The diagnostic accuracy of MRI for the detection of partial- and full-thickness rotator cuff tears in adults

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CRD summary
This review concluded that magnetic resonance imaging (MRI) had excellent accuracy for the detection of full-thickness rotator cuff tears, but was less accurate for partial-thickness tears. The authors also concluded that higher field strength (3.0T) MRI systems were more accurate. These conclusions appear to be an over interpretation of the data presented.

Authors' objectives
To assess the diagnostic test accuracy of magnetic resonance imaging (MRI) in the detection of partial- and full-thickness rotator cuff tears in adults.

Searching
Several sources were searched from inception to May 2011 including Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, EMBASE and Zetoc. Grey literature was searched using the following databases: OpenSIGLE, International Clinical Trials Registry Platform, Current Controlled Trials, UKCRN Portfolio Database, National Technical Information Service and the UK National Research Register Archive. An example search strategy was reported. Experts in the field were contacted and the bibliographies of retrieved articles were screened for additional studies.

Study selection
Studies of any design that assessed the accuracy of MRI for diagnosing rotator cuff (supraspinatus, infraspinatus, teres minor, subscapularis) tear pathology in adults were eligible for inclusion. Studies were required to use arthroscopic or open surgical findings as the reference standard to confirm diagnosis.

Studies that solely assessed the diagnostic test accuracy of magnetic resonance arthrography were excluded.

The mean age of study participants was 47.8 years. Approximately half of the included studies used MRI field strength of 1.5T; field strengths ranged from 0.5 to 3.0T. Approximately half of the included studies reported that MRI examinations were reviewed by one or more specialist musculoskeletal radiologists. The time elapsing between MRI examination and reference standard confirmation ranged from less than two weeks to 3.8 months.

One reviewer screened retrieved titles and abstracts for relevance. The full texts of potentially eligible studies were assessed for inclusion by one reviewer and independently checked by two other reviewers.

Assessment of study quality
The methodological quality of included studies was assessed using the 14-item QUADAS tool.

Two reviewers independently assessed study quality and assessments were checked by a third reviewer. Disagreements were resolved by discussion.

Data extraction
Numbers of true positive, false negative, false positive and true negative MRI results were extracted. These data were used to calculate separate sensitivity and specificity values, with 95% confidence intervals (CIs) for the detection of partial- and full-thickness rotator cuff tears.

Data were extracted by one reviewer and checked by a second reviewer.

Study authors were contacted for additional information where necessary.

Methods of synthesis
Summary estimates of sensitivity and specificity, positive and negative likelihood ratio and diagnostic odds ratio, with 95% confidence intervals, were calculated using a random-effects model. Summary receiver operating characteristic (SROC) curves were generated using the Moses and Littenberg model.

Separate analyses were undertaken for partial- and full-thickness rotator cuff tears.

Between study heterogeneity was assessed using $\chi^2$ and $I^2$. Subgroup analyses were undertaken to compare MRI using different field strengths (equal to or less than 1.0T, 1.5T and 3.0T) and to compare interpretation by specialist musculoskeletal radiologists or general radiologists.

**Results of the review**

Forty-four studies, which assessed 2,751 shoulders in 2,710 patients, were included in the review. All included studies recruited an appropriate spectrum of patients and over 85% were rated as avoiding verification biases. However, approximately 40% of studies did not clearly report that MRI results were interpreted blind to the reference standard diagnosis, and only two studies stated that reference standard assessments were made without knowledge of the MRI results.

The pooled estimate of MRI sensitivity for detection of partial-thickness rotator cuff tears was 80% (95% CI 79 to 84) and specificity was 95% (95% CI 94 to 97). The pooled estimate of positive likelihood ratio was 6.4 (95% CI 2.6 to 15.5) and negative 0.3 (95% CI 0.1 to 0.6). Twenty-six studies were included in these analyses and $I^2$ was reported as 93% (not reported separately for each outcome measure).

The pooled estimate of MRI sensitivity for detection of full-thickness rotator cuff tears was 91% (95% CI 86 to 94%) and specificity was 97% (95% CI 96 to 98%). The pooled estimate of positive likelihood ratio was 13.6 (95% CI 4.7 to 39.1) and negative was 0.1 (95% CI 0.1 to 0.2). Twenty-four studies were included in these analyses and $I^2$ was reported as 95% (not reported separately for each outcome measure).

The authors reported that subgroup analyses showed that, whilst there was little difference in the accuracy of MRI whether interpreted by musculoskeletal radiologists or general radiologists, systems with greater field strength (3.0T) were more accurate than lower field strength systems.

**Authors’ conclusions**

The diagnostic test accuracy of MRI for the detection of full-thickness rotator cuff tears was excellent, but was more limited for partial-thickness tears.

**CRD commentary**

This review reported clear and appropriate inclusion criteria and searched a range of sources for relevant studies. Searches did not appear to be restricted by language and included attempts to identify unpublished studies. Measures to minimise error and bias were applied throughout the review process, and the methodological quality of included studies was assessed and reported. The authors stated that studies with apparent methodological or study characteristic heterogeneity were excluded from meta-analyses, but it was unclear which, if any, studies were excluded from which analyses on this basis. Reporting of the results of heterogeneity assessment was generally poor and, given the apparent statistical heterogeneity, the use of a simple random-effects model to generate pooled estimates was of questionable validity.

The numerical results of subgroup analyses reported showed no clear differences in sensitivity and specificity between different MRI field strengths or between interpretation by specialist musculoskeletal radiologists or general radiologists, with the exception that the specificity of 1.5T MRI appeared lower than that of 1.0T and smaller or 3.0T systems for partial-thickness rotator cuff tears. However, the authors stated that there were a number of other differences. Similarly, the authors’ conclusion that the accuracy of MRI for the detection of partial-thickness tears was more limited than for full-thickness rotator cuff tears appeared an over simplification; the only clear difference between the two applications was a lower sensitivity for partial-thickness tears, which indicated that MRI may be less useful for ruling out partial-thickness tears. In summary, the authors’ conclusions appear to be an over interpretation of the data presented.

**Implications of the review for practice and research**
Practice: The authors did not specify any recommendations for clinical practice.

Research: The authors stated that further prospective trials were required to determine the optimal sequence and imaging protocol for detection of rotator cuff tears. The findings of imaging accuracy and clinical outcome could then be combined to determine a new diagnostic algorithm for image reading.

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