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Posterior Translation of the Radial Head in Magnetic Resonance Imaging of Lateral Epicondylitis

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Background: Posterolateral rotatory instability is produced by disruption of the lateral collateral ligament complex (LCLC); it is commonly induced by trauma, with few cases reported due to lateral epicondylitis. We examined the amount of posterior transition of the radial head with or without LCLC injury, common extensor tendon (CET) injury, and Baker classification in lateral epicondylitis.
Methods: We retrospectively studied patients with lateral epicondylitis of the humerus who underwent surgery between April 2016 and July 2021. Fifteen elbows with coronal and sagittal images on preoperative magnetic resonance imaging (MRI) were included. We investigated the amount of posterior transition of the radial head in sagittal MRI images of the elbow, which were compared based on LCLC and CET lesion.
Results: The mean age of patients was 49 years. The lesions in four, nine, and two patients were classified as LCLC0, LCLC1, and LCLC2, respectively. The mean radiohumeral distance values among the LCLC lesions were 0.65, 2.46, and 2.22 mm in LCLC0, LCLC1, and LCLC2, respectively, with the RHD between LCLC0 and LCLC1 differing significantly. In five, six, and four patients, the lesions were classified as CET1, CET2, and CET3, respectively. The mean RHD values among the CET lesions were 1.33, 2.68, and 1.48 mm in CET1, CET2, and CET3, respectively.
Conclusions: Our results showed that posterior transition of the radial head is greater in patients with lateral epicondylitis with LCLC lesions on MRI than those with normal findings of LCLC. *(Plast Reconstr Surg Glob Open 2024; 12:e5746; doi: 10.1097/GOX.0000000000005746; Published online 17 April 2024.)*

INTRODUCTION

Lateral epicondylitis is a common and idiopathic- or work-related condition associated with the lateral epicondyle of the humerus.[1] It is known to be a multifactorial condition with elements of repetitive microtrauma in individuals who overuse their upper limbs. Magnetic resonance imaging (MRI) studies have reported that lateral epicondylitis is associated with injury to the lateral collateral ligament complex (LCLC). In 63% cases of lateral epicondylitis, MRI showed lateral ulnar collateral ligament (LUCL) damage.[2]

Biomechanical studies have revealed that the LCLC is the primary lateral stabilizer of the elbow and maintains the radiocapitellar joint when the forearm is in supination.[3,4] Disruption of the LCLC causes posterolateral rotatory instability (PLRI),[5] which usually occurs as a result of trauma.

We hypothesized that posterior translation of the radial head also occurs in lateral epicondylitis. LCLC injury may appear as radiocapitellar incongruency or posterior translation of the radial head in MR images of patients with lateral epicondylitis. Therefore, in this study, we aimed to examine the amount of posterior translation of the radial head in relation to the presence of LCLC lesions, common extensor tendon (CET) lesions, and Baker classification in cases of lateral epicondylitis using clinical records at our university hospital.

METHODS

Patient Selection and Participant Characteristics

We retrospectively evaluated patients with lateral epicondylitis of the humerus who underwent surgery at our institution between April 2016 and July 2021. All patients were diagnosed and operated on by a physician qualified as a specialist by the Japanese Society for Surgery of the Hand. Of the 18 elbows operated on during that period, 15 with preoperative coronal and sagittal MR images were included in the study. Fourteen patients underwent

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arthroscopic surgery, and one patient underwent open surgery. The arthroscopic lateral epicondylitis release was performed as follows: The proximal origin of the extensor carpi radialis brevis (ECRB) was resected. In some cases, the radiocapitellar synovial plica was also resected. The open release of lateral epicondylitis was performed as follows: The extensor carpi radialis longus and the extensor digitorum communis interface were identified and incised. The extensor carpi radialis longus was retracted anteriorly. The degenerated tissue at the ECRB origin was identified and resected.

Data on patients' age, sex, affected side, work, smoking history, time from onset to surgery, and cortisone injection therapy were obtained from medical records.

This study was conducted in compliance with the Declaration of Helsinki, approved by our institution's ethics authority, and conducted in accordance with the policies and regulations of our institution. Previously collected patient data were used in the study, and information disclosure documents were therefore released without requiring individual consent.

Image Assessment and Measurements

We assessed the amount of posterior translation of the radial head and examined any differences in relation to the presence of LCLC and CET lesions with MRI and Baker classification.[6] Preoperative MRI was performed in 10 and five elbows with a 3.0-T system (TIM Trio 3T, Siemens Healthineers, Germany; MAGNETOM Verio 3T, Siemens Healthineers, Germany; Vantage Galan 3T, Canon Medical Systems, Japan; Philips Achieva 3T, Philips Healthcare, the Netherlands; and MAGNETOM Skyra, Siemens Healthineers, Germany) and a 1.5-T system (Intera 1.5T MRI scanner, Philips Healthcare, the Netherlands; Vantage Titan 1.5T, Canon Medical Systems, Japan; MAGNETOM Aera 1.5T, Siemens Healthineers, USA; ECHELON Smart, FUJIFILM Healthcare Corporation, Japan; and MAGNETOM Avanto 1.5T, Siemens Healthineers, USA), respectively.

The LCLC and CET were evaluated on T2-weighted or short-tau inversion recovery coronal images. Based on MRI findings, LCLC lesions were categorized as follows: LCLC0, normal status; LCLC1, partial tear, thickening, or thinning of the ligament; and LCLC2, near-complete or complete tear.

Similarly, based on MRI findings, CET lesions were categorized as follows: CET1, tendinopathy or low-grade partial tears; CET2, intermediate-grade partial tears; and CET3, high-grade partial or complete tears. In accordance with the criteria used in previous studies, a low-grade partial tear was defined as an injury covering less than 20% of the tendon thickness, an intermediate-grade partial tear was an injury covering 20%–80% of the tendon thickness, and a high-grade partial tear was an injury covering more than 80% of the tendon thickness. A full tear was defined as a tear showing no continuity with the attachment of the lateral epicondyle of the humerus.[2,7,8]

The posterior translation of the radial head was measured in T2- or T2-weighted sagittal images following a method described in a previous study[9] (Fig. 1). The sagittal image of the slice closest to the center of the radial head was selected as the slice image to be measured. The longitudinal axis of the proximal radius was marked as the line passing through the center of the radial shaft 1 cm above the radial tuberosity and the center of the radial head. The center of the capitellum was set as the center point of the circle. The circle's curvature was similar to the capitellum curvature in the same slice as the longitudinal axis measurement of the proximal radius. The radio-humeral distance (RHD), which was defined as the distance of the perpendicular line from the center of rotation to a straight line, with positive values indicating a backward direction, was measured. We also reviewed the recorded videos of arthroscopic surgery and performed Baker classification in 14 patients, excluding one who underwent open surgery.

Takeaways

Question: Can lateral collateral ligament complex injury in patients with lateral epicondylitis cause the posterior translation of the radial head?

Findings: Posterior transition of the radial head is greater in the patients of lateral epicondylitis with lateral collateral ligament complex lesion on magnetic resonance imaging than those with normal findings.

Meaning: The posterior translation of the radial head can occur in patients with lateral epicondylitis.

MRI and Arthroscopy Finding Reviews

We conducted reviews of MRI and arthroscopy findings at our hospital from October 2020 to February 2021. Two authors (M.S. and H.Y.) reviewed the cases independently and identified the grade corresponding to each MRI and arthroscopy finding. Discrepancies among the two reviewers in the assessments were resolved by discussions after they rereviewed the MRI and arthroscopy findings.

The inter-reviewer agreements for grading of MRI and arthroscopy findings were evaluated using kappa coefficients and categorized as follows: near-perfect (0.81–1.00), substantial (0.61–0.80), moderate (0.41–0.60), fair (0.21–0.40), or poor (0.00–0.20). The authors (M.S. and H.Y.) were certified as qualified specialists by the Japanese Society for Surgery of the Hand.

Statistical Analyses

Between-group differences for continuous variables were evaluated using the Kruskal–Wallis test. Statistical significance was considered at P less than 0.05. We calculated the intraclass correlation coefficients for Baker classification and MRI findings of LCLC and CET. All statistical analyses were performed using IBM SPSS Statistics, version 28 (IBM Corporation, Armonk, N.Y.).

RESULTS

Patients

The mean age of the patients (seven men and eight women) was 49 (range, 36–81) years. The affected side

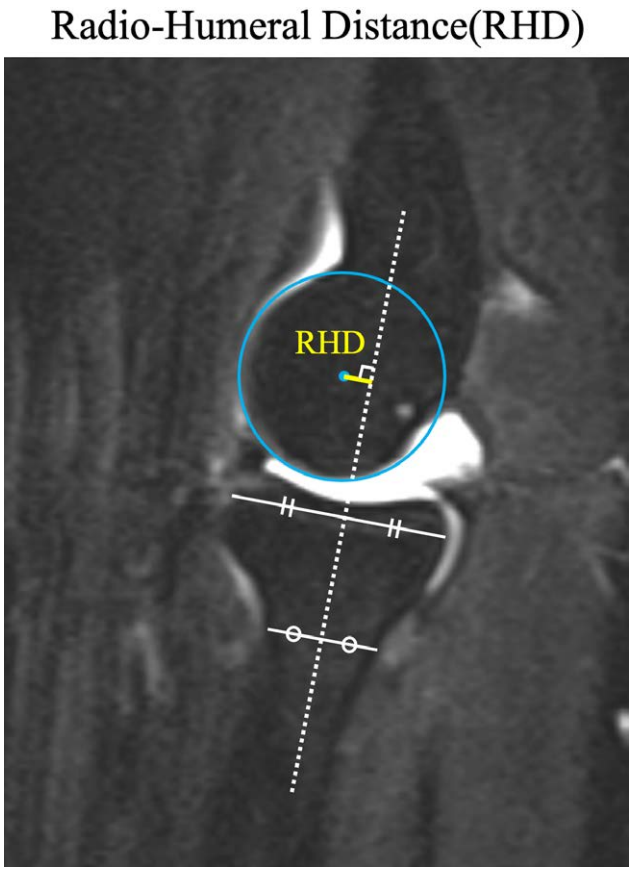

Fig. 1. The measurement of posterior translation of the radial head. The sagittal image of the slice closest to the center of the radial head was selected. The lines at the radial shaft 1 cm above the radial tuberosity and the radial head (white solid line). The longitudinal axis of the proximal radius (white dotted line). The circle with curvature similar to the capitellum curvature and the center point of the circle (blue circle and dot). Radio-humeral distance: defined as the distance of the perpendicular line from the center of rotation to a straight line (yellow line).

was the right elbow in nine patients and the left in six. Seven patients had a history of smoking, and seven performed manual labor, including a surgeon, a nurse, two childcare workers, a dry cleaner, and two factory workers. Five patients performed desk- or office-type work, including a salesperson, a researcher, an artist (painter), and two desk workers. Two patients were household workers, and one was a retiree. The time from symptom onset to surgery ranged from 7 months to several years. All patients received single or multiple cortisone injections before surgery (Table 1).

Validity of the Classification of MRI and Arthroscopy Findings

The classification of LCLC and CET lesions, the Baker classification, inter-reviewer agreement data, and RHD values are presented in Table 2. All inter-reviewer agreements for the classification of MRI and arthroscopy findings were substantial.

Classification of LCLC and CET Lesions and the Related RHD Data

The LCLC lesions in four, nine, and two patients were classified as LCLC0, LCLC1, and LCLC2, respectively. The mean RHD values were 0.65, 2.46, and 2.22 mm in LCLC0, LCLC1, and LCLC2 cases, respectively, and the RHD values differed significantly between LCLC0 and LCLC1 cases ($P = 0.045$; Fig. 2).

The CET lesions in five, six, and four patients were classified as CET1, CET2, and CET3, respectively. The mean RHD values were 1.33, 2.68, and 1.48 mm in CET1, CET2, and CET3 cases, respectively, without significant differences among the three groups.

Baker Classification and RHD

Baker classification indicated eight, two, and four type I, II, and III lesions, respectively. The mean RHD values were 1.24, 3.79, and 2.45 mm in type I, II, and III lesions, respectively, without significant differences among the three groups (Table 2).

DISCUSSION

In this study, we investigated the amount of posterior translation of the radial head on sagittal MRI of the elbow and compared the amounts of translation with LCLC, CET, and Baker classification in patients with lateral epicondylitis. The group where LCLC damage was classified as intermediate-grade partial tear showed more posterior translation of the radial head than that where the LCLC was considered largely normal.

LCLC lesions have reportedly been associated with the posterior translation of the radial head after trauma in PLRI. A clinical study investigated trauma patients undergoing preoperative MRI evaluations of clinically and arthroscopically proven unstable elbow joints, reporting that radiocapitellar incongruity of more than 2 mm was highly suspicious, and incongruity of more than 3.4 mm reliably confirmed the diagnosis of elbow instability.[10] In this study, the average RHD of LCLC1 and LCLC2 cases was more than 2 mm. Therefore, although patients in this study had disease backgrounds different from those of trauma, the results were in agreement with those of previous studies.

We identified LCLC lesions in 12 patients, including two with complete tears. All patients had received cortisone injections preoperatively, and more than half (10 patients) had received multiple injections, although the content and number of injections were not described in some cases because injections were also administered at previous hospitals. A nationwide database study previously reported that preoperative treatment using three or more injections was the most significant risk factor for reoperation in patients with lateral epicondylitis.[11] An animal study showed that steroid injection into the tendon caused a reduction in collagen tensile strength.[12] Other clinical studies also reported that multiple steroid injections are a risk factor for LCLC insufficiency.[13–15] Additionally, patients with chronic lateral epicondylitis were reported to show instability after multiple steroid injections.[16] Therefore,

TABLE 1. Characteristics of Patients Included in This Study

Case No.	Age (y)	Sex	Occupation	Affected Side	Smoking History	History of Injection before Surgery	Period from Symptom Onset to Surgery
1	54	Female	Artist (painter)	Right	–	+	7 mo
2	47	Female	Salesperson	Left	–	+	1 y, 11 mo
3	53	Female	Researcher	Left	–	+	3 y, 5 mo
4	40	Female	Factory worker	Right	+	+	7 mo
5	52	Male	Surgeon	Left	+	+	2 y, 2 mo
6	51	Male	Dry cleaner	Right	+	+	Approximately 2 y
7	36	Male	Office worker	Left	+	+	Several years
8	39	Male	Office worker	Right	+	+	7 mo
9	81	Male	Retiree	Left	+	+	1 y, 5 mo
10	54	Female	Household worker	Right	–	+	7 mo
11	45	Female	Childcare worker	Right	+	+	6 mo
12	58	Female	Household worker	Right	–	+	1 y, 5 mo
13	47	Female	Nurse	Left	–	+	Approximately 2 y
14	40	Male	Factory worker	Right	–	+	2 y, 4 mo
15	42	Male	Childcare worker	Right	–	+	Approximately 2 y

TABLE 2. LCLC, CET, and Baker Classification and RHD Values

Case No.	Classification of LCLC	Classification of CET	MRI	Baker Classification	RHD (mm)
1	LCLC1	CET3	3T	Type III	1.76
2	LCLC0	CET1	1.5T	Type I	0
3	LCLC1	CET2	3T	Type II	5.32
4	LCLC1	CET1	3T	Type I	2.55
5	LCLC1	CET2	3T	Type I	2.00
6	LCLC1	CET1	3T	Type I	2.28
7	LCLC1	CET3	3T	Type III	2.25
8	LCLC0	CET2	3T	Type I	0.74
9	LCLC2	CET2	3T	Type III	2.53
10	LCLC1	CET2	1.5T	Type III	3.24
11	LCLC1	CET2	3T	Type II	2.25
12	LCLC0	CET1	1.5T	Type I	0.90
13	LCLC1	CET3	3T	Type I	0.50
14	LCLC2	CET3	1.5T	— (open surgery)	1.91
15	LCLC0	CET1	1.5T	Type I	0.94
Inter-reviewer agreement (κ)	0.737	0.685		0.618	

Classification of LCLC lesions: LCLC0, normal status; LCLC1, partial tear, thickening or thinning of the ligament; LCLC2, near-complete or complete tear.
Classification of CET lesions: CET1, tendinopathy or low-grade partial tear; CET2, intermediate-grade partial tear; CET3, high-grade partial or complete tear.

multiple steroid injections may have contributed to the fragility of the LCLC ligament in our study patients. They may also have been involved in the MRI findings for the lesion and contributed to instability characterized by posterior translation of the radial head on MRI.

MR scans are static images and are unsuitable for dynamic evaluation. Therefore, the gold standard for the diagnosis of lateral epicondylitis and ligamentous instability is essentially a clinical evaluation with a physical diagnosis. The pivot shift test of the elbow was designed to test for PLRI caused by insufficiency of LUCL and radial collateral ligament (RCL). This test is applicable for patients who are awake, although it is most successful when they are under general anesthesia.[17] The sensitivity of the pivot test was 38% when awake and 100% under anesthesia.[18] However, diagnosis using the pivot shift test is usually difficult because the clinical examination can be misleading unless performed under anesthesia. Therefore, MRI can be extremely useful in evaluating LUCL tears in patients with lateral elbow pain or instability.[19]

Arthroscopic surgery was performed in all but one of the cases. LCLC lesions were variously classified as types I to III in the Baker classification, with LCLC1 as type I and LCLC2 as type III. A clinical study reported that the correlation (κ values) between MRI and arthroscopy findings for the presence or absence of the capsular tear at the undersurface of ECRB was 0.48, 0.48, and 0.27 in MRI evaluations performed by the radiologist, surgeon, and fellow, respectively. Therefore, MRI was significantly less reliable when interpreted by less-experienced surgeons.[20] If MRI shows a normal joint capsule (LCLC0) or only thickening or thinning of the ligament (LCLC1) and no disruption of tissue continuity, the case was classified as type 1 in the Baker classification. A partial tear (LCLC1) is considered a type II or III injury in the Baker classification. A complete tear (LCLC2) is classified

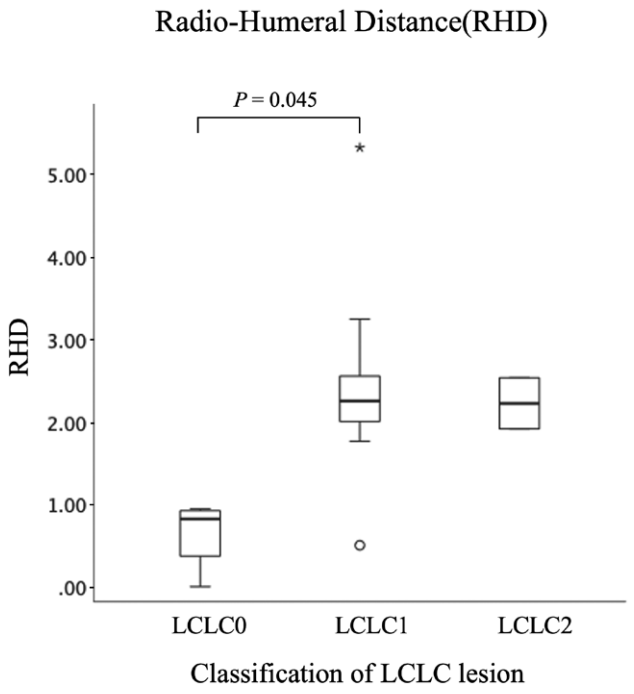

Fig. 2. Amount of posterior translation of the radial head in relation to LCLC lesion classification. The average RHD in LCLC1 and LCLC2 was greater than that in LCLC0. RHD differed significantly between LCLC0 and LCLC1..

as type III because the LCLC and joint wrapping are integrated, and the evaluation is considered to be in compliance.

This study had some limitations. First, LUCL, which is considered the primary stabilizer of the elbow joint against PLRI, was not distinguished from RCL in the MRI evaluation. A systematic review supported the ability of MRI to detect ligament lesions; however, MRI cannot definitively distinguish ligament lesions between the RCL and LUCL.[21] Even in anatomic dissections, differentiating the LUCL and RCL at the site of humeral attachment is difficult because both ligaments originate in the inferior aspect of the lateral epicondyle.[22,23] Nevertheless, there was little need to distinguish the LUCL and RCL, and the results would not be affected by this factor because the LCLC in this study was assessed at a site close to the attachment.

Second, we observed only the condition of the elbow joint, including the lateral side, under arthroscopy but did not perform confirmatory diagnostic stress tests for PLRI. An MRI was not performed on the upper extremity in a specific position in this retrospective study. The position of the radial head may change depending on the line of the forearm, particularly in the presence of elbow instability. The positions of the radial tuberosity in axial imaging of all included patients were facing the medial direction.[24] The MRI forearm positioning was considered close to neutral; therefore, MRI forearm positioning did not affect the results.

Third, longitudinal studies must be performed to clarify the clinical significance of these novel findings.

In conclusion, the present study showed that posterior translation of the radial head is greater in patients showing lateral epicondylitis with LCLC lesions on MRI than in those showing normal findings. The results indicated the possibility of PLRI in patients with lateral epicondylitis with LCLC lesions.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

ETHICAL APPROVAL

The study was conducted in compliance with the Declaration of Helsinki, was approved by our institution's ethics authority, and was conducted in accordance with the policies and regulations of our institution.

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