Original Research Article

To evaluate and investigate potential relationship between MRI abnormalities of the common extensor tendon (CET) and its clinical symptom in Patients with Chronic Lateral Epicondylitis

Anamika Meena[1], Alka Goyal[2*]

[1]Consultant Radiologist, Department of Radiology, Paras HMRI, Patna, Bihar, India
[2]Assistant Professor, Department of Radiology, SMS Jaipur, Rajasthan, India

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Abstract

Aims: To evaluate of magnetic resonance imaging (MRI) of Patients with Chronic Lateral Epicondylitis and investigate whether there is a potential relationship between MRI abnormalities of the common extensor tendon (CET) and its clinical symptom. **Material and Methods**: A randomized study was conducted in the Department of Radiology in Paras HMRI, Patna, Bihar, India and Department of Radiology SMS Jaipur, Rajasthan. The study group comprised 30 consecutive patients (20 men and 10 women) with a clinical diagnosis of chronic lateral epicondylitis, which were examined on 1.5 T MR. An MRI scoring system was used to grade the degree of tendinopahty. Clinical symptoms were assessed using the Patient Rated Tennis Elbow Evaluation (PRTEE). **Results**: Total 30 elbows had MRI assessed tendinopathy, that includes 13 (43.33%) with grade 1, 10 (33.33%) with grade 2, and 7 (23.3%) with grade 3 .The average intra-observer agreement for grading the severity of tendinopathy was 79.17%. The median PRTEE score of all patients was 76 (range 8– 98), the median PRTEE score of tendinopathy score 1 was 28, the median PRTEE score of tendinopathy score 2 was 54, and the median PRTEE score of tendinopathy score 3 was 98. The PRTEE scores were gradually increased with the tendinopathy scores. A significantly positive correlation between tendinopathy scores and PRTEE scores (correlation coefficient r ¼ 0.945, P < 0.01). **Conclusion**: MRI is a reliable tool in determining radiological severity of chronical lateral epicondylitis. The severity of MRI signals changes positively correlate with the patient's clinical symptom.

Keywords: MRI, Epicondylitis, Tendinopathy.

Introduction

Lateral epicondylitis, commonly known as ''tennis elbow'', is the most common cause of discomfort or disability of elbow[1]. Lateral epicondylitis, caused by repeated contraction of the forearm extensor muscles, progressively results in micro-tearing with subsequent degeneration, immature repair, and tendinosis, particularly at initial part of the common extensor tendon (CET)[2,3].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[4-6].The diagnostic gold standard of lateral epicondylitis is essentially clinical examination. Radiographic film image and ultrasound are also helpful to clinical diagnosis, and MR imaging is not needed initially. However, when some symptoms are resistant to medical management[6], it is necessary to need an MRI scan, which can provide additional information about other abnormalities.

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[7]. Magnetic resonance imaging (MRI) has an excellent

**Correspondence*
Dr. Alka Goyal
Assistant Professor, Department of Radiology, SMS Jaipur, Rajasthan, India
E-mail: goyalalka1988@gmail.com

contrast resolution of soft tissue and have demonstrated acceptable levels of sensitivity, specificity, and accuracy in the diagnosis of lateral epicondylitis[8-10].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.

Material and Methods

A randomized study was conducted in the Department of Department of Radiology in Paras HMRI, Patna, Bihar, India.

Methodology

30 consecutive patients with a clinical diagnosis of chronic lateral epicondylitis were evaluated. There were 20 men and 10 women with a mean age of 47.7 years (range, 19–54 years). The average total duration of symptoms was 1.8 years (range, 6 months to 2 years). None of the patients underwent corticosteroid injection within 4 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 1.5-Tesla MR system 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 3. All MR images were interpreted separately by 3 radiologists, who were blinded to all clinical information and were not aware of the severity of disease. Each reader reviewed the images on 3 separate occasions at least 3 weeks apart. A scoring system was devised to grade the severity of tendinopathy at the lateral epicondyle (Table 4); this system was a modified system devised by Walz et al.[11] All individuals had a standardized clinical assessment with a validate instrument called Patient-Rated Tennis Elbow Evaluation (PRTEE),[12] 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).

Statistical analysis

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 agreements. 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 $P < 0.05$.

Results

A total of 30 elbows (19 right, 11 left) in 30 patients were included in this study, of all the patients, 30 elbows had MRI assessed tendinopathy, that includes 13 (43.33%) with grade 1 (Figure 1), , 10 (33.33%) with grade 2, (Figure 2) , and 7 (23.3%) with grade 3 (Figure 3). The average intra-observer agreement for grading the severity of tendinopathy was 79.17%. Weighted kappa values for intra-observer reliability were 0.787, 0.737, and 0.889 ($P < 0.001$) for radiologists, respectively. An overall weighted kappa value of 0.716 indicates good inter-observer reliability[13]. The median PRTEE score of all patients was 76 (range 8– 98), the median PRTEE score of tendinopathy score 1 was 28,the median PRTEE score of tendinopathy score 2 was 54, and the median PRTEE score of tendinopathy score 3 was 98. 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 ¼ 0.945, $P < 0.01$).

Table 1: Demographic Profile of Patients

Gender	**N=120**	**Percentage**
Male	80	66.67
Female	40	33.33
Age (years)		
Below 20 years	2	1.67
20-30	34	28.33
30-40	52	43.33

40-50	24	20
Above 50	8	6.67

Table 2: MRI assessed tendinopathy

Parameter	N=120	Percentage
Grade 1	50	41.67%
Grade 2	37	30.83%
Grade 3	33	27.5%

Table 3: Parameters of MRI Sequences

Plane	Sequence	TR (ms)	TE (ms)	ETL	Matrix	BW (Hz)	FOV mm	Thickness (mm)	Gap (mm)
Coronal	T1 FSE	800	24	4	310×256	17	160	2.5	0.25
Coronal	T2 FS FRFSE	2000	51	10	310×256	33	160	2.5	0.25
Axial	T1 FSE	800	17	5	310×256	17	180	2.5	0.25
Axial	T2 FS FRFSE	2380	46	12	310×256	33	180	2.5	0.25
Sagittal	T1 FSE	800	26	5	310×256	17	160	2.5	0.25
Sagittal	T2 FS FRFSE	2000	46	14	310×256	33	160	2.5	0.25

BW ¼ bandwidth, ETL ¼ echo train length, FOV ¼ field of view, FRFSE ¼ fast recovery fast spin echo, FS ¼ fat saturated, FSE ¼ fast spin echo, TE ¼ echo time, TR ¼ repetition time.

Table 4: The Classification of the CET

Tendinopathy Score	MR Findings of CET
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
Moderate	Moderate focal increase in the tendon signal not equal to that of fluid
Severe	Marked a generalized focal increase in the tendon signal with or without frank fluid signal intensity

CET ¼ common extensor tendon

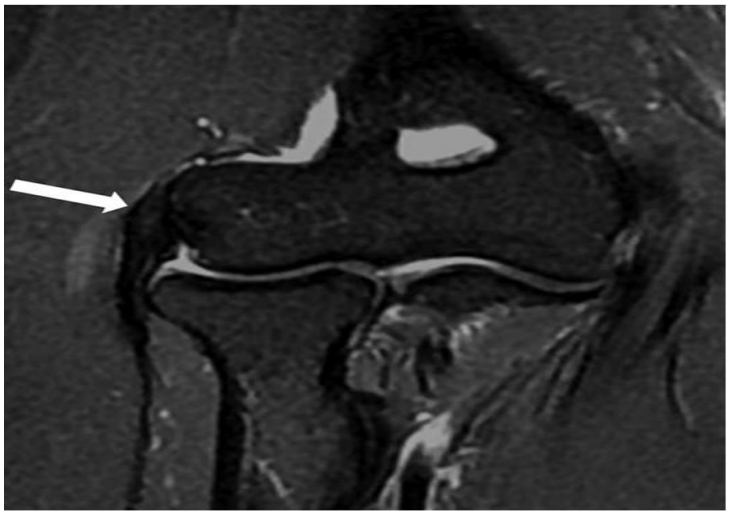

Figure 1: 42-year-old man with right elbow pain 7 months (Tendinopathy score ¼ 1; PRTEE score ¼ 28). Coronal T2-weighted fat-suppressed MR image shows a mild focal increased tendon signal (white arrow). PRTEE¼ Patient-Rated Tennis Elbow Evaluation

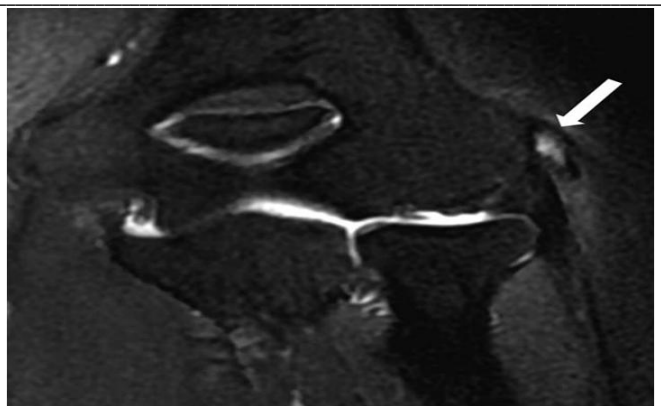

Figure 2: 52-year-old man with left elbow pain 1.6 years (Tendinopathy score¼ 2; PRTEE score¼ 57). Coronal T2-weighted fat-suppressed MR image shows moderate focal increased signal in tendon (white arrow). PRTEE¼ Patient-Rated Tennis Elbow Evaluation

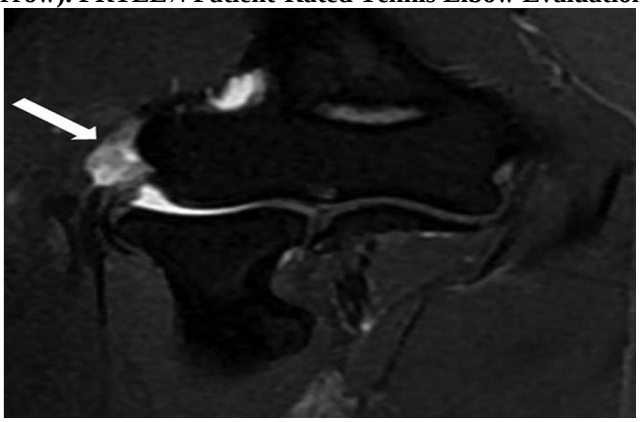

Figure 3: 42-year-old woman with right elbow pain 2 years (Tendinopathy score ¼ 3; PRTEE score ¼ 89). Coronal T2-weighted fat-suppressed MR image shows a generalized increase in the tendon signal (white arrow). PRTEE ¼ Patient-Rated Tennis Elbow Evaluation

Discussion

Lateral epicondylitis or tennis elbow is a pathologic condition of the CET[14]. The accepted cause is tendon injury often secondary to repetitive contractions of the forearm extensor muscles[15]. 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[16]. 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),[17] the Disabilities of Arm, Shoulder and Hand (DASH) Questionnaire,[18] and the Upper Extremity Function Scale (UEFS)[19]. 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[17]. The Patient-rated Tennis Elbow Evaluation (PRTEE) questionnaire was developed by MacDermid and colleagues focusing exclusively on patients with lateral epicondylitis[20]. In Romper's study,[12] it demonstrated that the PRTEE was a reliable, reproducible, and sensitive instrument to evaluate 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[21,22]. The series by Potter et al and Steinborn et al reported that MR assessment of

lateral epicondylits correlated well with surgical and histologic findings[23]. 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[24,25]. 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[26]. We have confirmed in this study, in accordance with previous studies,[21,24-26] that the majority of patients with clinical diagnosis of chronic lateral epicondylitis have signal changes on MR. The studies by Walton et al [27] and Martin et al [21] 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 [25] commented 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 epicondylitis. In Savnik's study, the clinical asssessment did not include any other functional deficits. Another study[28] by ultrasound also demonstrated that the changes of CET positively correlated with clinical symptoms of patients with lateral epicondylits. Therefore, for the patients with mild lateral epicondylitis evaluated 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 recommended; 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 studies[29-31]. indicate that these patients may also accompany with other abnormalities, such as lateral ligament injury, bone injury and edema of the wrist extensors muscles. Conclusively for the better clinical treatment including physiotherapy 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 comfirmed surgically. Some patients in this study had received some therapy such as wrist or forearm strap; physiotherapy strengthening exercises and corticosteroid injection may influence the results of MR or clinical assesment. All of the subjects in our study are patients with chronic lateral epicondylitis, the findings present might not be applicable for patients with acute symtoms. We in here utilized only 1 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 radiological 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 epicondylitis; the severity of MR signal changes of CET positively correlated with the patient's clinical symptoms.

Conclusion

MRI is a reliable tool in determining radiological severity of chronical lateral epicondylitis. The severity of MRI signals changes positively correlate with the patient's clinical symptom.

References

1. Cohen MS, Romeo AA, Hennigan SP, Gordon M. Lateral epicondylitis: anatomic relationships of the extensor tendon origins and implications for arthroscopic treatment. J Shoulder Elbow Surg 2008;17: 954–960.
2. Bunata RE, Brown DS, Capelo R. Anatomic factors related to the cause of tennis elbow. J Bone Joint Surg Am 2007;89: 1955–1963.
3. Bisset L, Coombes B, Vicenzino B (2011) Tennis elbow. Clin Evid (Online) 2011.
4. Nirschl RP, Pettrone FA, Tennis elbow. The surgical treatment of lateral epicondylitis. J Bone Joint Surg Am. 1979;61:832–839.
5. Chen J, Wang A, Xu J, et al. In chronic lateral epicondylitis, apoptosis and autophagic cell death occur in the extensor carpi radialis brevis tendon. J Shoulder Elbow Surg. 2010;19:355–362.
6. Potter HG, Hannafin JA, Morwessel RM, et al. Lateral epicondylitis: correlation of MR imaging, surgical,and histopathologic findings. Radiology. 1995;196:43–46.
7. Plancher KD, Halbrecht J, Lourie GM. Medial and lateral epicondylitis in the athlete. Clin

Sports Med. 1996;15:283–305.
8. O'Driscoll SW, Bell DF, Morrey BF. Posterolateral rotatory instability of the elbow. J Bone Joint Surg Am. 1991;73:440–446.
9. Lattermann C, Romeo AA, Anbari A, et al. Arthroscopic debridement of the extensor carpi radialis brevis for recalcitrant lateral epicondylitis. J Shoulder Elbow Surg. 2010;19:651–656.
10. Kumar S, Stanley D, Burke NG, et al. Tennis elbow. Ann R Coll Surg Engl. 2011;93:432–436.
11. Walz DM, Newman JS, Konin GP, et al. Epicondylitis: pathogenesis, imaging, and treatment. Radiographics. 2010;30:167–184.
12. Rompe JD, Overend TJ, MacDermid JC. Validation of the patientrated tennis elbow evaluation questionnaire. J Hand Ther. 2007;20:3–10.
13. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics. 1977;33:159–174.
14. Connell D, Burke F, Coombes P, et al. Sonographic examination of lateral epicondylitis. AJR Am J Roentgenol. 2001;176 :777–782.
15. Murtagh JE. Tennis elbow. Aust Fam Physician. 1988;17: 90–9194-95.
16. Nirschl RP. Elbow tendinosis/tennis elbow. Clin Sports Med. 1992;11:851–870.
17. Sathyamoorthy P, Kemp GJ, Rawal A, et al. Development and validation of an elbow score. Rheumatology (Oxford). 2004;43:1 434–1440.
18. Beaton DE, Katz JN, Fossel AH, et al. Measuring the whole or the parts? Validity, reliability, and responsiveness of the disabilities of the arm, shoulder and hand outcome measure in different regions of the upper extremity. J Hand Ther. 2001;14:128–146.
19. Croisier JL, Foidart-Dessalle M, Tinant F, et al. An isokinetic eccentric programme for the management of chronic lateral epicondylar tendinopathy. Br J Sports Med. 2007;41:269–275.
20. Macdermid J. Update: the patient-rated forearm evaluation questionnaire is now the patient-rated tennis elbow evaluation. J Hand Ther. 2005;18:407–410.
21. Martin CE, Schweitzer ME. MR imaging of epicondylitis. Skeletal Radiol. 1998;27:133–138.
22. Thornton R, Riley GM, Steinbach LS. Magnetic resonance imaging of sports injuries of the elbow. Top Magn Reson Imaging. 2003;14:69–86.
23. Steinborn M, Heuck A, Jessel C, et al. Magnetic resonance imaging of lateral epicondylitis of the elbow with a 0.2-T dedicated system. Eur Radiol. 1999;9:1376–1380.
24. Van Kollenburg JA, Brouwer KM, Jupiter JB, et al. Magnetic resonance imaging signal abnormalities in enthesopathy of the extensor carpi radialis longus origin. J Hand Surg Am. 2009;34:1094–1098.
25. Savnik A, Jensen B, Norregaard J, et al. Magnetic resonance imaging in the evaluation of treatment response of lateral epicondylitis of the elbow. Eur Radiol. 2004;14:964–969.
26. Pasternack I, Tuovinen EM, Lohman M, et al. MR findings in humeral epicondylitis. A systematic review. Acta Radiol. 2001;42:434–440.
27. Walton MJ, Mackie K, Fallon M, et al. The reliability and validity of magnetic resonance imaging in the assessment of chronic lateral epicondylitis. J Hand Surg Am. 2011;36:475–479.
28. Clarke AW, Ahmad M, Curtis M, et al. Lateral elbow tendinopathy: correlation of ultrasound findings with pain and functional disability. Am J Sports Med. 2010;38:1209–1214.
29. Grafe MW, McAdams TR, Beaulieu CF, et al. Magnetic resonance imaging in diagnosis of chronic posterolateral rotatory instability of the elbow. Am J Orthop (Belle Mead NJ). 2003;32:501–503.
30. Bredella MA, Tirman PF, Fritz RC, et al. MR imaging findings of lateral ulnar collateral ligament abnormalities in patients with lateral epicondylitis. AJR Am J Roentgenol. 1999;173:1379–1382.
31. Coel M, Yamada CY, Ko J. MR imaging of patients with lateral epicondylitis of the elbow (tennis elbow): importance of increased signal of the anconeus muscle. AJR Am J Roentgenol. 1993;161:1019–1021.

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