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RESEARCH ARTICLE

Variation in Treatment for Trapeziometacarpal Arthrosis

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Abstract

Background: Treatment recommendations for trapeziometacarpal (TMC) arthrosis are highly variable from surgeon to surgeon. This study addressed the influence of viewing radiographs on a decision to offer surgery for TMC arthrosis.

Methods: In an online survey, 92 hand surgeons viewed clinical scenarios and were asked if they would offer surgery to 30 patients with TMC arthrosis. Forty-two observers were randomly assigned to review clinical information alone and 50 to review clinical information as well as radiographs. The degree of limitation of daily activities, time since diagnosis, prior treatment, pain with grind, crepitation with grind, and metacarpal adduction with metacarpophalangeal hyperextension were randomized for each patient scenario to determine the influence of these factors on offers of surgery. A cross-classified binary logistic multilevel regression analysis identified factors associated with surgeon offer of surgery.

Results: Surgeons were more likely to offer surgery when they viewed radiographs (42% vs. 32%, *P = 0.01*). Other factors associated variation in offer of surgery included greater limitation of daily activities, symptoms for a year, prior splint or injection, deformity of the metacarpophalangeal joint. Factors not associated included limb dominance, prominence of the TMC joint, crepitation with the grind test, and pinch and grip strength.

Conclusion: Surgeons that view radiographs are more likely to offer surgery to people with TMC arthrosis. Surgeons are also more likely to offer surgery when people do not adapt with time and nonoperative treatment. Given the notable influence of surgeon bias, and the potential for surgeon and patient impatience with the adaptation process, methods for increasing patient participation in the decision-making process merit additional attention and study.

Level of evidence: Not applicable.

Keywords: Decision-making, Interobserver variation, Osteoarthritis, Surgery, Trapeziometacarpal arthrosis, Treatment

Introduction

Treatment recommendations for trapeziometacarpal (TMC) arthrosis are highly variable from surgeon to surgeon. Spaans et al. (1) found fair interobserver agreement among eight surgeons on preferred treatment for 40 patients with TMC arthrosis based on radiographs, symptoms, and the Disabilities of the Arm, Shoulder, and Hand score. The greatest variability was amongst Eaton-Littler stages 2 and 3. Another retrospective study found a wide variety of practice variation for hand osteoarthritis amongst six hand surgeons (2). A survey of active members of the American Society for Surgery of the Hand found that 62% preferred trapeziectomy with ligament

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reconstruction and tendon interposition (LRTI) for Eaton stage 3, despite the evidence that trapeziectomy alone is just as effective with fewer complications (3-5). Additional research is merited to determine the factors that account for surgeon-to-surgeon variation in treatment recommendations in order to aid efforts to reduce the influence of surgeon preferences and values in favour of the preferences and values of the patient.

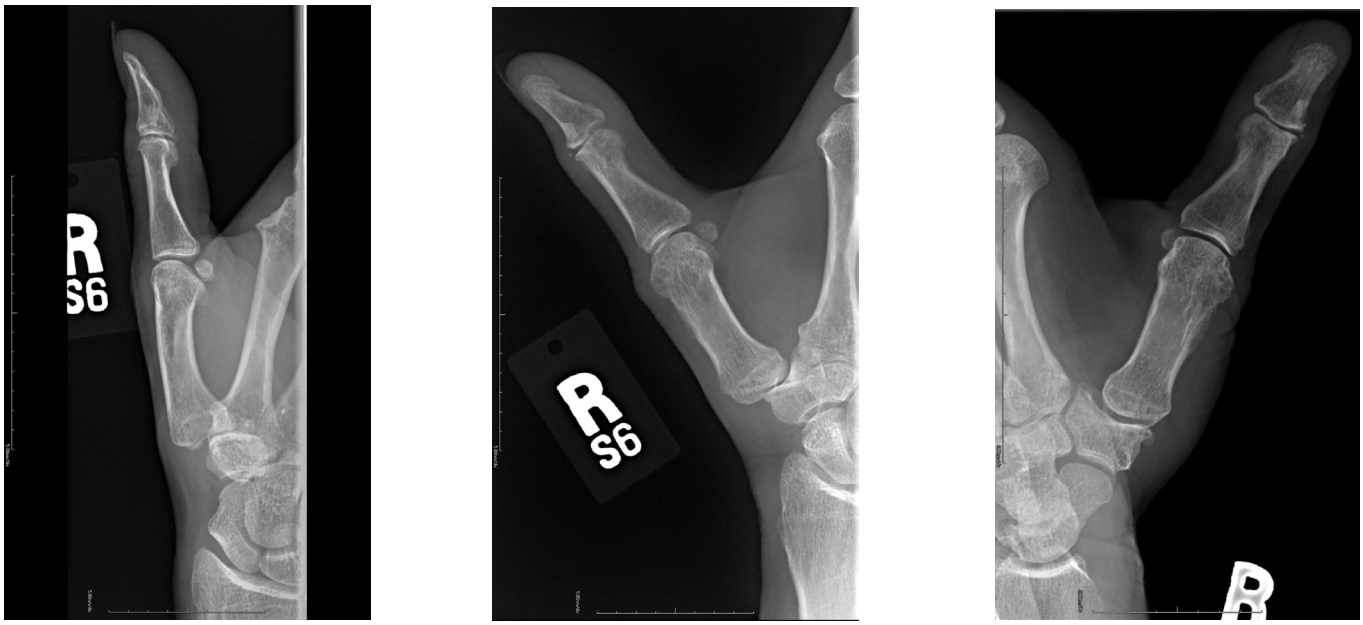
This study randomized a large number of hand surgeons to give treatment recommendations based on randomly varied circumstances of patients with TMC arthrosis in order to address the primary null hypothesis that there are no factors associated with a recommendation for operative treatment for TMC arthrosis among patient factors, surgeon factors, and radiographic factors.

Materials and Methods

Two-hundred and eighty-three hand surgeons of the Science of Variation Group (SOVG) (6), a web-based collaborative, were invited between November 2014 and January 2015 to participate in an online survey about their preferred treatment method for presentations of patients with TMC arthrosis based on clinical information alone or on clinical information in combination with radiographs [Figure 1]. Hand surgeons that did not complete the survey within three weeks received a reminder email. Observers did not receive any incentives other than acknowledgement that they were part of the SOVG. There was no time limit to complete the survey, but we collected the online data after 8 weeks. This study was approved by the institutional review board (IRB).

Thirty consecutive patients diagnosed with TMC arthrosis were identified from a database. Inclusion criteria were (1) adult patients (≥18 years) and (2) adequate quality set of radiographs (Robert [true anteroposterior] view, true lateral view, and oblique view). Exclusion criteria were (1) pregnancy (IRB mandated) and (2) prior surgery for TMC arthrosis on the selected side. The diagnosis of TMC arthrosis was based on symptoms, physical examination and radiographic findings. Observers were randomly assigned on a 1:1 basis to choose their preferred method of treatment for the 30 patient presentations based on clinical information alone or on clinical information in combination with radiographs. Patients were presented in a random order.

Clinical information consisted of demographic information (sex, age, dominant or nondominant thumb), symptoms (how much the pain limited daily activities [not, slightly, moderately, severely, or impossible to perform activities]), previous diagnosis (no previous diagnosis, 3 months ago, or 1 year ago), previous treatment (none, splint, or splint and cortisone injection) and physical examination (fullness at the base of the thumb ['shoulder sign'; yes or no], pain [none, mild, moderate, severe, or extreme] with the grind test, crepitation [none, mild, moderate, substantial, or severe] with the grind



(a) (b) (c)

Figure 1. The scenario prior to randomization of the elements for the lateral (A), oblique (B), and Robert (C) radiographs depicted in the figure: A 62 year-old man has pain at the base of her (dominant/nondominant) thumb. The pain (does not limit/slightly limits/moderately limits/severely limits/makes impossible) daily activities. The patient was diagnosed with trapeziometacarpal arthrosis (now/ 3 months ago/ 1 year ago). The patient has (not treated it/ tried a splint/ tried a cortisone injection). On physical exam there (is / is not) fullness at the base of the thumb (so called "shoulder sign"), and (no/ mild/ moderate, severe/ extreme) pain and (no/ mild/ moderate/ substantial/ severe) crepitation with grind test. There is no adduction contracture and no MCP hyperextension. There (is / is not) an adduction contracture and MCP hyperextension. Pinch and grip strength are (good / poor).

test, adduction contracture and metacarpophalangeal hyperextension [yes or no], and pinch and grip strength [poor or good]). The above-mentioned clinical information of all 30 patients was fictional, except for sex, age and radiographs which were extracted from 30 'real' patients. All fictive patient characteristics were randomly assigned with a balanced distribution over the possible categories for each patient presentation every time an observer rated a patient [Figure 1]. This created a large random set of patients. Observers were unaware that the clinical information for patient presentations was both fictive and randomized.

Statistical analysis

We evaluated 15 parameters for the observer characteristics and 23 parameters for the patient characteristics in 2760 measurements (92 unique observers * 30 patients). Given the rule of thumb of a minimum of 10 independent measurements per parameter, we had sufficient power for our goal.

Due to the hierarchical data structure, a cross-classified binary logistic multilevel regression analysis was used to identify factors that determine when hand surgeons (observers) recommend surgery. Data was clustered both within patient presentations and observers since all observers rated all patients. Elements of the clinical information that were reported on 5-point Likert scales (e.g., pain with grind test) were considered categorical variables for analyses. First of all, each individual predictor variable (i.e., each patient or surgeon characteristic) was separately entered as a fixed effect into a regression model, which further only included random intercepts for patient presentation and observer, to examine the bivariable relationship. Variables with $P<0.15$ in this bivariable analysis, were included as candidate fixed effects in the final multivariable regression analysis, again including the random intercepts for patient presentation and observer. Variable selection by the backward stepwise approach (selection criterion: overall $P<0.05$) was used to determine the best fitting regression model.

The same multilevel regression procedure was conducted for the subgroup of observers on which we had data regarding the prevalence of hazardous attitudes (n = 62), adding the attitudes as an extra predictor. None of the hand surgeons had hazardous levels of impulsivity and/or resignation/external locus of control; therefore, these variables could not be entered into the bivariable multilevel analysis.

Characteristics of observers

A total of 92 of the 283 invited hand surgeons (33%) completed the study, 20 hand surgeons only partially completed the survey and were excluded from analysis, one opted out and 170 surgeons (60%) did not respond. The response rate should be viewed in light of the known high rate of unresponsiveness among the members of the SOVG; this is due to out of date email addresses and a subgroup of inactive members that rarely participate. Of the hand surgeons who completed the study, 42 observers were assigned to review clinical information alone and 50 to review clinical information as well as radiographs [Table 1].

Table 1. Surgeon Characteristics (n = 92)

	Total (n = 92)		Clinical information only (n = 42)		Clinical information and radiographs (n = 50)	
Parameter	**Number**	**%**	**Number**	**%**	**Number**	**%**
Sex						
Male	79	85.9	37	88.1	42	84.0
Female	13	14.1	5	11.9	8	16.0
Location of practice						
North America	73	79.3	33	78.6	40	80.0
Europe and United Kingdom	9	9.8	3	7.1	6	12.0
Central and South America	7	7.6	3	7.1	4	8.0
Other	3	3.3	3	7.1	0	0.0
Training						
Orthopaedic Surgery	80	87.0	35	83.3	45	90.0
Plastic Surgery	10	10.9	5	11.9	5	10.0
General Surgery	2	2.2	2	4.8	0	0.0
Specialization						
Hand Surgery	90	97.8	40	95.2	50	100.0
General Orthopaedic Surgery	2	2.2	2	4.8	0	0.0

Table 1. Continued

Years in independent practice						
1–5	19	20.7	4	9.5	15	30.0
6–10	21	22.8	12	28.6	9	18.0
11–20	34	37.0	17	40.5	17	34.0
>20	18	19.6	9	21.4	9	18.0
Practice setting						
Hospital-employed, academic	53	57.6	22	52.4	31	62.0
Hospital-employed, non-academic	10	10.9	5	11.9	5	10.0
Private practice	29	31.5	15	35.7	14	28.0
Supervising surgical trainees in operating room						
No	16	17.4	8	19.0	8	16.0
Yes	76	82.6	34	81.0	42	84.0
Number of patients typically treated annually with TMC arthrosis						
1–20	8	8.7	4	9.5	4	8.0
21–50	24	26.1	9	21.4	15	30.0
>50	60	65.2	29	69.0	31	62.0
Hazardous attitudes (n = 62)						
Macho						
No	45	72.6	25	75.8	20	69.0
Yes	17	27.4	8	24.2	9	31.0
Self-confidence						
No	57	91.9	28	84.8	29	100.0
Yes	5	8.1	5	15.2	0	0.0
Worry/anxiety						
No	58	93.5	30	90.9	28	96.6
Yes	4	6.5	3	9.1	1	3.4
Antiauthority						
No	59	95.2	31	93.9	28	96.6
Yes	3	4.8	2	6.1	1	3.4
Impulsive						
No	62	100.0	33	100.0	29	100.0
Yes	0	0.0	0	0.0	0	0.0
Resignation/external locus of control						
No	62	100.0	33	100.0	29	100.0
Yes	0	0.0	0	0.0	0	0.0

Results

Thirteen variables met the criterion of *P<0.15* in bivariable analysis and were entered into the backwards stepwise multivariable regression analysis [Table 2]. Accounting for potential interaction among variables using multilevel regression, the factors independently associated with a higher likelihood of a recommendation for surgery included: pain with a greater limiting effect on daily activities, previous diagnosis of TMC arthrosis (1 year ago compared to no previous diagnosis), previous treatment of TMC arthrosis (previous splint or splint and cortisone injection compared to no previous treatment), greater pain with the grind test, adduction contracture

Table 2. Bivariable Regression Analyses for Operative Treatment of TMC Arthrosis (92 Observers)

Patient parameter	*F*	df	*P value*
Sex	3.6	1	0.058
Age	1.8	1	0.18
Dominant thumb	2.8	1	0.092
Daily activities	**37**	**4**	**< 0.001**
Diagnosis of TMC arthrosis	2.5	2	0.082
Previous treatment for TMC arthrosis	**270**	**2**	**< 0.001**
Shoulder sign	0.45	1	0.50
Pain with the grind test	**4.9**	**4**	**< 0.001**
Crepitation with the grind test	0.26	4	0.91
Adduction contracture and MCP hyperextension	**5.7**	**1**	**0.017**
Pinch and grip strength	1.2	1	0.27
Radiographic parameter			
Radiographs (yes / no)	**5.5**	**1**	**0.019**
Surgeon parameter			
Sex	3.5	1	0.062
Location of practice	**9.7**	**3**	**< 0.001**
Training	**6.3**	**2**	**0.0019**
Specialization	0.17	1	0.68
Years in independent practice	0.45	3	0.72
Practice setting	**3.0**	**2**	**0.048**
Supervising surgical trainees in operating room	1.7	1	0.19
Number of patients typically treated annually with TMC arthrosis	**6.7**	**2**	**0.0013**

DF = degrees of freedom. Numbers in bold indicate significance at $P < 0.05$.

and metacarpophalangeal hyperextension, viewing radiographs of the thumb, location of surgeon's practice (Europe and United Kingdom or Central and South America compared to North America), and surgeon training (Plastic Surgery compared to Orthopaedic Surgery or Plastic Surgery compared to General Surgery) [Table 3].

On average, surgeons preferred operative treatment for 38% of patients, but the rate of surgical treatment recommendation varied greatly; there was one surgeon who preferred operative treatment for all patients (100%), and two surgeons who preferred nonoperative treatment for all patients (0%).

Discussion

There is substantial and unexplained variation in rates of surgery for TMC arthrosis from surgeon to surgeon. Such variation generally indicates that the preferences and values of the surgeon have a greater influence on treatment decisions than the preferences and values of the patient (7). The latter was not investigated in this study. The role of surgery in patients with TMC arthrosis and the optimal technique are open to debate (5, 8). We studied the factors that have the greatest influence on surgeon recommendations to better aid efforts to reduce surgeon-to-surgeon variation in treatment of TMC arthrosis.

This study has several limitations. First, only surgeons participating in the SOVG were evaluated and a substantial portion of the SOVG members rarely or never participates. Secondly, due to the randomization of fictive patient characteristics (except for sex and age) there might have been one or more combinations of clinical information that would occur infrequently. Third, only a small amount of clinical information was presented. Occupation, avocation, and other information might influence the decision-making process. Fourth, observers responded to the question about their preferred treatment for a particular patient by picking their preferred treatment(s) from a list or by choosing "other" and describing the treatment. When a surgeon chose any kind of surgical option, we considered it "operative" treatment unless they mentioned that there was no absolute indication or urgency for surgery. Finally, we did not account for patient's preferences and wishes.

In this study, surgeons were more likely to recommend

Table 3. Best Multilevel Regression Model for Operative Treatment of TMC Arthrosis (92 Observers)

Patient parameter	Rate of surgery recommendation	*F*	*P* value	Odds ratio	95% confidence interval	
					Lower	Upper
Daily activities		46	**< 0.001**			
The pain does not limit daily activities	22%		Reference category	Reference category	Reference category	Reference category
The pain slightly limits daily activities	31%		**0.0017**	1.8	1.2	2.6
The pain moderately limits daily activities	39%		**< 0.001**	4.0	2.8	5.8
The pain severely limits daily activities	48%		**< 0.001**	7.3	5.1	11
The pain makes it impossible to perform activities of daily living	50%		**< 0.001**	8.5	5.9	12
Diagnosis of TMC arthrosis		3.6	**0.027**			
No previous diagnosis	35%		Reference category	Reference category	Reference category	Reference category
3 months ago	38%		0.24	1.2	0.90	1.5
1 year ago	40%		**0.0074**	1.4	1.1	1.9
Previous treatment for TMC arthrosis		271	**< 0.001**			
No previous treatment	15%		Reference category	Reference category	Reference category	Reference category
Splint	31%		**< 0.001**	4.0	2.9	5.4
Splint and cortisone injection	67%		**< 0.001**	44	32	62
Pain with grind test		6.3	**< 0.001**			
No pain	32%		Reference category	Reference category	Reference category	Reference category
Mild pain	35%		**0.020**	1.5	1.1	2.2
Moderate pain	41%		**0.0012**	1.8	1.3	2.5
Severe pain	40%		**< 0.001**	2.0	1.4	2.9
Extreme pain	41%		**< 0.001**	2.2	1.6	3.2
Adduction contracture and MCP hyperextension		6.8	**0.0090**			
No	36%		Reference category	Reference category	Reference category	Reference category
Yes	40%		**0.0090**	1.3	1.1	1.7
Radiographic parameter						
Radiographs		6.7	**0.010**			
No	32%		Reference category	Reference category	Reference category	Reference category
Yes	42%		**0.010**	2.3	1.2	4.2
Surgeon parameter						
Location of practice		6.3	**< 0.001**			
North America	32%		Reference category	Reference category	Reference category	Reference category
Europe and United Kingdom	65%		**0.0025**	5.3	1.8	15
Central and South America	60%		**< 0.001**	6.8	2.2	21
Other	36%		0.53	1.7	0.31	9.8
Training		4.2	**0.014**			
Orthopaedic Surgery	36%		0.20	4.4	0.46	42
Plastic Surgery	57%		**0.023**	17	1.5	196
General Surgery	18%		Reference category	Reference category	Reference category	Reference category

Numbers in bold indicate significance at $P < 0.05$.

Table 4. Bivariable Regression Analyses for Operative Treatment of TMC Arthrosis Including Hazardous Attitudes (62 Observers)

Surgeon parameter	*F*	df	*P value*
Hazardous attitudes			
Macho	1.1	1	0.30
Self-confidence	1.8	1	0.18
Worry/anxiety	0.63	1	0.43
Antiauthority	1.6	1	0.21

DF = degrees of freedom.

surgery for patients with greater symptoms and disability, a prior diagnosis or treatment, and when presented with radiographs. The influence of radiographic appearance represents an unhelpful cognitive bias. There is mounting evidence that symptom intensity, magnitude of disability, and dissatisfaction with treatment are related to symptoms of depression and ineffective coping strategies, with relatively limited relation to objective impairment and pathophysiology (8-10). Surgeons have long recognized that symptoms and disability do not correlate with radiographic severity of arthrosis (11-13). We see patients every day that have severe TMC arthrosis they are not even aware of, and we have found that variation corresponds with effectiveness of coping strategies (14). There is sufficient evidence that we hope surgeons will reconsider and be more cautious with recommendations based on the misconception that greater illness always reflects greater disease and that treatment of the pathophysiology will always relieve symptoms and limit disability. Only a small degree of regional variation in surgery rates for common conditions can be explained by differences in illness burden, diagnostic practices, and patient attitudes about medical intervention (7). Studies have shown that surgeons' beliefs, preferences and attitudes, and the extent to which patient preferences are incorporated into the decision-making process, better explain treatment variation (7, 15-17). Even though our results did not show a relationship between hazardous attitudes and treatment preference, location of practice and surgical training might partially reflect surgeons' beliefs, preferences and attitudes. A survey among orthopaedic surgeons and referring physicians (rheumatologists and family physicians) for total knee arthroplasty found that (1) the opinion of the referring physicians varied greater than those of the surgeons; (2) the reasons for referral by referring physicians differed from the reasons the surgeons opted for total knee arthroplasty; and (3) half of the total variability of the most appropriate candidate (based on patient characteristics) for total knee arthroplasty was due to inconsistent individual physicians' opinions (18). The latter is something that could potentially also play a role in the treatment decision-making for TMC arthrosis.

Our findings are consistent with studies that found substantial variation and inconsistency of recommendations for adenotonsillectomy (19) and knee arthroplasty (18, 20). Radiographic severity of knee arthrosis influences orthopaedic surgeon and even more so rheumatologist recommendations for total knee arthroplasty (18, 21). A retrospective study by Ochtman et al. (22) found substantial surgeon-to-surgeon variation in treatment strategies and rates of surgery for TMC arthrosis. A larger retrospective study by Becker et al. (2) showed that a younger patient age, seeing a second surgeon, and treatment by specific hand surgeons were associated with a greater likelihood of undergoing surgery for hand arthrosis. In a survey of 1,156 active members of the American Society for Surgery of the Hand nearly half (46%) chose to continue nonoperative treatment for a 42-year-old woman with moderate to severe pain and minimal radiographic changes, who was also unsatisfied with splinting and one corticosteroid injection (3). These hand surgeons were more likely from the mid-Atlantic compared to all other regions (60% and 45%, respectively) and more likely in practice for ≤15 years compared to those in practice for 16 to 25 years (52% and 46%, respectively) (3).

Surgeon-to-surgeon variation in recommendations for surgery relate most strongly to each surgeon's circumstances and training as well as the influence of greater symptoms and disability, and exposure to radiographs. Given these notable surgeon biases, methods for increasing patient participation in the decision-making process merit additional attention and study. So-called decision aids are videos, websites, pamphlets, etc. that intend to provide patients with balanced, dispassionate, understandable information about their problem and the treatment options. The use of decision aids has resulted in a reduction of discretionary, preference-sensitive surgery in other fields (23), presumably at least in part because patients might recognize their maladaptive thoughts and emotions and be open to modifying them before undergoing the risks, discomforts, and inconveniences of surgery. In other words, well informed patients might be less likely to place all of their hope in invasive, passive treatments and more likely to feel hopeful no matter what they choose.

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