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Systematic Review

Diagnostic Accuracy of Ultrasonography in Lateral Epicondyle Tendinopathy: A Systematic Review

Muhammad Umer[1*], Rifat Hassan[1], Hozefa Dahodwala[1], Adnaan Haque[1], Ibrahim Younis[1], Imran Lasker[1], Irfan Ahmed[1]

[1]London North West University Healthcare NHS Trust, Imperial College Healthcare NHS Trust, London, United Kingdom.

***Corresponding Author:** Muhammad Umer, London North West University Healthcare NHS Trust, Imperial College Healthcare NHS Trust, London, United Kingdom.

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Abstract

Introduction: Lateral Epicondyle Tendinopathy (LET), or 'Tennis Elbow', is a common musculoskeletal condition affecting athletes and individuals engaging in repetitive movements of the common extensor tendon (CET). Ultrasonography (US) is a popular, cost-effective and non-invasive imaging modality to assess the elbow for LET. Several characteristic US findings have been reported, but there is no established consensus for which are best diagnostic for LET. We systematically reviewed the published literature for the diagnostic accuracy (sensitivity and specificity) of US for LET.

Methods: The PubMed database was searched systematically to identify relevant articles published from inception to 29th June 2026. The inclusion criteria involved studies investigating the diagnostic accuracy of US findings in LET against a reference standard, e.g. clinical examination or magnetic resonance imaging (MRI). Excluded studies were those lacking diagnostic outcome data or those combining imaging modalities in calculating diagnostic accuracy. Sensitivities and specificities were extracted from the studies.

Results: In total, 147 records were identified and 11 studies were included in this review following screening (Figure 1). Tendon thickening of ≥ 4.85 mm demonstrated the highest sensitivity (90.5%), whilst ≥ 4.2 mm was the most specific (95.2%). Neovascularisation assessment via colour Doppler demonstrated superior sensitivities (57–95%) and specificities (88–100%) when compared to power Doppler. When assessing tendon elasticity, shear-wave elastosonography (SWE) and grey-scale US displayed superior sensitivities (90.5–100% and 95% respectively) compared to compression sonoelastography (SEL). However, all three US techniques confirmed elasticity changes are highly specific for LET.

Conclusion: The US findings of tendon thickening, neovascularisation and tendon elasticity changes have high sensitivities and specificities for LET. Other signs, such as cortical irregularities and tendon tears, varied in their diagnostic accuracies. However, these characteristic US findings, alongside a patient history and clinical examination, can prove useful in the overall diagnostic context of LET.

Keywords: *Tennis Elbow; Lateral Epicondylitis; Tendinopathy; Ultrasonography*

Introduction

Lateral Epicondyle Tendinopathy (LET), commonly known as 'Tennis Elbow', is one of the most frequently encountered overuse tendinopathies of the upper limb. It arises from repetitive loading of the common extensor tendon (CET) origin at the lateral epicondyle of the humerus, and is well recognised in racquet-sport athletes as well as individuals whose occupations involve repetitive wrist extension and forearm supination/pronation [1].

Clinical diagnosis of LET is typically made using a combination of history and provocative examination tests, such as resisted wrist extension and palpation over the lateral epicondyle. However, clinical assessment alone can lack specificity for confirming tendon pathology, and imaging is often used as an adjunct to support diagnosis, guide management, and exclude differential pathology. Magnetic resonance imaging (MRI) is highly regarded as a reference standard for soft-tissue assessment of the CET, but its cost and limited accessibility make it impractical as a first-line investigation. Ultrasonography (US) has therefore become a popular alternative as a dynamic, real-time, cost-effective and non-invasive modality that allows direct visualisation of the CET and surrounding structures in the outpatient setting.

A range of characteristic US findings have been described in association with LET, spanning tendon morphology (thickening, tearing, cortical irregularity, hypo-echoic change), vascularity (neovascularisation on power and colour Doppler), calcific change, and tissue stiffness (assessed with shear-wave elastography, compression sonoelastography, and qualitative grey-scale assessment) [2–12]. Despite this substantial body of literature, there is still no established consensus as to which of these US findings offers the best diagnostic accuracy for LET. The reported sensitivities and specificities also vary between studies, reference standards, and patient populations giving an unclear impression for diagnostic criteria [2–12].

Given this variability, and the continued reliance on US as a first-line imaging investigation for suspected LET in clinical practice, this systematic review aimed to collate and evaluate the diagnostic accuracy (sensitivity and specificity) of the characteristic US findings reported for LET.

Materials and Methods

2.1 Search Strategy

This systematic review was conducted in accordance with PRISMA guidelines. The PubMed database was searched systematically to identify relevant articles published from inception to 29th June 2026, using the following search string:

("lateral epicondylitis"[MeSH Terms] OR "lateral epicondylitis"[Title/Abstract] OR "tennis elbow"[Title/Abstract] OR "lateral epicondylalgia"[Title/Abstract] OR "lateral epicondylar tendinopathy"[Title/Abstract] OR "lateral epicondylosis"[Title/Abstract] OR "lateral epicondylopathy"[Title/Abstract] OR "common extensor tendon"[Title/Abstract]) AND ("ultrasonography"[MeSH Terms] OR ultrasound*[Title/Abstract] OR sonograph*[Title/Abstract] OR "ultrasound imaging"[Title/Abstract] OR "diagnostic imaging"[Title/Abstract] OR elastograph*[Title/Abstract] OR "superb microvascular imaging"[Title/Abstract]) AND ("sensitivity and specificity"[MeSH Terms] OR "diagnostic accuracy"[Title/Abstract] OR sensitivity[Title/Abstract] OR specificity[Title/Abstract] OR diagnos*[Title/Abstract])

2.2 Eligibility Criteria

Inclusion criteria: Studies investigating the diagnostic accuracy of US findings in LET against a reference standard, e.g. clinical examination or magnetic resonance imaging (MRI).

Exclusion criteria: Studies lacking diagnostic outcome data, those combining imaging modalities in calculating diagnostic accuracy, non-human (animal or cadaveric) studies, and studies focused on treatment or management outcomes rather than diagnostic accuracy.

2.3 Study Selection and Data Extraction

The PubMed search identified 147 records. Following screening of titles and abstracts against the eligibility criteria, 133 records were excluded. These were majority excluded for being non-human studies, focused on treatment or management outcomes rather than diagnosis, or otherwise outside the scope of the review which left 14 studies for full-text review. Of these, three were excluded because they did not report sensitivity or specificity data for the individual ultrasound findings assessed, leaving 11 studies for inclusion in this review [2–12] (Figure 1). For each included study, data were extracted on the characteristic US finding(s) assessed and the reported sensitivity and specificity for LET.

2.4 Quality Assessment

No formal methodological quality or risk-of-bias assessment (e.g. QUADAS-2) was performed on the included diagnostic accuracy studies. This is acknowledged as a limitation in Section 4.3.

3. Results

3.1 Study Selection

The PubMed search identified 147 records. Following title and abstract screening, 14 studies were assessed at full-text stage; three were excluded for not reporting diagnostic accuracy (sensitivity/specificity) data for the ultrasound findings evaluated. Eleven studies met the eligibility criteria and were included in the final review [2–12] (Figure 1).

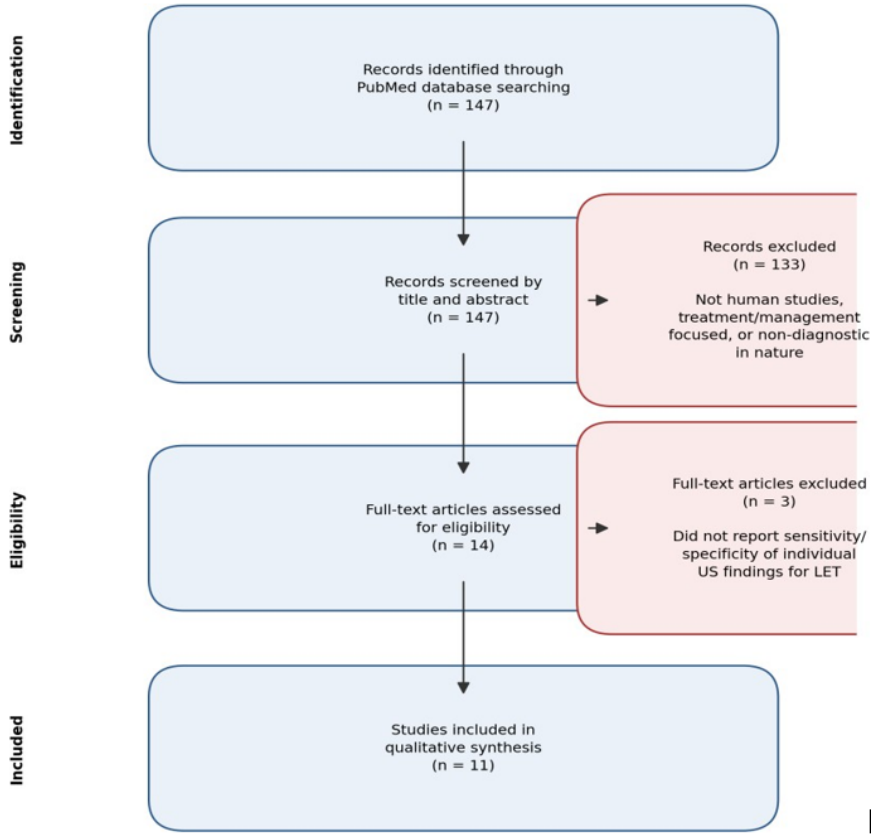

Figure 1. *PRISMA flow diagram of study identification and selection.*

3.2 Tendon Thickening and Structural Changes

CET thickening was the most widely reported US finding. A thickness threshold of ≥ 4.85 mm demonstrated the highest sensitivity of all findings assessed (90.5%), while a threshold of ≥ 4.2 mm was the most specific (95.2%), illustrating a trade-off between sensitivity and specificity at different thickness cut-offs [2,3,5,8]. A ≥10% side-to-side difference in thickness between the symptomatic and asymptomatic elbow showed more modest diagnostic performance (sensitivity 70–72%; specificity 52–67%) [2,3,5,8]. CET tears were highly specific (85.2–100%) but had low-to-moderate sensitivity (14–64.5%) [4,11]. Cortical irregularities (sensitivity 18–63%; specificity 63–100%) [5,8,10,11] and hypo-echoic change (sensitivity 53–92%; specificity 60–100%) [3,8,9,10,11] both showed wide diagnostic ranges. Calcification was infrequently sensitive but consistently specific, whether assessed as an internal (sensitivity 7–33%; specificity 83–100%) or external (sensitivity 45%; specificity 90%) finding [3,11]. Full diagnostic accuracy data for each US finding are presented in Table 1.

Table 1. Diagnostic accuracy of the characteristic ultrasound findings for Lateral Epicondyle Tendinopathy (LET).

Characteristic Ultrasound Finding	Reference(s)	Sensitivity (%)	Specificity (%)
Common Extensor Tendon (CET)			
Thickening	[2,3,5,8]	—	—
≥ 4.2 mm		78.4	95.2
≥ 4.85 mm		90.5	85.7
+10% difference (symptomatic vs			
asymptomatic side)		70–72	52–67
CET Tear	[4,11]	14–64.5	85.2–100
Neovascularisation	[3,7,8,10,11]	—	—
Via Power Doppler		19–81	77–100
Via Colour Doppler		57–95	88–100
Calcification	[3,11]	—	—
Internal		7–33	83–100
External		45	90
Hypoechoic Changes	[3,8,9,10,11]	53–92	60–100
Cortical Irregularities	[5,8,10,11]	18–63	63–100
Elasticity	[2,6,9,12]	—	—
Shear-wave elastography (SWE)		90.5–100	89–93
Compression sonoelastography (SEL)		78	92
Ultrasonography (US, grey-scale)		95	89

3.3 Neovascularisation

Neovascularisation assessed via colour Doppler demonstrated superior diagnostic accuracy (sensitivity 57–95%; specificity 88–100%) compared with power Doppler (sensitivity 19–81%; specificity 77–100%) [3,7,8,10,11], suggesting colour Doppler may be the more reliable Doppler technique for detecting neovascular change associated with LET.

3.4 Tendon Elasticity

Assessment of CET elasticity showed the most consistently strong diagnostic performance of any US technique evaluated. Shear-wave elastography (SWE) achieved a sensitivity of 90.5–100% and specificity of 89–93%; qualitative grey-scale ultrasonography (US) assessment of elasticity achieved a sensitivity of 95% and specificity of 89%; while compression sonoelastography (SEL) achieved a lower sensitivity of 78%, with a specificity of 92% [2,6,9,12]. All three techniques therefore confirmed that elasticity change is a highly specific finding for LET, with SWE and grey-scale US offering the additional benefit of high sensitivity.

4. Discussion

4.1 Summary of Main Findings

This review found considerable variability in the diagnostic performance of individual US findings for LET. Tendon thickening displayed a clear sensitivity–specificity trade-off depending on the threshold applied, with lower thresholds (≥4.2 mm) favouring specificity and higher thresholds (≥4.85 mm) favouring sensitivity [2,3,5,8]. This suggests that the choice of thickness cut-off should be guided by the clinical purpose of the scan. This can include a lower threshold to rule LET in with confidence, or a higher threshold to rule it out. Neovascularisation assessed via colour Doppler outperformed power Doppler across both sensitivity and specificity, which may reflect colour Doppler's greater sensitivity to slow, low-volume flow typical of tendinopathic neovessels [3,7,8,10,11]. Tendon elasticity assessment, whether by SWE or grey-scale US, produced the most balanced and consistently high diagnostic accuracy of the categories assessed, supporting its emerging role as a valuable adjunct to conventional grey-scale imaging [2,6,9,12].

4.2 Clinical Implications

No single US finding achieved uniformly high sensitivity and specificity in isolation, mirroring the pattern seen with other tendinopathies imaged sonographically. This supports a multi-modal US assessment of the CET which involves combining morphological assessment (thickening, tears, cortical irregularity), vascular assessment (colour Doppler), and elastographic assessment if available. This can be consistently accurate for LET diagnosis rather than typical over-reliance on a single characteristic finding. Given that US remains cost-effective, non-invasive, and dynamic compared with MRI, these findings support its continued role as a first-line imaging investigation for suspected LET especially when used alongside a thorough patient history and clinical examination rather than as a standalone diagnostic test.

4.3 Strengths and Limitations

This review's principal strength is its specific focus on the comparative diagnostic accuracy of individual US findings for LET, including a systematic comparison between Doppler techniques and between elastographic modalities, extending the search to June 2026.

Several limitations should be considered. First, the search was restricted to a single database, PubMed; no additional databases (e.g. Embase, CINAHL, Web of Science, or the Cochrane Library) were searched, which may have limited retrieval of eligible studies not indexed in PubMed. Secondly, no formal risk-of-bias or methodological quality assessment (e.g. QUADAS-2) was performed on the included diagnostic accuracy studies. In addition, included studies used heterogeneous reference standards with some validating against MRI whilst others against clinical examination alone, which limits direct comparability between reported sensitivities and specificities. This is because clinical examination itself has recognised diagnostic limitations. Thickness thresholds, Doppler settings, and elastography techniques varied between studies and equipment and US accuracy is recognised to be highly operator-dependent, which may not be fully captured by pooled sensitivity/specificity ranges. Finally, with only 11 included studies, pooled or meta-analytic estimates were not calculated in this review, and reported ranges should be interpreted with this in mind.

5. Conclusion

US findings of tendon thickening, neovascularisation, and tendon elasticity change all demonstrate high sensitivities and specificities for LET, supporting their use as reliable diagnostic indicators when identified. Other signs, including cortical irregularities and tendon tears, showed more variable diagnostic accuracy and are better regarded as supportive rather than standalone findings. In clinical practice, these characteristic US findings should be interpreted alongside a thorough patient history and clinical examination, and further prospective studies with standardised thresholds, Doppler protocols, and reference standards are needed to strengthen consensus on the optimal US assessment of LET.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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