Ultrasonography for detection of disc displacement of temporomandibular joint: a systematic review and meta-analysis

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CRD summary
This review concluded that the accuracy of ultrasound was acceptable so could be used as a rapid test to rule out some clinically suspected disc displacements of the temporomandibular joint. Limitations in the analysis and apparent between-study heterogeneity mean that conclusions should be interpreted cautiously.

Authors’ objectives
To assess the diagnostic accuracy of ultrasound for the detection of disc displacement of the temporomandibular joint.

Searching
MEDLINE, EMBASE and the Chinese Biomedical Literature Database were searched from inception to April 2011, without language restriction. Search terms were reported. Relevant dental journals (not specified) and the bibliographies of included studies were screened for additional articles. WHO International Clinical Trials Registry was searched for ongoing trials.

Study selection
Studies that assessed the diagnostic accuracy of ultrasound for the detection of disc displacement of the temporomandibular joint, in any participants with clinical signs or symptoms of temporomandibular disorders, were eligible for inclusion. Studies were required to use magnetic resonance imaging (MRI) angiography as the reference standard to confirm diagnosis and to report diagnostic outcome measures (such as sensitivity, specificity, accuracy). Positive diagnoses included abnormal disc location (internal derangement), anterior displacement with or without reduction and lateral or posterior displacement. A normal disc position was defined as the posterior band above the condyle in the closed-mouth position and between the condyle and the articular eminence in the open-mouth position.

The age of study participants ranged from 13 to 78 years and most were female, their presenting symptoms varied (reported in the article). Most included studies used 1.5T MRI as the reference standard. Ultrasound interpretation varied across studies, with approximately half identifying the disc as hypoechoic.

Two reviewers assessed studies for inclusion and any disagreements were resolved by discussion or consultation with a third reviewer.

Assessment of study quality
The methodological quality of the included studies was assessed using a modified version of the QUADAS tool which included six items: representative participant spectrum; acceptable delay between index (ultrasound) test and reference standard; partial verification avoided; differential verification avoided; index test results interpreted blind to the reference standard; reference standard results interpreted blind to the index test. If all items were rated as low risk, the study was rated as low risk of bias overall.

Two reviewers assessed study quality and any disagreements were resolved by discussion or consultation with a third reviewer.

Data extraction
Data were extracted on the study design (cohort or case-control) and the numbers of true positive, false negative, false positive and true negative test results for each study. Sensitivity and specificity estimates, with 95% confidence intervals (CIs), were calculated.

Two reviewers extracted data and any disagreements were resolved by discussion or consultation with a third reviewer.

Methods of synthesis
Pooled estimates of sensitivity and specificity, positive and negative likelihood ratio (LR), and diagnostic odds ratio (DOR), with 95% confidence intervals, were calculated using a random-effects model, or a fixed-effect model where $I^2$ was less than 50%. A summary receiver operating characteristic (SROC) curve was constructed, using the Moses and Littenberg model, and the area under the curve (AUC) and $Q^*$ (point where sensitivity and specificity are equal) were calculated.

Between-study heterogeneity was assessed using the $X^2$ test and the $I^2$ statistic, and investigated using meta-regression.

**Results of the review**

Fifteen studies (14 cohort studies and one case-control; 924 participants) were included in the review. Six studies were rated as having a low risk of bias. Two studies did not include a representative spectrum of participants and one did not avoid partial verification bias. Three remaining studies were rated as high risk of bias because one or more QUADAS criteria were rated as unclear.

Pooled estimate of ultrasound sensitivity for the detection of internal derangement, in the closed-mouth position was 81% (95% CI 77 to 84%; $I^2$ 86.1%) and specificity was 78% (95% CI 74 to 82%; $I^2$ 83.4%) based on eight studies. Pooled sensitivity estimate for the detection of internal derangement, in the open-mouth position was 69% (95% CI 64 to 74%) and specificity was 89% (95% CI 86 to 91%); the number of studies and results of heterogeneity assessment were not reported.

Pooled estimate of ultrasound sensitivity for the detection of anterior displacement without reduction was 79% (95% CI 71 to 85%) and specificity was 91% (95% CI 87 to 95%). Pooled estimate of sensitivity for the detection of anterior displacement with reduction was 76% (95% CI 65 to 85%) and specificity was 82% (95% CI 76 to 87%). The numbers of studies and results of heterogeneity assessments were not reported.

Meta-regression indicated that results were not affected by type of ultrasound, image dimensions, type of transducer or ultrasonic image of the disc.

Likelihood ratios, diagnostic odds ratios, area under the SROC curve and $Q^*$ values were reported in the article.

No studies reported data on lateral or posterior displacement.

**Authors' conclusions**

The diagnostic accuracy of ultrasound was acceptable and it could be used as a rapid test to rule out some clinically suspected diagnoses. The ability of ultrasound to detect lateral and posterior displacement remained unclear.

**CRD commentary**

This review assessed the diagnostic accuracy of ultrasound for the detection of disc displacement of the temporomandibular joint. Appropriate inclusion criteria were defined and the authors searched a range of sources without language restriction, which decreased the likelihood of missing relevant studies. Measures to minimise error and bias were applied throughout the review process and the methodological quality of included studies was assessed using an appropriate tool; approximately half of the included studies were rated as low risk of bias.

The meta-analytic methods used were not those currently recommended and may not have been appropriate given the apparent between-study heterogeneity in the main analysis (heterogeneity assessments were not reported for the other analyses. Limitations in the analysis and apparent between-study heterogeneity mean that conclusions should be interpreted cautiously.

**Implications of the review for practice and research**

**Practice:** The authors stated that ultrasound could be used as a rapid test to rule out some clinically suspected temporomandibular disorders. They further stated that positive ultrasound findings should be confirmed by magnetic resonance imaging.

**Research:** The authors stated that more high quality studies were needed to assess some ultrasonographic methods and standard diagnostic criteria should be established.
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