Comparison of the efficacy of sonography, magnetic resonance imaging and conventional radiography for the detection of bone erosions in rheumatoid arthritis patients: a systematic review and meta-analysis


CRD summary
This review concluded that ultrasonography was more effective for erosion detection than X-ray and had a comparable efficacy to magnetic resonance imaging with good reproducibility. Inappropriate analysis and other limitations of the review and limitations of the available evidence mean that the conclusions and implications for practice should not be used to inform clinical decision making.

Authors' objectives
To compare ultrasonography against magnetic resonance imaging (MRI) and conventional radiography (X-ray) in terms of their ability to detect bone erosion in patients with rheumatoid arthritis and evaluate the reproducibility of ultrasonography.

Searching
PubMed, EMBASE and Cochrane Central Register of Controlled Trials (CENTRAL) were searched to August 2009 for studies published in English or French; search terms were reported. Reference lists from relevant studies and reviews were searched. Conference abstracts from two appropriate associations from 2007 to 2009 were searched.

Study selection
Eligible studies were controlled trials that compared ultrasonography against MRI and/or X-ray in terms the number of bone erosions detected in adults with rheumatoid arthritis. Trials that assessed the reproducibility of ultrasonography were included.

Across the included studies, mean age of participants ranged from 38 to 65 years, 53% to 100% of the participants were women and mean duration of rheumatoid arthritis ranged from 0.3 to 15 years. Where reported, between 42.9% and 82% of patients were rheumatoid factor-positive. There was substantial variation across studies in terms of joints assessed, frequency of the ultrasonography array, ultrasonography definition of erosion and (where reported) technical specification of MRI and the projection of X-ray.

The authors did not state how many reviewers selected studies for the review.

Assessment of study quality
One reviewer assessed study quality using the 14-point QUADAS tool.

Data extraction
One reviewer extracted data for the number of patients and joints with at least one erosion for each of the tests of interest and the intra- and inter-observer reproducibility of ultrasonography. Odds ratios (OR) with 95% confidence intervals (CI) were calculated for erosion rates. Reproducibility was considered excellent if the k-coefficient or intra-class coefficient were 0.8 or more and good if the k-coefficient was more than 0.6 and intra-class coefficient was more than 0.8; definitions were not given for the authors' classification of moderate or for inter-observer reproducibility.

Methods of synthesis
Pooled odds ratios with 95% CI were calculated using a Mantel-Haenszel random-effects model (significant statistical heterogeneity observed) or a fixed-effect model (heterogeneity not observed). Heterogeneity was assessed using Cochran's Q and I² (I²>50% was considered significant heterogeneity). The number needed to screen (NNS) with 95% CI was calculated when a statistically significant difference between tests was detected.

Sensitivity/subgroup analyses were used to evaluate the impact of each study, date of publication, study quality, participant age, disease duration, X-ray projection parameters and including medial joints. Publication bias was
investigated using the Begg and Egger's test.

**Results of the review**

Twenty-one studies met the inclusion criteria (913 patients, range one to 125). All of the studies met at least 10 of the 14 QUADAS criteria. Intra-reliability was considered good in three studies (230 patients). Inter-reliability (seven studies, 369 patients) was considered excellent in four studies, good in two studies and moderate in one study.

There was no statistically difference in detection rates between ultrasonography and MRI whether a per patient (OR 1.76, 95% CI 0.73 to 4.38; nine studies, 338 patients) or per joint (OR 1.19, 95% CI 0.76 to 1.88; seven studies, 869 joints) analysis was used. Compared with X-ray (14 studies), ultrasonography detected significantly more erosions at the patient level (OR 0.31, 95% CI 0.19 to 0.51; 592 patients) and joint level (OR 0.30, 95% CI 0.18 to 0.48; 4,047 joints). \( I^2 \) was between 55% and 75% for these analyses. Publication bias was not detected.

Results from sensitivity/subgroup analyses were reported.

**Authors’ conclusions**

Ultrasonography was more effective for erosion detection than X-ray and had comparable efficacy to MRI and good reproducibility.

**CRD commentary**

The review addressed a clear question supported by reproducible inclusion criteria. Several relevant sources were searched, including sources for unpublished studies. The search was restricted by language. The search and eligibility were restricted to controlled trials but one of the included studies was a case report so it seemed that inclusion criteria were not applied consistently. It seemed that methods to reduce error and bias during the review process were not employed.

Despite the restriction to controlled trials, the authors used a quality assessment tool designed for diagnostic accuracy studies with no apparent adaptation of the tool. Only summary scores were presented for the quality assessment so it was unclear which study was subject to which bias and therefore the potential importance of that bias. It appeared that the studies in the meta-analyses were single-gate (diagnostic cohort) studies, which made the use of QUADAS appropriate. However, these studies were used subsequently as if they were RCTs, which was not appropriate. The pooled odds ratios for detection rates did not take into account whether the two tests detected erosion in the same or different patients and whether that detection was accurate, as the number of false positive and false negative results was unknown. The authors stated that only two of the included studies used the gold standard of computed tomography to confirm the diagnosis of erosion; the sensitivity for one of these studies was reported but it was unclear whether a reference standard was used in the other studies and if so, what this was. There was considerable clinical variation between the studies.

The authors’ conclusion that the detection rate for ultrasonography was better than X-ray and comparable to MRI was correct but clinically uninformative without some indication of accuracy. Given the inappropriateness of the analysis conducted and other limitations of the review and the limitations of the available evidence, the conclusions and implications for practice should not be used to inform clinical decision making.

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

**Practice:** The authors stated that ultrasonography should be integrated into routine rheumatoid arthritis management, especially at disease onset. They also stated that because of the cost advantages over MRI, ultrasonography may be of particular interest for diagnosis and monitoring of structural changes in rheumatoid arthritis.

**Research:** The authors stated that further studies were needed to clarify whether ultrasonography erosions were comparable with X-ray erosions in detecting poor outcomes in patients with rheumatoid arthritis. They also stated that the specificity of ultrasonography for erosion detection and clinical significance of ultrasonography erosion should be studied in prospective trials to determine whether ultrasonography was a surrogate tool for early diagnosis of rheumatoid arthritis.

**Funding**
Abbott France.

**Bibliographic details**

**PubMedID**
21278073

**DOI**
10.1093/rheumatology/keq437

**Original Paper URL**
http://rheumatology.oxfordjournals.org/content/50/6/1137.abstract

**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Arthritis, Rheumatoid /diagnosis /radiography /ultrasonography; Bone Diseases /diagnosis /radiography /ultrasonography; Bone and Bones /pathology /radiography /ultrasonography; Diagnostic Imaging /methods; Disease Progression; Female; France; Humans; Magnetic Resonance Imaging /methods; Male; Radiography /methods; Sensitivity and Specificity; Severity of Illness Index; Ultrasonography, Doppler /methods

**AccessionNumber**
12012000173

**Date bibliographic record published**
13/02/2012

**Date abstract record published**
31/05/2013

**Record Status**
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.