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Original article

The diagnostic test accuracy of ultrasound for the detection of lateral epicondylitis: A systematic review and meta-analysis

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ABSTRACT

Background: The purpose of this study was to determine the diagnostic test accuracy of ultrasound for the detection of lateral epicondylitis.
Methods: An electronic search of databases registering published (MEDLINE, EMBASE, CINAHL, AMED, Cochrane Library, ScienceDirect) and unpublished literature was conducted to January 2013. All diagnostic accuracy studies that compared the accuracy of ultrasound (index test) with a reference standard for lateral epicondylitis were included. The methodological quality of each of the studies was appraised using the QUADAS tool. When appropriate, the pooled sensitivity and specificity analysis was conducted.
Results: Ten studies investigating 711 participants and 1077 elbows were included in this review. Ultrasound had variable sensitivity and specificity (sensitivity: 64%–100%; specificity: 36%–100%). The available literature had modest methodological quality, and was limited in terms of sample sizes and blinding between index and reference test results.
Conclusions: There is evidence to support the use of ultrasound in the detection of lateral epicondylitis. However, its accuracy appears to be highly dependent on numerous variables, such as operator experience, equipment and stage of pathology. Judgement should be used when considering the benefit of ultrasound for use in clinical practice. Further research assessing variables such a transducer frequency independently is specifically warranted.
Level of evidence: Level II.

1. Introduction

Lateral epicondylitis is one of the most commonly diagnosed elbow pathologies and has a population prevalence in 1.3% of the general population [1–6] and 7% in manual workers [7]. The most common features of lateral epicondylitis are pain and hyperalgesia [4,8,9]. While the initial diagnosis of lateral epicondylitis is generally performed through clinical assessment and patient history [10–12], literature has indicated the use of diagnostic imaging to assist with more complex cases [5,13,14]. In addition, ultrasound has gained support as a secondary diagnostic examination, supporting or refuting clinical examination findings to improve the accuracy of lateral epicondylitis diagnosis [10–12].

Ultrasound has been advocated as a diagnostic imaging modality for the detection of soft tissue injuries [15–18]. Literature has suggested that ultrasound has a growing place in modern health care [19,20]. However, no review has examined all the available literature on the diagnostic test accuracy of ultrasound for detecting lateral epicondylitis. Therefore, the purpose of this review was specifically to analyse the literature relating to the diagnostic test accuracy of ultrasound for the detection of suspected lateral epicondylitis.

2. Materials and methods

2.1. Search strategy

A PRISMA compliant systematic review method was adopted [21]. The primary search was conducted for the electronic databases: MEDLINE, EMBASE, CINAHL, AMED, Cochrane Library and Science Direct. These were searched: January 1990 to January 2013, to identify studies that used ultrasound as a diagnostic tool for identifying lateral epicondylitis.

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Box 1: MEDLINE search strategy.

TERMS and BOOLEAN OPERATORS
1. Lateral epicondylitis
2. Lateral epicondyalgia
3. Tennis elbow
4. Lateral elbow tendinosis
5. Lateral elbow tendinopathy
6. Lateral elbow epicondylopathy
7. OR/1–6
8. Ultrasound
9. Sonography
10. US
11. Ultrasonography
12. High intensity focused ultrasound
13. Diagnostic imaging
14. OR/8–13
15. Arthroscopy
16. Arthroscopic surgery
17. OR/15–16
18. Sensitivity
19. Specificity
20. True positive
21. False positive
22. True negative
23. False negative
24. OR/18–23
25. AND/7,14,17,24

A secondary search was conducted for on-going trials and unpublished literature using the databases: Current Controlled Trials; WHO International Clinical Trials Registry Platform; Open Grey (System for Information on Grey Literature in Europe); UK National Research Register Archive; UKCRN Portfolio Database and the National Technical Information Service.

Reference lists for all included papers were reviewed to identify any further studies. Finally, all corresponding authors from the papers obtained were contacted to review the search results and identify any omitted papers.

The search strategy was independently performed by one reviewer (SL) and verified by a second (TS). An example of the MEDLINE search strategy is presenting in Box 1. This strategy was adapted for each individual search engine.

2.2. Eligibility criteria

2.2.1. Inclusion criteria

The inclusion criteria include:

- participants who presented with persistent lateral elbow pain with suspected lateral epicondylitis were included;
- both male and female, athletic and non-athletic individuals;
- participants with recurrent as well as first-time lateral epicondylitis.

2.3. Exclusion criteria

The exclusion criteria include:

- studies were excluded if they were written prior to January 1990 due to heterogeneity in imaging techniques and equipment [22];
- studies whose populations were solely paediatrics (< 16 years of age);
- animal or cadaver studies;
- papers published in non-English languages;
- studies using therapeutic rather than diagnostic ultrasound.

2.4. Study selection

All search results (titles and abstracts) were reviewed by one reviewer (SL) using the eligibility criteria. The full-texts of all potentially eligible papers were ordered and re-reviewed by one reviewer (SL), and verified by a second (TS). Full-text papers satisfying the criteria were included in the final review.

2.5. Data extraction

As with study eligibility, data was independently extracted from all included studies by one reviewer (SL), and verified by a second (TS). Data was extracted using a standard data extraction form. Data extracted included:

- study design;
- location study undertaken;
- sample size;
- gender;
- age range;
- cause of condition;
- severity and duration of symptoms; type of ultrasound machine used;
- frequency of ultrasound used;
- profession of clinician undertaking the ultrasound;
- length of experience;
- reference standard assessment;
- profession of clinician undertaking this assessment;
- assessment details;
- findings including, sensitivity, specificity, true positive, true negative, false positive, false negative values.

2.6. Methodological appraisal

All included studies were assessed for methodological quality using the quality assessment of diagnostic accuracy studies (QUADAS) tool [23]. This is a validated tool for the appraisal of diagnostic accuracy studies [24]. All included papers were appraised and verified by one reviewer (SL) and verified by a second (TS).

2.7. Data analyses

All studies were assessed for heterogeneity by observing the data extraction tables and sensitivity/specificity forest plots. When evidence of heterogeneity was demonstrated in respect to study characteristics, populations or interventions, the studies were assessed using a narrative approach. When there was minimal evidence of observed heterogeneity, pooled estimates of sensitivity and specificity, with 95% confidence interval (CI) were computed. Statistical heterogeneity among studies was assessed by a chi^2 test for heterogeneity and by calculating the I^2 statistic to highlight the effect of true variability [25]. A summary receiver operating characteristic plot (sROC) was calculated for the pooled dataset.

Analyses were conducted using the Review Manager 5.1 for Windows (The Nordic Cochrane Centre, Copenhagen, The Cochrane Collaboration, 2008).

3. Results

3.1. Search results

The PRISMA flow diagram summarising the search results is presented as Fig. 1. A total of 31 papers were identified from the search results. From these, 10 papers satisfied the eligibility criteria and were included in the review.