Magnetic Resonance Imaging of Patients With Chronic Lateral Epicondylitis

Is There a Relationship Between Magnetic Resonance Imaging Abnormalities of the Common Extensor Tendon and the Patient’s Clinical Symptom?

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Abstract: The aim of the study is to determine the inter-reliability and intra-observer reliability of magnetic resonance imaging (MRI) for lateral epicondylitis and investigate whether there is a potential relationship between MRI abnormalities of the common extensor tendon (CET) and its clinical symptom.

The study group comprised 96 consecutive patients (46 men and 50 women) with a clinical diagnosis of chronic lateral epicondylitis, which were examined on 3.0 T MR. An MRI scoring system was used to grade the degree of tendinopathy. Three independent musculoskeletal radiologists, who were blinded to the patients’ clinical information, scored images separately. Clinical symptoms were assessed using the Patient-Rated Tennis Elbow Evaluation (PRTEE).

Of all the patients, total 96 elbows had MRI-assessed tendinopathy, including 38 (39.6%) with grade 1, 31 (32.3%) with grade 2, and 27 (28.1%) with grade 3. Inter-observer reliability and intra-observer agreement for MRI interpretation of the grades of tendinopathy was good, and a positive correlation between the grades of tendinopathy and PRTEE was determined.

MRI is a reliable tool in determining radiological severity of chronic lateral epicondylitis. The severity of MR signal changes positively correlate with the patient’s clinical symptom.

INTRODUCTION

Lateral epicondylitis (also known as “tennis elbow”), generally caused by the extensive usage of common extensor tendon (CET), that predominantly affects the extensor carpi radialis brevis. The term “epicondylitis” actually is a misnomer, because the condition does not exactly feature acute or chronic inflammatory cells thereby suggesting “lateral elbow tendinopathy” as a more appropriate term. Histological studies have shown mucinous degeneration and angiofibroblastic hyperplasia within the tendon leading to partial or complete tear.2–4

The gold standard diagnosis of lateral epicondylitis is essentially the clinical history and examination. Patients complain of pain in the lateral elbow that is typically exacerbated by digital resisting and wrist extension. At physical examination, patients demonstrate localized tenderness at the CET.5 Magnetic resonance imaging (MRI) has an excellent contrast resolution of soft tissue and have demonstrated acceptable levels of sensitivity, specificity, and accuracy in the diagnosis of lateral epicondylitis.6–8 However, few studies has determined the inter-reliability and intra-reliability for lateral epicondylitis and relationship between MRI abnormalities of the CET and the patient’s clinical symptom.

MATERIALS AND METHODS

The investigation conforms to the principles outlined in the declaration of Helsinki. The study was approved by the local institutional review board of Jiangsu province hospital, and informed consent was obtained from all patients.

Between May 2009 and June 2014, 96 consecutive patients with a clinical diagnosis of chronic lateral epicondylitis were evaluated. There were 46 men and 50 women with a mean age of 46.2 years (range, 23–51 years). The average total duration of symptoms was 1.6 years (range, 6 months to 3 years). None of the patients underwent corticosteroid injection within 3 months of MR examination. No patients had received surgical treatment before MRI assessment. Plain radiography of the elbow had been performed to exclude the possibility of bony pathology such as osteoarthritis or intra-articular loose bodies.

All subjects had an MRI assessment of the affected arms using a 3-Tesla MR system (SignaHDxt, GE Medical Systems, Milwaukee, WI) with a dedicated surface coil employed. Examination was performed in supine position with the affected elbow extended and the palms in supination. In order to obtain high-quality images, the affected arms were placed as close as possible to the center of the MR scanner. Parameters of MRI sequences are provided in Table 1.

All MR images were interpreted separately by 3 musculoskeletal radiologists, who were blinded to all clinical symptoms.
information and were not aware of the severity of disease. Each reader reviewed the images on 3 separate occasions at least 2 weeks apart. A scoring system was devised to grade the severity of tendinopathy at the lateral epicondyle (Table 2); this system was a modified system devised by Walz et al.9

All individuals had a standardized clinical assessment with a validate instrument called Patient-Rated Tennis Elbow Evaluation (PRTEE).10 The questionnaire include 2 parts: Part 1 deal with pain (5 questions graded 0 to 10) and part 2 deal with functional disability (10 questions graded 0 to 10). Part 2 is subdivided into specific (eg, turning a doorknob) and usual (dressing, washing) activities. Functional scores are then halved and added to pains scores. The minimum obtainable score is 0 (no pain or disability) and the maximum is 100 (severe pain and disability).

All statistical analysis was performed by using SPSS 16.0. Mean values ± standard deviations were given for normal distributed data and otherwise median with interquartile range. Overall agreement for MRI score was calculated. An inter- and intra-observer reliability analysis, using a linear-weighted Fleiss’ kappa statistic, was performed to determine consistency of the 3 radiologists. Kappa value of 0.41 to 0.60 was considered to represent fair agreement: 0.61 to 0.80 good and 0.81 to 1.00 excellent agreement. In the second step, following the kappa test, the MR score for each observation from 3 experts were averaged, and the obtained value was correlated with the standardized clinical assessment measure by using Spearman’s rank correlation test. And the correlation was considered significant at \( P < 0.05 \).

| Tendinopathy Score | MR Findings of CET |
|---------------------|---------------------|
| 1 Normal/mild       | Complete homogenous low intensity or mild focal increase in the tendon signal on fat-suppressed T2 images not equal to that of fluid |
| 2 Moderate          | Moderate focal increase in the tendon signal not equal to that of fluid |
| 3 Severe            | Marked a generalized focal increase in the tendon signal with or without frank fluid signal intensity |

CET = common extensor tendon.

### RESULTS

A total of 96 elbows (66 right, 30 left) in 96 patients were included in this study, of all the patients, 96 elbows had MRI-assessed tendinopathy, that includes 38 (39.6%) with grade 1 (Figure 1), 31 (32.3%) with grade 2 (Figure 2), and 27 (28.1%) with grade 3 (Figure 3).

The average intra-observer agreement for grading the severity of tendinopathy was 77.3%. Weighted kappa values for intra-observer reliability were 0.762, 0.721, and 0.937 (\( P < 0.001 \)) for radiologists, respectively. An overall weighted kappa value of 0.732 indicates good inter-observer reliability.11

The median PRTEE score of all patients was 61 (range 8–98), the median PRTEE score of tendinopathy score 1 was 21,
the median PRTEE score of tendinopathy score 2 was 45, and the median PRTEE score of tendinopathy score 3 was 86. Figure 4 shows a box-and-whiskers comparison of PRTEE scores for different tendinopathy scores. The box represents the upper and lower quartiles (interquartile range); the solid black line across the box represents the median. The whiskers show the range of PRTEE scores, and the circles indicate outliers. As Figure 4 shows, the PRTEE scores were gradually increased with the tendinopathy scores. Spearman’s test showed a significantly positive correlation between tendinopathy scores and PRTEE scores (correlation coefficient $r = 0.920, P < 0.01$).

**DISCUSSION**

Lateral epicondylitis or tennis elbow is a pathologic condition of the CET. The accepted cause is tendon injury often secondary to repetitive contractions of the forearm extensor muscles. This lead to disruption of the internal structure of the tendon and degeneration of the cells and matrix, which ultimately leads to macroscopic tear and tendon failure.

Diagnosis of lateral epicondylitis is often made clinically; patients exhibit a continuum of symptoms that range relatively mild, yet persistent, annoyances during daily activities to severe and significantly limiting symptoms in all most facets of life. There have been many outcome measures to stratify patients according to their symptom such as the visual analog scale (VAS), the Disabilities of Arm, Shoulder and Hand (DASH) Questionnaire, and the Upper Extremity Function Scale (UEFS). However, these measures may not accurately assess
the symptoms and functions of an individual joint. They are
lengthy and contain questions irrelevant to a specific problem or
procedure.15 The Patient-rated Tennis Elbow Evaluation
(PRTEE) questionnaire was developed by MacDermid and
colleagues focusing exclusively on patients with lateral epicon-
dylitis.18 In Romper’s study,10 it demonstrated that the PRTEE
was a reliable, reproducible, and sensitive instrument to evalu-
ate lateral epicondylitis, and had a higher standardized response
means (SRM) than the other outcome measures. Thus, in our
study, we chose the PRTEE as the clinical assessment for
patients with lateral epicondylitis.

The appearance of tendinopathy in lateral epicondylitis on
MRI includes an increased signal within or around the CET,
tendon thickening, and a discrete collection of fluid between the
lateral collateral ligament.19,20 The series by Potter et al and
Steinborn et al reported that MR assessment of lateral epicon-
dylitis correlated well with surgical and histologic findings.4,21

Some previous studies have demonstrated that individuals
with diagnosis of lateral epicondylitis are statistically more likely
to have signal changes on MRI than that of controls.22,23 This is
also confirmed by a meta-analysis study showing that ~90% of
patients with lateral epicondylitis had abnormal signal in CET
of affected elbows compared with 14% of controls.24

We have confirmed in this study, in accordance with previous studies,9,22–24 that the majority of patients with
clinical diagnosis of chronic lateral epicondylitis have signal
changes on MR. The studies by Walton et al25 and Martin et al
15 reported that there was a good MRI inter- and intraobserver
reliability in the assessment of tendinopathy; we have also
confirmed that the severity of MRI signal changes can be
reliably interpreted by different radiologists and at multiple
views. So far, the relationship between MRI findings in CET
and the clinical symptom of lateral epicondylitis is still much
less clear. The study by Savnik et al.15 confirmed that there
was no difference in the pain level in patients with and without
MR signal changes. However, in our study, we find that there is
a positive correlation between the degree of MRI signal changes
and the PRTEE. The discrepant results might be due to the
different methods of clinical assessments of lateral epicon-
dylitis. In Savnik’s study, the clinical assessment did not include
any other functional deficits. Another study26 by ultrasound
also demonstrated that the changes of CET positively correlated
with clinical symptoms of patients with lateral epicondylitis.
Therefore, for the patients with mild lateral epicondylitis eval-
uated by PRTEE, the CET often shows mild focal increased
signal intensity on MR T2WI images, which suggests the
presence of mild injury, the treatment initially is conservative
and consists of rest and activity modification, if the clinical
symptoms progress, an MR examination should be recom-
ended; for the patients with moderate lateral epicondylitis
evaluated by PRTEE, CET often portrays moderate focal
increased intensity reflecting the moderate injury of CET
whereas severe lateral epicondylitis evaluated by PRTEE,
CET often depicts generalized focal increased signal intensity
on MR T2WI images, suggesting severe injury of CET.

Previous studies27–29 indicate that these patients may also
accompanied with other abnormalities, such as lateral ligament
injury, bone injury and edema of the wrist extensors muscles.
Conclusively for the better clinical treatment including phy-
siotherapy strengthening exercises, corticosteroid injection, and
surgery, a total and a comprehensive assessment of elbow is
needed which can be well acquired with the help of MRI.

This study has some weaknesses. Few patients for whom
the diagnosis of chronic lateral epicondylitis was confirmed
surgically. Some patients in this study had received some
therapy such as wrist or forearm strap; physiotherapy strength-
ening exercises and corticosteroid injection may influence the
results of MR or clinical assessment. All of the subjects in our
study are patients with chronic lateral epicondylitis, the findings
present might not be applicable for patients with acute symptoms.
We in here utilized only single method for the assessment of
relationship between MR findings and clinical symptoms, it also
merits further study.

In summary, MRI is a reliable tool in determining radi-
ological severity of lateral epicondylitis and can be reliably
reported between observers on different occasions; MRI is also
a valid tool in evaluating the clinical severity of lateral epi-
donidylitis; the severity of MR signal changes of CET positively
 correlated with the patient’s clinical symptoms.

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