SD; 9.2)	36 (37.5)
Management of TMC OA	
Conservative	62 (64.6)
Surgical	34 (35.4)
Sex	
Men	33 (34.4)
Women	63 (65.6)
Race	
White	91 (94.8)
Nonwhite	5 (5.2)
Marital status	
Single	12 (12.5)
Married	63 (65.6)
Did not respond	21 (21.9)
Education	
Less than college	29 (30.2)
College graduate	24 (25)
Professional-graduate school	43 (44.8)
Actively Working	
No	48 (50.0)
Yes	33 (34.4)
Unknown	15 (15.6)
Hand Dominance	
Right	79 (82.3)
Left	17 (17.7)
Dominant hand affected	
No	32 (33.3)
Yes	64 (66.7)
Preceding injury	
No	73 (76.1)
Yes	8 (8.3)
Unknown	15 (16.6)
Depression or anxiety	
No	85 (88.5)
Yes	11 (11.5)
Prior treatment	
None	14 (14.6)
Conservative without use of steroids	39 (40.6)
Conservative with use of steroids	43 (44.8)

Statistical analysis, study size

Sample size was determined with a power analysis (80% power, $P < .05$) that showed that 88 patients were needed to detect the minimal clinically important difference of 12 points on the full Michigan Hand Questionnaire. Our minimal clinically important difference was chosen based on previous work by London et al,[7] who reported an minimal clinically important difference ranging from 8–13 for the Michigan Hand Questionnaire, depending on the methodology used. Descriptive statistics were calculated in terms of means and standard deviations for continuous variables and

Table 2
Comparison of Demographic and Clinical Factors by Surgical Management of TMC OA Among Patients Diagnosed With TMC OA (n = 96)

	Management of TMC OA		Total	*P* Value
	Conservative	Surgical		
Sample	62 (64.6)	34 (35.4)	96 (100)	
Age (y); mean (SD)	62.6 (8)	62.3 (7.9)	62.5 (7.9)	.852
Number of comorbidities; mean (SD)	1.5 (1.4)	3.3 (3.3)	2.3 (2.5)	.012
Expectation score; continuous; mean (SD)	61.7 (24.3)	78.1 (22.2)	67.5 (24.8)	.001
bMHQ score; continuous; mean (SD)	59.6 (16.7)	51.4 (14.9)	56.7 (16.5)	.019
Thumb arthritis expectations survey scores				.001
Below median	40 (64.5)	10 (29.4)	50 (52.1)	
Above median	22 (35.5)	24 (70.6)	46 (47.9)	
Hand function as measured by bMHQ				.027
Low function	13 (21)	16 (47.1)	29 (30.2)	
Average function	22 (35.5)	9 (26.5)	31 (32.3)	
High function	27 (43.5)	9 (26.5)	36 (37.5)	
Sex				.227
Men	24 (38.7)	9 (26.5)	33 (34.4)	
Women	38 (61.3)	25 (73.5)	63 (65.6)	
Race				.826
White	59 (95.2)	32 (94.1)	91 (94.8)	
Nonwhite	3 (4.8)	2 (5.9)	5 (5.2)	
Marital status				.599
Single	9 (14.5)	3 (8.8)	12 (12.5)	
Divorced	46 (74.2)	17 (50)	63 (65.6)	
Education				.383
HS graduate	17 (30.9)	12 (60)	29 (38.7)	
Some college	14 (25.5)	10 (50)	24 (32)	
College graduate	31 (56.4)	12 (60)	43 (57.3)	
Hand dominance				.402
Right	49 (79)	30 (88.2)	79 (82.3)	
Left	13 (21)	4 (11.8)	17 (17.7)	
Dominant hand affected				.546
No	22 (35.5)	10 (29.4)	32 (33.3)	
Yes	40 (64.5)	24 (70.6)	64 (66.7)	
Preceding injury				1.00
No	56 (90.3)	17 (89.5)	73 (90.1)	
Yes	6 (9.7)	2 (10.5)	8 (9.9)	
Depression or anxiety				1.00
No	56 (88.9)	29 (85.3)	84 (87.5)	
Yes	7 (11.1)	4 (11.8)	11 (11.5)	
Previous treatment any				.243
No	12 (19.4)	3 (8.8)	15 (15.6)	
Yes	50 (80.6)	31 (91.2)	81 (84.4)	
Previous interventions				<.001
None	12 (19.4)	2 (5.9)	14 (14.6)	
No steroid	34 (54.8)	5 (14.7)	39 (40.6)	
With steroids	16 (25.8)	27 (79.4)	43 (44.8)	
Comorbidities				.088
None	16 (16)	6 (6)	22 (22)	
1 or 2	17 (38.6)	10 (32.3)	27 (36)	
>2	11 (25)	15 (48.4)	26 (34.7)	

Study participants were stratified into 2 groups based on whether opted for surgical treatment of their TMC OA. Demographic and clinical characteristics of these 2 groups then were compared.

frequencies and percentages for discrete variables. Expectations and bMHQ scores were considered as a continuous variable (ie, overall survey score) and as a categorical variable. For the latter, expectations scores were split by the group median and categorized as above median and below median, and bMHQ scores were split into tertiles and categorized as low function, average function, and high function, similar to previous studies.[8]

Shapiro-Wilks tests were used to test the normality of the distribution of expectations and bMHQ scores. Independent samples *t*-tests were used to report *P* values on outcomes that met the assumption of normality. Nonparametric Mann-Whitney U tests were used on those outcomes that did not meet the normal distribution assumption. Pearson correlation coefficients were used to report the bivariate correlation between patient expectations and bMHQ scores. Multivariable logistic regression was used to assess the association between the categorical bMHQ and Expectation Survey scores and the outcome of opting for surgical treatment. This outcome of eventual surgical treatment in the treatment of the TMC OA was the dependent variable for all regression analyses models. All other variables were considered independent, including the categorical patient expectations score and bMHQ Scores. Multiple simple logistic regression models were used to identify possible covariates; that is, variables that were associated with surgical treatment. All possible covariates were entered simultaneously into the model to build the fully adjusted model.

A stepwise selection of variables was used to build the most parsimonious model by retaining independent variables that achieved a *P* value of $\leq$.20 . Age, sex, and treatment were considered clinically relevant and were retained in the final model regardless of *P* value. Hosmer-Lemeshow goodness of fit tests was used to assess how well each model fit the observed data. $P < .05$ was considered statistically significant.

Table 3
Comparison of Demographic and Clinical Factors by Thumb Arthritis Expectations Survey Scores Patients Diagnosed With TMC OA (n = 96)

	Thumb Arthritis Expectations Survey Scores		Total	*P* Value
	Below Median	Above Median		
Sample	46 (47.9)	46 (47.9)	96 (100)	
Age (y); mean (SD)	62.6 (8.1)	62.4 (7.9)	62.5 (7.9)	.919
Number of comorbidities; mean (SD)	2.1 (2.8)	2.4 (2.4)	2.3 (2.5)	.386
Expectation score; continuous; mean (SD)	47.6 (16.7)	89.2 (8.4)	67.5 (24.8)	<.001
bMHQ score; continuous; mean (SD)	61.5 (16.9)	51.5 (14.5)	56.7 (16.5)	.002
Management of TMC OA				.001
Conservative	40 (80)	22 (47.8)	62 (64.6)	
Surgical	10 (20)	24 (52.2)	34 (35.4)	
Hand function as measured by bMHQ				.004
Low function	9 (18)	20 (43.5)	29 (30.2)	
Average function	15 (30)	16 (34.8)	31 (32.3)	
High function	26 (52)	10 (21.7)	36 (37.5)	
Sex				.609
Men	16 (32)	17 (37)	33 (34.4)	
Women	34 (68)	29 (63)	63 (65.6)	
Race				1.00
White	47 (94)	44 (95.7)	91 (94.8)	
Nonwhite	3 (6)	2 (4.3)	5 (5.2)	
Marital status				.575
Single	6 (14)	6 (18.8)	12 (16)	
Divorced	37 (86)	26 (81.3)	63 (84)	
Education				.138
HS graduate	16 (32)	13 (28.3)	29 (30.2)	
Some college	16 (32)	8 (17.4)	24 (25)	
College graduate	18 (36)	25 (54.3)	43 (44.8)	
Hand dominance				.54
Right	40 (80)	39 (84.8)	79 (82.3)	
Left	10 (20)	7 (15.2)	17 (17.7)	
Dominant hand affected				.312
No	19 (38)	13 (28.3)	32 (33.3)	
Yes	31 (62)	33 (71.7)	64 (66.7)	
Preceding injury				.715
No	43 (91.5)	30 (88.2)	73 (90.1)	
Yes	4 (8.5)	4 (11.8)	8 (9.9)	
Depression or anxiety				.437
No	44 (86.3)	41 (91.1)	85 (88.5)	
Yes	7 (13.7)	4 (8.9)	11 (11.5)	
Previous treatment any				.504
No	9 (18)	6 (13)	15 (15.6)	
Yes	41 (82)	40 (87)	81 (84.4)	
Previous interventions				.369
None	9 (18)	5 (10.9)	14 (14.6)	
No steroid	22 (44)	17 (37)	39 (40.6)	
With steroids	19 (38)	24 (52.2)	43 (44.8)	
Comorbidities				.186
None	10 (10)	12 (12)	22 (22)	
1 or 2	17 (45.9)	10 (26.3)	27 (36)	
>2	10 (27)	16 (42.1)	26 (34.7)	

Study participants were stratified into 2 groups based on the median expectations score of 73.6. Demographic and clinical characteristics of these 2 groups then were compared.

Results

Demographics, description of study population

Mean age of the study population was 63 years (range 37–80); 63 (66%) were woman and 33 (34%) were man. The mean number of comorbidities was 2.3 (range, 0–16), the dominant hand was affected in 64 patients (67%), 48 (50%) were actively working, 63 (66%) were married, 8 (8%) reported a preceding injury, and 11 (12%) reported a history of depression or anxiety (Table 1).

Bivariable analyses of surgical outcome and expectations scores are shown in Tables 2 and 3. Patients who elected for surgical management of their TMC OA were similar in age, but had more comorbidities ($P < .05$), higher expectations scores ($P < .05$), and lower bMHQ scores ($P < .05$). More surgical patients had higher than median expectations scores ($P < .05$), had lower hand function ($P < .05$), and had been treated with corticosteroids ($P < .05$) than nonsurgical patients. When comparing patients with below median expectation scores, patients with above median expectation scores had lower average bMHQ scores ($P < .05$), more often elected for surgery ($P < .05$), and had low hand function ($P < .05$).

Simple logistic regression models found that hand function (as measured by bMHQ scores), thumb arthritis expectation survey scores, history of previous injury, history of previous treatment, and number of comorbidities were associated significantly with surgical treatment of TMC OA ($P < .05$, each). The fully adjusted model found that patients whose prior treatment included steroid injections had 12 times higher odds of electing for surgical treatment than patients who never received treatment for TMC OA (adjusted odds ratio [AOR], 11.95; 95% confidence interval [95% CI], 1.13–126.39; $P < .05$) while controlling for expectation scores, hand function, history of previous injury, and number of comorbidities. The most parsimonious model found that hand function, thumb arthritis expectation survey scores, and prior treatments for TMC

Table 4
Multivariable Linear Regression Analysis of Associations for Surgical Treatment of TMC OA (n = 96)

	Fully Adjusted Model		Parsimonious Model	
	AOR (95% CI)	*P* Value	AOR (95% CI)	*P* Value
Low expectation	1 (1.00–1.00)		1.00 (1.00–1.00)	
High expectation	2.17 (0.38–12.31)	.38	3.92 (1.29–11.88)	.02*
Low function	1 (1.00–1.00)		1.00 (1.00–1.00)	
Average function	0.32 (0.04–2.64)	.29	0.26 (0.07–0.92)	.04*
High function	0.4 (0.04–3.94)	.43	0.43 (0.12–1.60)	.21
No Previous injury	1 (1.00–1.00)			
Previous injury	0.22 (0.01–3.27)	.27		
No prior treatment	1 (1.00–1.00)		1.00 (1.00–1.00)	
Prior Tx. no steroids	0.46 (0.04–5.87)	.55	0.89 (0.13–5.95)	.9
Prior Tx W/ steroids	11.95 (1.13–126.39)	.04*	13.08 (2.22–76.95)	.00**
No comorbidities	1 (1.00–1.00)			
1 or 2 comorbidities	3.79 (0.56–25.55)	.17		
>2 comorbidities	0.11 (0.01–2.06)	.14		
Hosmer-Lemeshow goodness of fit (χ^2)	56.3	.003	13.1	.285

Multivariable linear regression analysis determined that expectations score, hand function, history of previous injury, history of previous treatment for TMC OA, and number of comorbidities were associated with patient's decision for surgical management of their TMC OA (surgery).
The fully adjusted model contains all variable associated with surgery. The most parsimonious model only variables significantly associated with surgery.
*$P < .05$; **$P < .001$.

OA were associated significantly with the surgical treatment of TMC OA. After controlling for all possible covariates, the odds of having surgery was 3.9 times higher among patients who had high expectations (above median) compared to patients who had low expectations (AOR, 3.9; 95% CI, 1.3–11.2, $P < .05$; Table 4). Patients with average hand function were 74.5% less likely to elect for surgery than those with low hand function (AOR, 0.3; 95% CI, 0.1–0.9, $P < .05$; Table 4). Patients previously treated with steroids were 13 times more likely to elect for surgery than those who were never treated for TMC arthritis (AOR, 13.1; 95% CI, 2.2–77.0; $P < .05$). A comparison of Hosmer-Lemeshow goodness of fit tests found that the parsimonious model fit the data better than the fully adjusted model.

Discussion

Our analysis of expectations in patients with TMC OA showed that patients who have lower function as measured by the bMHQ, who have higher expectations as measured by the Thumb Arthritis Expectations Survey, and who have received previous methods of nonsurgical treatment were more likely to opt for surgery. Despite our prior results that hinted otherwise, age was not a significant predictor of surgical management of TMC OA. These results corroborate findings from previous studies. Laarhoven et al[9] conducted a cross-sectional study investigating the reasons for and outcomes after TMC surgical treatment and found that >50% of patients reported improved function and reduction of pain as their main reasons for pursuing primary surgical treatment of TMC OA. Wouters et al[10] conducted a cross-sectional, multicentered study to analyze differences between patient scheduled for surgery and those treated nonoperatively. They found that patients treated surgically had a higher expectation and a worse psychological profile than patients treated nonoperatively.

Results from this study not only provide a framework to understand how clinical history, functional status, and patient expectations can modify a patient's decision to choose surgical versus nonsurgical treatment, but also identifies correlates associated with patient expectations. We find this preferable over having to make assumptions about what patients will expect.

Our analysis used validated surveys. This study used the Thumb Arthritis Expectations Survey and the bMHQ. While patient characteristics and perspectives are integral to quality reporting schemes and measuring outcomes,[3–6,11–19] the focus on patient expectations is a distinct feature of this study. Identification of factors that affect patient expectations with hip, knee, shoulder, and spine conditions has contributed to a deeper understanding of how patient expectations are impacted and fulfilled after treatment.[20–24] Expectations with regard to TMC OA have shown unique disease patterns compared to hip, shoulder, spine, and foot and ankle OA, which has prompted this and related ongoing exploration.[25–30] Pretreatment functional status is multifactorial, and understanding the impact of these factors on patient perceived outcome has served as 1 motivator of this investigation.

This study has the following limitations. First, study participants were recruited from a single hospital. Although our hospital receives a geographically and ethnically diverse group of patients, the participants of this study may not be representative of other specific and unique patient populations. Second, this study also was placed within the context of correlating 2 surveys in the assessment of patient expectations, and not of patient satisfaction. While studies have explored the relationship of patient expectations and satisfaction, this remains unclear,[29–32] and information on satisfaction is not available from our study as this study was not designed to assess this. Such information specific to thumb arthritis might be useful in future studies and is part of our ongoing investigations. Third, this study did not document objective measures of disease severity. Previous studies have suggested little to no correlation between disease severity, defined by the Eaton staging of disease, and patient reported outcome measures.[33–35] Because there are no absolute clinically objective indicators of surgery, such as pinch strength and deformity, we believed that objective measures were not necessary for the purposes of this study. Fourth, the association between surgeon recommendations and patient expectations has not been assessed in this study; however, to our knowledge no prior studies have created a validated method to assess specifically and only the association of surgeon recommendations on patient expectations and the decision to pursue surgical treatment. In our study, we view surgeon recommendations as one of a host of potential factors, such as personal pain tolerance, work and family status, overriding medical conditions, hearsay, the internet, and so forth, that are embedded within and captured by the expectations score, which show significant correlation in patients who choose surgical treatment.

This study reproduces and affirms the previously validated performance characteristics of the Thumb Arthritis Expectations Survey that this investigation has applied.[1,2] The results of this

study support that there are multiple domains that contribute to the patient's choice between nonsurgical and operative treatment, which includes an understanding of patient expectations. This study indicates that the choice for surgical treatment is associated with pretreatment functional status, patient expectations, and the experience of having received prior nonsurgical treatment. We believe that an improved understanding of these correlations is important in improving overall quality of care.

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