Utility of MRI for diagnosing complete tears of the collateral ligaments of the metacarpophalangeal joints of the lesser digits

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Abstract

Background MRI has been shown to be highly accurate in assessing collateral ligament injuries of the metacarpophalangeal joint (MPJ) of the thumb. The purpose of this study is to evaluate the accuracy of MRI for diagnosing collateral ligament tears of the MPJ of the fingers. Our hypothesis is that MRI would accurately detect complete tears of collateral ligaments of the lesser digit MPJs.

Methods We retrospectively evaluated 22 digits in 20 patients undergoing finger MPJ collateral ligament repair. All patients had preoperative MRI scans. The findings on preoperative imaging studies were compared to the intraoperative findings. **Results** All patients had surgically confirmed complete tears of the collateral ligament in question. In 8 of 22 MRI scans (36 %), the preoperative imaging study was inaccurate. Of these eight patients, MRI was interpreted as no tear in one and a partial tear in seven. The sensitivity of MRI for diagnosing a complete tear was 64 %. In all three digits in which 3-T MRI scanning was utilized and documented, the preoperative imaging results did not correlate with the intraoperative findings.

Conclusions Although MRI can be considered a useful adjunct to evaluating patients with collateral ligament injuries of the fingers, the sensitivity is poor and the imaging results can underestimate the extent of injury. In light of this, the emphasis for determining appropriate course of treatment remains on

history and mechanism of injury, physical examination, and patient disability.

Keywords Collateral ligament injury · Lesser digit MCP joint · MRI

Introduction

Injuries to the collateral ligaments of the metacarpophalangeal (MCP) joints of the fingers are less common than their counterparts in the thumb metacarpophalangeal joint (MPJ). Most reports of this type of injury have focused on the radial collateral ligament (RCL) of the index finger [1, 2, 7–9]. In the fingers, the degree of normal versus pathologic collateral ligament laxity is not well documented, and the indications for and results of surgical repair are less well established. In part, this may be due to the increased difficulty in assessing instability of the lesser digit MPJs. The neighboring digits can preclude an accurate measure of laxity, and there can be some degree of preexisting “normal” laxity that may be greater than that of the collateral ligaments of the thumb. As a result, the use of ancillary imaging studies may have a greater role in the diagnosis of lesser digit MPJ collateral ligament injury. The purpose of the present study is to assess the accuracy of MRI for diagnosing collateral ligament tears at the MPJ of the fingers in a cohort of surgically treated patients.

Materials and Methods

The present study was performed using the data that was obtained for an Institutional Review Board approved study on surgical outcomes following lesser digit collateral ligament repair. We retrospectively reviewed 22 consecutive patients, with 24 closed traumatic lesser digit MCP collateral ligament

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ruptures that were treated surgically. Patients with avulsion fractures were not included in the study. Two patients who did not undergo preoperative MR imaging were excluded, leaving 20 patients with 22 ligament injuries for review. These patients all underwent standard, noncontrast MRI examination preoperatively. The preoperative imaging studies and intraoperative findings were compared. Results of the preoperative imaging studies were based on the interpretation of the attending radiologist's report. Where indicated in the MRI report, the strength of the MRI field (open, 1.5 or 3 T) was noted.

The clinical diagnosis of MCP collateral ligament tear was based upon patient history and physical exam that demonstrated pain or instability of the joint when held in 60° of flexion and stressed. The degree of instability was compared with the contralateral hand. Surgery was performed in patients who failed a trial of immobilization and had persistent pain, instability without and endpoint, and/or continued disability. Surgical treatment was performed by a single surgeon and involved a standard approach. An incision was made over the dorsolateral aspect of the involved MPJ on the side of the suspected ligamentous disruption. Full thickness skin flaps were elevated. The extensor mechanism and joint capsule were incised, and the ligament repaired from its site of rupture.

In all cases, there was a rupture from either the origin or insertion of the ligament, and the ligament was repaired with a suture anchor. The extensor mechanism was repaired, and the skin was closed. Postoperatively, the affected MPJs were immobilized in 80–90° flexion for 4 weeks. After this time, range of motion exercises was initiated under the supervision of a hand therapist.

Results

The results are summarized in Table 1. In 17 patients, the injury involved the dominant hand, and in three, the nondominant hand was injured. The involved fingers were six indexes, four long, four ring, and eight small. There were 8 ulnar collateral ligament (UCL) and 14 radial collateral ligament injuries, including three injuries of the index finger RCL.

All patients underwent preoperative imaging using standard, noncontrast enhanced MRI. All patients were found at the time of surgery to have complete collateral ligament tears. Nineteen of the ruptures were from the insertion on the base of the proximal phalanx; the remaining three ruptured from the

Table 1 The demographics, preoperative MRI, and intraoperative findings of patients undergoing lesser digit collateral ligament repair

Patient	Age	Sex	Hand dominance	Injured side	Injured digit	Injured ligament	Preoperative MRI results	Intraoperative correlation	Site of rupture
1	54	F	R	R	Index	UCL	Complete UCL, tech ns	Y	P1
2	48	F	R	L	Ring	RCL	1.5 T, complete RCL	Y	P1
3	42	F	R	R	Small	RCL	1.5 T, complete RCL	Y	P1
4	56	M	R	R	Ring	UCL	3 T, partial UCL/partial RCL	N	P1
4	56	M	R	R	Small	UCL	3 T, partial UCL/chronic RCL	N	P1
5	45	M	R	R	Long	UCL	High-grade partial tear UCL, MR tech ns	N	P1
6	57	F	R	R	Long	RCL	Complete RCL, MR tech ns	Y	P1
7	59	M	R	R	Ring	RCL	Partial RCL tear, MR tech ns	N	P1
8	50	F	R	L	Small	RCL	1.5 T, complete RCL	Y	P1
9	55	F	R	R	Index	UCL	1.5 T, complete UCL	Y	MC
10	51	M	R	L	Small	RCL	3 T, negative	N	MC
11	55	F	R	R	Index	RCL	Open 0.6 T, complete RCL	Y	P1
12	43	F	R	R	Small	RCL	MRI tech ns, complete RCL	Y	P1
13	48	F	R	R	Small	RCL	MRI tech ns, neg/sprain RCL	N	P1
14	34	M	R	R	Small	RCL	MRI tech ns, sprain RCL	N	P1
15	53	F	R	R	Index	RCL	MRI tech ns, complete RCL	Y	MC
16	58	F	R	R	Index	RCL	1.5 T, complete RCL	Y	P1
17	17	M	R	R	Index	UCL	1.5 T, complete UCL	Y	P1
18	25	M	R	R	Long	RCL	1.5 T, complete RCL	Y	P1
18	25	M	R	R	Ring	RCL	1.5 T, complete RCL	Y	P1
19	32	F	L	L	Small	RCL	1.5 T, complete RCL	Y	P1
20	27	F	R	R	Long	RCL	Open MRI, sprain	N	P1

RCL radial collateral ligament, UCL ulnar collateral ligament, tech ns technique not specified

Fig. 1 Axial T2-weighted MRI scan demonstrating a complete tear. The red arrow points to the torn RCL of the small finger. Intraoperative findings confirmed a complete tear

origin at the metacarpal. There were no cases of mid-substance rupture.

Of the 22 digits, the findings on MRI correlated to intraoperative findings in 64 % ($n=14$). Figures 1 and 2 are representative of an MRI which was interpreted correctly as a complete collateral ligament tear. Of the eight patients in whom MRI did not correlate to the complete tears seen intraoperatively, 88 % ($n=7$) were interpreted as a partial tear or sprain and one was negative for collateral ligament injury. Figures 3 and 4 are representative of an MRI interpreted as a partial tear, which did not correlate to intraoperative findings. The sensitivity of MRI for detecting complete tears was 64 %. The positive predictive value of MRI was 100 %. In the three digits in which 3-T MR imaging was utilized and documented in the report, the imaging results did not correlate to surgical findings in any of these cases.

Discussion

Ruptures of the collateral ligaments of the MPJ of the thumb are common injuries. Injuries to the collateral ligaments of the MPJ of the fingers are reported to be far less frequent. This

Fig. 2 Coronal T2-weighted MRI scan correctly demonstrating a complete tear. The red arrow points to the torn RCL of the small finger. Intraoperative findings confirmed a complete tear

Fig. 3 Axial T2-weighted MRI scan incorrectly demonstrating a high-grade partial tear. The white arrow points to the UCL of the long finger. Intraoperative findings revealed a complete tear of the ligament

may be due to their protected position, inherent stability of the ligaments, or surrounding structural support [9]. The frequency of these injuries may also be underestimated secondary to less awareness or less familiarity with the clinical diagnosis [1].

In assessing the thumb MPJ, imaging such as MRI and ultrasound have been shown to be highly accurate [3, 4, 6, 12, 13]. MRI has been found to have a sensitivity and specificity of 96 and 95 % for diagnosing tears of the ulnar collateral ligament of the thumb [12], but the combination of history, physical examination, and plain radiographic examination alone has also been found to be a reliable and cost-effective means of assessing the extent of injury and need for surgical treatment [5, 10]. In the fingers, however, normal physical exam parameters are not well established, and ancillary imaging studies therefore play a greater role in the diagnosis of these injuries.

Few studies have assessed the role of MR imaging in the evaluation of collateral ligament injuries of the fingers. Kang

Fig. 4 Coronal T2-weighted MRI scan incorrectly demonstrating a high-grade partial tear. The white arrow points to the UCL of the long finger. Intraoperative findings revealed a complete tear of the ligament

et al. [9] reported the results of 12 patients with index finger radial collateral ligament tears treated surgically. All of their patients underwent preoperative standard MR imaging with a dedicated wrist coil. The intraoperative findings in their series correlated in all cases with preoperative imaging.

Pfirmann et al. and Theumann et al. [11, 15] performed a two-part study to evaluate the role of MR imaging in evaluating the collateral ligaments. In the initial portion of the study, standard MRI and MR arthrography were used to evaluate the intact collateral ligaments in cadavers. Standard MRI was found to be effective in visualizing these structures. In the second portion of the study, simulated injury to the collateral ligaments was performed and the ligaments reimaged. Sensitivity, specificity, and accuracy of standard MR imaging was found to be 58.3, 93.2, and 85.7, respectively. These authors concluded that MRI was effective in diagnosing collateral ligament injuries.

Theumann et al. [14] also evaluated 39 MPJs with MR imaging and correlated the imaging results to surgical findings in ten patients. They performed the imaging with the joint both in flexion and extension and pre- and post-IV gadolinium contrast. In 77 % of patients, MR imaging revealed a collateral ligament injury. In 20 of their patients with a complete tear, the location could be determined only with the joint in flexion. In 45 % of the cases, though, the entire collateral ligament showed abnormality, and it was not possible to distinguish whether the injury was to the main or accessory collateral ligament or whether the proximal or distal aspect of the ligament was involved. The correlation between MRI and surgical findings was “excellent,” and they concluded that MRI accurately depicted injuries to the collateral ligaments.

In our study looking at the lesser digit MPJs, we found that the correlation between preoperative MRI and intraoperative findings was poor. In approximately one third of the patients, the preoperative MRI did not accurately confirm the presence of a complete tear. In all but one case, however, the preoperative MRI showed some degree of abnormality in the collateral ligament.

There are several possible explanations that our findings contrast with the studies above. Interpretation of the MRI of an injured ligament in vivo, where there is likely to be edema, swelling, and other potential concomitant or confounding injuries, may be more difficult than in a cadaver study. Depending on the chronicity of the injury, in vivo, there may be scar tissue interposed with the torn ligament that may be more difficult to differentiate from native tissue and may give the appearance of a partial tear. Also, in contrast to our study, the images in the report by Theumann et al. [14] were examined retrospectively by two radiologists, who were not blinded to the patients' clinical information. This may have improved their diagnostic accuracy versus our study in which a variety

of MRI facilities, and radiologists who had only the information provided on the prescription for the MRI, were utilized. In addition, in our study, no contrast was utilized for any of our patients, and all studies were performed with the MPJs in the standard position of extension.

There are several limitations to this study. First of all, it is a retrospective study in which we examined only those patients undergoing surgical intervention. This may have imparted a selection bias in the patients with partial tears or with complete tears who were treated non-operatively, in whom MRI may have accurately identified the extent of their injury, that were not included in our data analysis. On the other hand, given that these patients would have been treated non-operatively, it would have been impossible to confirm the imaging findings. Second, we used a variety of radiologists and imaging facilities in the examination of our patients. Although, this may have potentially resulted in a greater degree of variability in the quality and interpretation of the images, this does more accurately represent the clinical reality for most practitioners. It is possible that MRI scans performed in highly specialized centers may demonstrate better accuracy.

In light of our results, MRI can be considered to be an adjunct to evaluating patients with collateral ligament injuries of the fingers, but the sensitivity for detecting a complete tear is poor. Based on these results, MRI can indicate or confirm that there is pathology related to the collateral ligament, but the greater emphasis for determining appropriate course of treatment remains on history and mechanism of injury, physical examination, and patient disability.

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 (5). Informed consent was obtained from all patients for being included in the study.

Conflicts of Interests There are no conflicts of interests for any of the authors.

Statement of Informed Consent Patients have a right to privacy that should not be infringed without informed consent. Identifying information, including patients' names, initials, or hospital numbers, should not be published in written descriptions, photographs, and pedigrees unless the information is essential for scientific purposes and the patient (or parent or guardian) gives written informed consent for publication. Informed consent for this purpose requires that a patient who is identifiable be shown the manuscript to be published. Authors should identify Individuals who provide writing assistance and disclose the funding source for this assistance.

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