Variation in Repair of the Triangular Fibrocartilage Complex

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Abstract

Background There is controversy regarding the value of repair of the triangular fibrocartilage complex (TFCC). Given that an acute tear of the TFCC associated with a displaced distal radius fracture uncommonly benefits from repair, the role of repair in other settings is uncertain. Our impression is that TFCC repair is highly variable from surgeon-to-surgeon.

Purpose The purpose of this study is to determine the rate of TFCC repair in patients who had a magnetic resonance imaging (MRI) scan of the wrist obtained for ulnar-sided wrist pain, and that showed signal changes in the TFCC. We tested the primary null hypothesis that there are no demographic or surgeon factors associated with repair of the TFCC.

Patients and Methods Three hundred and ninety-four patients with ulnar-sided wrist pain and an MRI scan showing changes in the TFCC were included in this retrospective study. No patients had instability of the distal radioulnar joint (DRUJ) recorded in the medical record. Surgical repair of TFCC tears was used as the primary outcome during statistical analysis to identify factors associated with repair.

Results Out of 394 (6%), 25 patients underwent TFCC repair. We found that 10% of the treating surgeons (4 out of 41) performed 80% of the procedures (20 out of 25). Patients who discerned a trauma prior to their symptoms and patients whose MRI showed signal changes primarily in the ulnar portion of the TFCC were more likely to have surgical repair.

Conclusion We found that the rate of TFCC repair varies substantially from surgeon-to-surgeon. The observation that repair is more likely to happen when patients perceive themselves as injured suggests that perception of injury affects how patients and surgeons consider treatment options. To help avoid surgeries based on surgeon bias or patient misperception, we suggest studying the effect of tools that provide simple, balanced, dispassionate, and empowering information (e.g., decision aids) that can limit surgeon-to-surgeon variation.

Level of Evidence Level IV.

Keywords

- magnetic resonance imaging
- repair
- surgery
- triangular fibrocartilage complex

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Ulnar-sided wrist pain is often ascribed to pathology of the triangular fibrocartilage complex (TFCC).^{1,2} In this article, we use the common terminology TFCC to refer to the relevant structures, which are usually limited to the dorsal and volar radioulnar ligaments and the intervening triangular fibrocartilage. Changes in the TFCC are more common as we age and can be accelerated in the setting of ulnocarpal impaction.³ Acute injury of the TFCC is common in association with a fracture of the distal radius, but is not routinely repaired in this setting.^{4–6} This does not seem to influence outcomes after wrist fracture.⁷

Given the fact that an acute tear of the TFCC associated with fracture of the distal radius uncommonly benefits from repair, the role of repair in other settings is uncertain.⁸ Our impression is that TFCC repair is highly variable from surgeon-to-surgeon, and that many surgeons never repair the TFCC.

The purpose of this study is to determine the rate of TFCC repair in patients who had a magnetic resonance imaging (MRI) scan of the wrist obtained for ulnar-sided wrist pain, and that showed signal changes in the TFCC. We tested the primary null hypothesis that there are no demographic or surgeon factors associated with repair of the TFCC.

Patients and Methods

This study was approved by our Institutional Review Board and a waiver of informed consent was granted. All adults who had an MRI scan of the upper extremity between January 2005 and January 2015 at one of two institutions were identified in our hospital data registration system using the Current Procedural Terminology (CPT) codes 73221, 73222, and 73223. We text searched the corresponding radiology reports for signal changes in the radioulnar ligaments and triangular fibrocartilage disc, including common misspellings and synonyms. Radiology reports of 1,443 MRI scans were flagged in our initial search. After manual review of the reports, 58 were incorrectly identified as reporting signal changes in the TFCC and were excluded. We extracted the patient history and the indication for the MRI scan from the electronic medical records. We excluded a total of 991 patients: 876 because the reported signal changes in the TFCC were incidental to the

reason for ordering the MRI scan, 59 patients who had prior wrist surgery, 48 patients who had an arthritic disorder, 7 patients who had ulnar styloid resection, and 1 patient whose electronic medical record was not available. The final cohort included 394 patients who had MRI signal changes in the TFCC and pain on the ulnar side of the wrist without notable instability of the distal radioulnar joint (–Table 1). All patients with distal radius fractures had healed, remote fractures. No patients had deformity of the distal radius. As instability of the wrist is neither clearly defined, nor objectively measurable, some surgeons diagnose and offer treatment for instability more often than others. This cohort only included patients without dislocation of the distal radioulnar joint with forearm rotation so we could investigate variations in treatment of patients with lesser degrees of instability. We identified surgical repair of the TFCC by reviewing the medical records and operative notes.

Outcome Measures and Study Variables

Our primary outcome measure was operative TFCC repair. Repair was defined as the suturing of an avulsed peripheral margin of the TFCC, either open or arthroscopic. We recorded whether patients thought a (remote) trauma caused their wrist problems. The treating surgeon, a medical history including a distal radius fracture, MRI signs of ulnar impaction syndrome, scapholunate and lunotriquetral ligament signal changes, and location of signal change within the TFCC were determined by record review.

Statistical Analysis

Means and standard deviations (SDs) are reported for continuous variables, frequencies, and percentages for categorical variables. In bivariate analyses, we used a Fisher exact test for the association between categorical variables—male sex, affected side, hospital of service, history of smoking, treating surgeon, perceived trauma as cause of pain, associated conditions, and location of signal change in the TFCC—and having a TFCC repair. We used a two-sample unpaired Student’s *t*-test to compare the means of the continuous variable age among patients with and without surgical TFCC repair.

Table 1 Demographics of patients with ulnar side wrist pain and MRI signal changes in the TFCC

	All patients ^a	TFCC repair	No TFCC repair	<i>p</i> -Value
	(<i>n</i> = 394)	(<i>n</i> = 25)	(<i>n</i> = 369)	
Age in y (mean, SD)	45 (14)	39 (12)	45 (14)	0.055
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
Male sex	177 (45)	7 (28)	170 (46)	0.097
Right side affected	235 (60)	20 (80)	215 (58)	0.035
Hospital of service				
Hospital 1	228 (58)	10 (40)	218 (59)	0.092
Hospital 2	166 (42)	15 (60)	151 (41)	
History of smoking	119 (30)	7 (28)	112 (30)	0.99

Abbreviations: MRI, magnetic resonance imaging; SD, standard deviation; TFCC, triangular fibrocartilage complex.

Note: Each *p*-value of less than 0.05 is considered statistically significant.

^aAll patients = patients that had MRI signal changes in the TFCC and ulnar-sided wrist pain.

Table 2 TFCC repair per surgeon per patient with ulnar side wrist pain and TFCC signal abnormality

	Repair (%)	No repair (%)	p-Value
	(n = 25)	(n = 369)	
Surgeon			
1	2 (14)	12 (86)	0.042
2	5 (12)	36 (88)	
3	6 (12)	46 (88)	
4	1 (11)	8 (89)	
5	7 (10)	65 (90)	
6	1 (6.3)	15 (94)	
7	1 (5.6)	17 (94)	
8	1 (1.4)	70 (99)	
9	—	12 (100)	
10	—	16 (100)	
Remaining surgeons (31)	1 (1.4)	72 (99)	

Abbreviation: TFCC, triangular fibrocartilage complex.

With the numbers available, we decided not to perform multi-variable modeling. Statistical significance was set at 5% ($p < 0.05$) and we performed all statistical analyses using Stata (Version 13, StataCorp LP, College Station, TX).

Results

Out of 394 patients, 54 (14%) had wrist arthroscopy. Twenty-five patients (6%) had TFCC repair: 6 open and 19 arthroscopic. One open repair was performed based on MRI findings alone, while the other five open repairs followed preliminary diagnostic arthroscopy. All open repairs were performed with a suture anchor. The lesions repaired with the open method were all peripheral. Nine of 41 attending hand surgeons performed one or more TFCC repairs, including 13 hand fellows each of whom were credentialed as attendings and operated independently for a year in our setting. Twenty of the 25 TFCC repairs (80%) were performed by 4 of the 41 total hand surgeons ($p = 0.042$; ► **Table 2**). Other factors that were associated with TFCC repair were perceived trauma (8.6% among patients with perceived trauma vs. 3.1% in patients with nontraumatic wrist pain; $p = 0.035$; ► **Table 3**) and MRI signal changes located primarily in the ulnar portion of the TFCC (11% of people with ulnar-sided TFCC signal changes compared with 2.3% of patients with signal changes in other parts of the TFCC; $p < 0.001$).

Discussion

Operative treatment of TFCC pathology includes debridement, repair, or ulnar shortening.^{8,9} We found substantial variability in repair based largely on surgeon preference.^{10,11} We sought factors associated with TFCC repair among

Table 3 Bivariate analysis

	Repair (%)	No repair (%)	p-Value
	(n = 25)	(n = 369)	
Perceived trauma as cause of pain			
Yes	20 (80)	213 (58)	0.035
No	5 (20)	156 (42)	
Associated conditions			
Distal radius fracture	2 (8.0)	18 (4.9)	0.37
Ulnar impaction syndrome	3 (12)	39 (11)	0.74
SL/LT ligament signal change	6 (24)	90 (24)	0.99
Location of signal change in TFCC			
Indiscriminate	—	19 (4.8)	0.62
Central	10 (40)	187 (51)	0.41
Ulnar	20 (80)	158 (43)	< 0.001
Radial	4 (16)	57 (15)	0.99

Abbreviations: LT, lunotriquetral; SL, scapholunate; TFCC, triangular fibrocartilage complex.

patients who had increased MRI signal in the TFCC and found that 10% of hand surgeons performed 80% of the repairs. We also found that perceived trauma and MRI signal changes located in the ulnar portion of the TFCC were associated with TFCC repair.

Our findings should be considered in light of a few shortcomings. The retrospective design limited what we could study and the accuracy and completeness of the data. There were no protocols for the diagnosis and treatment of the dorsal and volar distal radioulnar ligaments and the triangular fibrocartilage. This study applies best to patients that have an MRI to evaluate wrist pain—a diagnostic maneuver that is highly variable from surgeon-to-surgeon and a diagnostic method of uncertain value in this context. Based on common practice, it is our opinion that surgeons who order MRI scans for wrist pain are more likely to operate, so these data cannot be considered representative of the average patient with wrist pain. Given the low overall incidence of TFCC repair, we had limited statistical power to identify factors independently associated with repair. This study does not account for patients who had a repair without a prior MRI scan of the wrist; but that is likely uncommon. We chose to identify patients based on MRI findings to have a large heterogeneous control group. The definition and diagnosis of instability of the distal radioulnar joint are incomplete. We did not find any evidence of notable instability in the medical records, nor was it offered by surgeons as a justification for repair. We were unable to assess the type and force of a reported injury. We therefore refer only to the presence or absence of perceived injury. Given the prevalence of signal changes in the TFCC and the tendency for humans to misinterpret pain as injury, we expect a substantial percentage of these signal changes and any associated pathology to be unrelated to injury.¹²

We found that TFCC repair varies substantially among hand surgeons, reinforcing the fact that such repairs are discretionary and highly preference sensitive. The optimal treatment of peripheral avulsions without wrist instability remains subject of debate, particularly in patients with positive ulnar variance.^{13,14} There is limited data regarding the relative benefits of repair or surgery of any type.⁹ The evidence is limited to a few small retrospective case series, typically describing a particular operative technique. In setting of a displaced distal radius fracture, the TFCC is often damaged but nearly always heals without problems in the absence of specific treatment.^{4-7,15,16}

TFCC repair varies substantially between surgeons. Some surgeons never offer a repair, others do so regularly and the others are somewhere in between. The observation that repair is more likely when patients perceive themselves as injured suggests that subjective factors such as misperception of an injury affect how patients and surgeons consider treatment options. To help avoid surgeries based on surgeon bias or patient misperception, we suggest studying the effect of tools that provide simple, balanced, dispassionate, empowering information (e.g., decision aids) that can limit surgeon-to-surgeon variation and help patients ensure their preferences are based on their values and not on misconceptions.

Note

This work was performed at the Hand and Upper Extremity Service, Department of Orthopedic Surgery, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts, and Yawkey Center, 55 Fruit Street, Boston, Massachusetts. Institutional Review Board approval was obtained from Massachusetts General Hospital; Data Repository Protocol 2009P001019.

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None.

Conflict of Interest

None.

References

- Skalski MR, White EA, Patel DB, Schein AJ, RiveraMelo H, Matcuk GR Jr. The traumatized TFCC: an illustrated review of the anatomy and injury patterns of the triangular fibrocartilage complex. *Curr Probl Diagn Radiol* 2016;45(01):39-50
- Smith TO, Drew B, Toms AP, Jerosch-Herold C, Chojnowski AJ. Diagnostic accuracy of magnetic resonance imaging and magnetic resonance arthrography for triangular fibrocartilaginous complex injury: a systematic review and meta-analysis. *J Bone Joint Surg Am* 2012;94(09):824-832
- Mikić ZD. Age changes in the triangular fibrocartilage of the wrist joint. *J Anat* 1978;126(Pt 2):367-384
- Fujitani R, Omokawa S, Akahane M, Iida A, Ono H, Tanaka Y. Predictors of distal radioulnar joint instability in distal radius fractures. *J Hand Surg Am* 2011;36(12):1919-1925
- Bombaci H, Polat A, Deniz G, Akinci O. The value of plain X-rays in predicting TFCC injury after distal radial fractures. *J Hand Surg Eur Vol* 2008;33(03):322-326
- Mrkonjic A, Geijer M, Lindau T, Tägil M. The natural course of traumatic triangular fibrocartilage complex tears in distal radial fractures: a 13-15 year follow-up of arthroscopically diagnosed but untreated injuries. *J Hand Surg Am* 2012;37(08):1555-1560
- Deniz G, Kose O, Yanik S, Colakoglu T, Tugay A. Effect of untreated triangular fibrocartilage complex (TFCC) tears on the clinical outcome of conservatively treated distal radius fractures. *Eur J Orthop Surg Traumatol* 2014;24(07):1155-1159
- Cody ME, Nakamura DT, Small KM, Yoshioka H. MR Imaging of the triangular fibrocartilage complex. *Magn Reson Imaging Clin N Am* 2015;23(03):393-403
- Cardenas-Montemayor E, Hartl JF, Wolf MB, et al. Subjective and objective results of arthroscopic debridement of ulnar-sided TFCC (Palmer type 1B) lesions with stable distal radio-ulnar joint. *Arch Orthop Trauma Surg* 2013;133(02):287-293
- Atzei A, Rizzo A, Luchetti R, Fairplay T. Arthroscopic foveal repair of triangular fibrocartilage complex peripheral lesion with distal radioulnar joint instability. *Tech Hand Up Extrem Surg* 2008;12(04):226-235
- Nishizuka T, Tatebe M, Hirata H, Shinohara T, Yamamoto M, Iwatsuki K. Simple debridement has little useful value on the clinical course of recalcitrant ulnar wrist pain. *Bone Joint J* 2013;95-B(12):1687-1696
- Iordache SD, Rowan R, Garvin GJ, Osman S, Grewal R, Faber KJ. Prevalence of triangular fibrocartilage complex abnormalities on MRI scans of asymptomatic wrists. *J Hand Surg Am* 2012;37(01):98-103
- Estrella EP, Hung L-K, Ho P-C, Tse WL. Arthroscopic repair of triangular fibrocartilage complex tears. *Arthroscopy* 2007;23(07):729-737
- Minami A, Kato H. Ulnar shortening for triangular fibrocartilage complex tears associated with ulnar positive variance. *J Hand Surg Am* 1998;23(05):904-908
- Lindau T, Adlercreutz C, Aspenberg P. Peripheral tears of the triangular fibrocartilage complex cause distal radioulnar joint instability after distal radial fractures. *J Hand Surg Am* 2000;25(03):464-468
- Richards RS, Bennett JD, Roth JH, Milne K Jr. Arthroscopic diagnosis of intra-articular soft tissue injuries associated with distal radial fractures. *J Hand Surg Am* 1997;22(05):772-776