Variation in the Rate of Surgery for Ulnar Collateral Ligament Injury of the Metacarpophalangeal Joint of the Thumb

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Abstract

Background: The indications for repair of rupture of the ulnar collateral ligament (UCL) of the metacarpophalangeal (MP) joint of the thumb are debated. We studied factors predictive of operative treatment. **Methods:** In this retrospective study, we queried the research database from 3 affiliated urban hospitals in a single city in the United States and identified 383 patients with a thumb MP UCL injury. We recorded age, sex, treating surgeon, and whether or not a magnetic resonance imaging (MRI) was ordered. If radiographs showed a concomitant avulsion fracture, we measured fragment size and displacement. Multivariable logistic regression was used to identify factors independently associated with surgery. **Results:** Surgery was independently associated with older patient age, widely displaced fractures (≥ 2 mm), and obtaining an MRI. Two specific surgeons were less likely to operate. Compared with patients without a fracture, fractures without displacement were less likely to have surgery. **Conclusions:** The rate of surgery for acute thumb MP UCL injury varies based on patient characteristics and the individual treating surgeon. Variation might decrease with improved diagnostic techniques and consideration of practice guidelines. Future studies are needed to determine the patients and injuries that will benefit most from surgery.

Keywords: ulnar collateral ligament, thumb, skier's thumb, injury

Introduction

The indications for surgical repair of ulnar collateral ligament (UCL) injuries of the metacarpophalangeal (MP) joint of the thumb are still debated, but without appropriate treatment these injuries may result in MP instability, thumb pinch and grip weakness, and osteoarthritis.^{2,19,20,26} Surgery is often recommended for widely displaced unstable bony avulsion fractures and acute ligament tears with sufficient instability to suspect a Stener lesion (displacement of the UCL superficial to the adductor aponeurosis).^{13,17} Some of the variation in operative rates might be due to the fact that the diagnostic methods for diagnosing a Stener lesion have limited reliability and accuracy.²² For some surgeons, the presence of a displaced avulsion fracture is an indication for surgical intervention even if it is not displaced enough to be superficial to the adductor aponeurosis.^{8,27}

Based on the observations and opinions of some of our colleagues, we thought the presence or absence of an avulsion fracture might influence variations in the rate of surgery for acute thumb MP UCL injury regardless of displacement. In this study, we tested the primary null hypothesis that the rate of surgery does not vary based on the presence of an avulsion fracture after controlling for

patient demographics, the use of additional imaging, the fragment size, fracture displacement, time from injury to diagnosis, the surgeon's primary surgical specialty, and the surgeon.

Methods

Study Design and Patient Selection

With the approval of our institutional review board, we used a research database from 3 affiliated urban hospitals in a single city in the United States.²³ Data were reviewed from all patients who received a diagnosis (*International Classification of Diseases, Ninth Revision* [ICD-9] code) of UCL

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Table 1. Baseline Characteristics of 383 Patients With Acute Ulnar Collateral Ligament Injury of the Thumb.

Variable	Median (interquartile range)
Age (y)	42 (30-53)
Variable	Proportion (number)
Men	50% (191)
Avulsion fracture	30% (113)
Large fragment	7% (26)
Small fragment	23% (87)
Fracture displacement	70% (79)
Widely	14% (16)
Rotated	28% (32)
Minimal	27% (31)
Not displaced	30% (34)
Radiograph	100% (383)
Additional imaging	
Magnetic resonance imaging	11% (41)
Surgeon	
Surgeon 1	5.3% (20)
Surgeon 2	3.0% (11)
Surgeon 3	5.7% (22)
Surgeon 4	8.4% (32)
Surgeon 5	9.4% (36)
Surgeon 6	4.0% (15)
Surgeon 7	8.4% (32)
Surgeon 8	12% (46)
Surgeon 9	8.6% (33)
Other	7.2% (27)
Surgeon 11	28% (109)
Specialty	
Orthopedic surgery	94% (361)
Plastic surgery	6% (22)
Surgery	33% (125)

injury and unspecified disorders of the hand (ie, 719.84, 841.1, 842.12, see online Supplemental Table S1) between January 1, 2000, and December 31, 2012. Using word searches of the medical record for thumb MP UCL ligament injury and synonyms (see online Supplemental Table S2), we identified 978 patients with a thumb MP UCL injury. Patients were included if they were 18 years of age or older, had an isolated acute injury of the UCL (≤ 30 days), were evaluated by a hand surgeon, and had a radiograph performed. Exclusion was based on incomplete records (eg, name of treating surgeon not mentioned, unknown date of injury, or date of first visit), lesions of both radial and ulnar collateral ligaments, unknown injury/fracture age, and those patients who presented for a second opinion.

After reviewing the record, 588 patients were excluded who did not have a thumb MP UCL ligament injury based on clinical evaluation ($n = 171$), had incomplete records ($n = 23$), presented with both radial and ulnar collateral ligament injury

Table 2. Bivariate Analysis of Factors Associated With Surgery for Acute Ulnar Collateral Ligament Injury of the Thumb ($n = 383$).

Variable	Nonoperative treatment (n = 258)	Surgery (n = 125)	P value
Age	40 (28-50)	47 (37-57)	.0001
Sex			
Men	53% (136)	44% (55)	.13
Women	47% (122)	56% (70)	
Avulsion fracture			
Yes	31% (79)	27% (34)	.55
No	69% (179)	73% (91)	
Fragment size			
Large fragment	23% (18)	24% (8)	.82
Small fragment	77% (61)	76% (26)	
Fracture displacement			
Widely	6% (5)	32% (11)	.003
Rotated	27% (21)	32% (11)	
Minimal	30% (24)	21% (7)	
No displacement	37% (29)	15% (5)	
Magnetic resonance imaging			
Yes	7% (19)	18% (22)	.004
No	93% (239)	82% (103)	
Surgeon			
Surgeon 1	40% (8)	60% (12)	<.0001
Surgeon 2	45% (5)	55% (6)	
Surgeon 3	45% (10)	55% (12)	
Surgeon 4	47% (15)	53% (17)	
Surgeon 5	56% (20)	44% (16)	
Surgeon 6	60% (9)	40% (6)	
Surgeon 7	69% (22)	31% (10)	
Surgeon 8	72% (33)	28% (13)	
Surgeon 9	79% (26)	21% (7)	
Other	81% (22)	19% (5)	
Surgeon 11	81% (88)	19% (21)	
Specialty			
Orthopedic surgery	94% (243)	93% (118)	.99
Plastic surgery	6% (15)	7% (7)	

Note. Bold indicates significant difference ($P < .05$).

($n = 2$), were treated outside the study period ($n = 3$), were injured more than 30 days prior to presentation ($n = 276$), were not seen by a hand surgeon ($n = 43$), were seen for a second opinion ($n = 15$), had unclear injury/fracture age ($n = 1$), were aged under 18 years ($n = 31$), and had no imaging retrievable ($n = 30$). Eleven surgeons treated more than 10 patients with thumb MP UCL ligament injury. Eighteen surgeons who treated fewer than 10 patients were grouped together (Table 1). We used Current Procedural Terminology (CPT) codes cross-checked with word search for thumb MP UCL injury (eg, skier's thumb, thumb MP UCL rupture, gamekeeper's thumb) to identify operations performed for this reason.

Table 3. Multivariable Logistic Regression Analysis of Factors Independently Associated With Surgery for Acute Ulnar Collateral Ligament Injury of the Thumb (n = 383).

Variable	OR (95% CI)	Standard error	P value	C statistic ^a
Age	1.03 (1.01-1.05)	0.01	<.0001	0.76
Magnetic resonance imaging	2.4 (1.1-5.2)	0.94	.02	
Fracture displacement (reference value: no fracture)				
Widely	6.1 (1.8-20)	3.7	.003	
Rotated	0.88 (0.37-2.1)	0.38	.76	
Minimal	0.80 (0.31-2.1)	0.39	.64	
No displacement	0.35 (0.13-0.99)	0.19	.048	
Surgeon (reference value: surgeon 4)				
Surgeon 1	2.2 (0.65-7.8)	1.4	.21	
Surgeon 2	1.5 (0.36-6.5)	1.1	.56	
Surgeon 3	0.81 (0.24-2.7)	0.50	.73	
Surgeon 8	0.41 (0.15-1.1)	0.21	.09	
Surgeon 5	0.72 (0.25-2.0)	0.38	.53	
Surgeon 6	0.74 (0.19-2.9)	0.52	.67	
Surgeon 7	0.51 (0.17-1.5)	0.29	.23	
Surgeon 9	0.25 (0.67-4.6)	0.15	.02	
Other	0.23 (0.06-0.80)	0.15	.02	
Surgeon 11	0.24 (0.10-0.59)	0.23	.002	

Note. Bold indicates significant difference ($P < .05$). OR = odds ratio; CI = confidence interval.

^aThe C statistic is a measure of model fit and is the area under the receiver operating characteristics curve.

Three hundred eighty-three patients were included of whom 50% (n = 191) were men, with a median age of 42 years (interquartile range [IR], 30-53 years). Approximately one-third (n = 125) of the patients underwent surgery. Thirty percent of the 383 patients (n = 113) had an avulsion fracture, of which 70% (n = 79) were displaced (Table 1).

Outcome Measures

Surgical intervention for UCL injuries with or without fractures was identified using CPT (see online Supplemental Table S3) codes. If a patient had multiple surgeries, we used the initial operation closest to the date of injury as the index surgery.

Explanatory variables were age, sex, avulsion fracture, fragment size, amount of displacement, magnetic resonance imaging (MRI), surgeon, and specialty (orthopedic or plastic surgery). We considered <2 mm in diameter a small fragment size and <2 mm minimally displaced.^{6,13}

The hospitals' research databases were used to identify demographics and radiology reports. In the radiology reports, we first searched for hand, wrist, or finger images with the use of Stata 13 (StataCorp LP, Texas), and then we used the following words to identify fractures: "avulsion,"

Figure 1. Illustration of thumb avulsion fracture; fragment (dashed line) and displacement (solid line) measurements.

“fracture,” and “fragment.” To determine the type of displacement and fragment size, the primary researcher measured fragment size as the distance between the center of the fragment base and the most proximal part of the fragment (maximal length). Displacement was measured as the distance between the center of the fragment's avulsed side and the center of the proximal phalanx's fractured side (Figure 1). Both fragment size and displacement were measured on the anteroposterior radiographic view. After fracture and displacement classification, a hand surgeon independently checked a random sample (n = 20), and the results were comparable in 95% of cases.

Statistical Analysis

All categorical variables were summarized with frequencies and percentages, and the median and interquartile ranges were used for continuous variables.

In bivariate analysis, Fisher exact test and chi-square test were used for categorical variables and the Wilcoxon rank sum test was used for continuous variables. To identify factors independently associated with surgery, all variables with a P value below .10 (see bivariate analysis in Table 2) were inserted in a multivariable logistic regression analysis. The categorical values were dummy coded. A 2-sided P value of less than .05 was considered significant. All statistical analyses were performed using Stata 13.0 (StataCorp LP, Texas).

Figure 2. Proportion of surgery per age group (n = 383).

Results

Accounting for potential interaction of variables using multivariable analysis, surgery was independently associated with older age (odds ratio [OR] 1.03, 95% confidence interval [CI] 1.01-1.05, $P < .0001$), widely displaced fracture (OR 6.1, 95% CI 1.8-20, $P = .003$), and obtaining an MRI (OR 2.4, 95% CI 1.1-5.2, $P = .02$). Two specific surgeons were substantially less likely to operate (surgeon 9: OR 0.25, 95% CI 0.67-4.6, $P = .02$; and surgeon 11: OR 0.24, 95% CI 0.10-0.59, $P = .002$). Compared with no fracture, surgery was less likely for a fracture without displacement (OR 0.35, 95% CI 0.13-0.99, $P = .048$; Table 3). As a caveat, while older age was associated with surgery on the continuum, considered by 10-year age groupings surgery seemed less likely after 60 years of age (Figure 2). The multivariable model had a C statistic of 0.76. This indicates that the model can predict the rate of surgery reasonably well (0.50 indicates that the model is no better than chance; greater than 0.80 indicates excellent performance).

Discussion

Hand surgeons agree that Stener lesions benefit from surgery. In part because the preoperative diagnosis of a Stener lesion has limited reliability and accuracy, the rates of surgery may vary based on surgeon beliefs, preferences, and values. Probabilities and uncertainties have variable influence on the recommendations and actions of each surgeon. In addition, some surgeons believe some non-Stener injuries benefit from operative treatment. We studied factors associated with operative treatment of thumb MP UCL injuries.

This study has some limitations. First, the patients treated at these 3 affiliated urban hospitals in a single city might not be representative of the average patient. Second,

our surgeons—many trained within the system—might not be representative of the average surgeon. Third, there are a small number of inaccuracies in the database (based on prior audits). These inaccuracies likely had little or no influence on the results because every patient was manually verified for the diagnosis of a thumb MP UCL injury. Fourth, surgeons may not have accurately recorded the acuity of the injury. Fifth, 1 particular surgeon made up over one-quarter (28%) of all the treated patients, was independently associated with surgery, had a high threshold for surgical intervention, and was less likely to operate. Therefore, it is possible this 1 surgeon influenced our results. Furthermore, our results are based on the reference standard-identified surgeon, which is in turn based on the cohort of surgeons participating in this study. Finally, patients with incomplete records were less likely to have surgery (13 of 148; 9%), which might have skewed the results.

Wide fracture displacement greater than or equal to 2 mm was associated with surgery, but the mere presence of a fracture and its size were not. Established outcomes (pinch and grip strength, range of motion, pain, and instability) after collateral ligament injuries with an associated avulsion fracture are primarily based on level IV retrospective case series and level V expert opinion. In some of these studies, surgery achieved greater pinch strength and less pain for displaced fractures (mean, 2 mm; range, 1-6 mm) compared with nonoperative treatment.^{8,13,24} On the contrary, one study documented 100% satisfaction a year after nonoperative treatment of modestly displaced fractures (up to 2 mm).²⁸ In addition, multiple studies reported complete stability and no pain in a high percentage of patients (between 63% and 100%) after nonoperative treatment for nondisplaced UCL avulsion fractures.^{5,11,13-16,21,25} In another study, there were no differences in pain (38% and 33%, respectively) and weakness (21% and 33%, respectively) between patients with and without slight fracture displacement (range, 0.5-1.5 mm) an average of 3 years (range, 1-5 years) after injury, but fragment size (5.4 vs 3.2 mm) was associated with greater pain.¹⁴ To our knowledge, there are no established evidence-based outcomes for collateral ligament injuries without an associated avulsion fracture.

Ordering an MRI was associated with a greater rate of surgery. Some surgeons use MRI for diagnosis of a Stener lesion despite questions about its reliability and accuracy.²² However, there are cadaveric studies reporting high sensitivity and specificity of MRI for the diagnosis of Stener lesions.^{1,29} In addition, current MRI technology demonstrates high rates of sensitivity and specificity in diagnosing UCL injury,¹⁸ and evidence shows that MRI is superior to ultrasound for diagnosis of Stener lesions.¹⁰ It seems likely that the higher rate of surgery in this study for patients who received an MRI is related to the individual surgeon's approach: Those who order imaging may be more likely to recommend surgery, independent of the clinical examination

and diagnostic imaging. In other words, it may be that some surgeons use more resources than others, somewhat independent of the type of resource.

The finding that older age was associated with surgery is inconsistent with studies that found younger patients seeking care were more likely to have surgery for discretionary conditions such as hip, knee, and hand osteoarthritis.^{3,9} Perhaps the influence of age is different for traumatic and nontraumatic injuries. On the contrary, there are other possible explanations for this finding, including surgeon and patient preferences, but this is beyond the scope of the present article.

In the absence of practice guidelines based on solid scientific evidence, our results show that treatment of UCL injury is in part determined by individual surgeon attitudes and preferences. Variability in care is not only based on diagnostic practices, patient's attitudes about medical intervention, and pathophysiology but also depends on the surgeon's approach to treatment. We have previously shown that practice variation and associated costs cannot only be explained by differences in pathophysiology, but appears to be more related to variation in surgeon preferences and values.^{3,12} In addition, some surgeons are more influenced by symptom intensity and magnitude of limitations while others are influenced more by objective pathophysiology.⁴

Practice variation is associated with greater health care costs. Variation might decrease with improved diagnostic techniques and consideration of practice guidelines. Reducing practice variation can reduce health care costs and improves the quality and efficiency of care.⁷ Future studies are needed to determine the patients and injuries that will benefit most from surgery.

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Ethical Approval

This study was approved by our institutional review board.

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

With the approval of our institutional review board, we used a research database from three affiliated urban hospitals in a single city in the United States.

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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