Accuracy of diagnostic imaging techniques in the diagnosis of aseptic loosening of the femoral component of a hip prosthesis: a meta-analysis


CRD summary
This review concluded that plain radiography, subtraction arthrography, bone scintigraphy and nuclear arthrography had similar diagnostic performance for detecting aseptic loosening of hip prostheses. However, plain radiograph and bone scintigraphy were preferred because of greater efficacy and lower morbidity. Given the review limitations and the lack of good-quality evidence supporting the stated preferred techniques, these conclusions may not be reliable.

Authors' objectives
To assess the diagnostic accuracy of plain radiography, subtraction arthrography, nuclear arthrography and bone scintigraphy for the evaluation of aseptic loosening of the femoral component of hip prostheses.

Searching
EMBASE and PubMed were searched from 1975 to June 2004 for publications in the English language. The bibliographies of eligible studies, textbooks and reviews were also searched. Conference proceedings, unpublished studies and abstracts were excluded.

Study selection
Study designs of evaluations included in the review
Studies with a minimum of 10 participants were eligible for inclusion. No further details of the study design were provided.

Specific interventions included in the review
Studies that evaluated the diagnostic performance of plain radiography, subtraction arthrography, nuclear arthrography or bone scintigraphy were eligible for inclusion. All four diagnostic tests were evaluated in the included studies.

Reference standard test against which the new test was compared
The ‘gold’ standard was reoperation or a minimum of 1-year follow up. Details of the reference standard used in each study were not reported; the authors stated that most studies used surgery.

Participants included in the review
Inclusion criteria relating to the participants were not specified. However, it was clear that patients with hip prostheses were to be included. Details of the participants in the included studies were not provided.

Outcomes assessed in the review
Studies were only included if they provided sufficient data on the detection of aseptic loosening of the femoral component of a hip prosthesis for 2x2 contingency tables to be calculated.

How were decisions on the relevance of primary studies made?
Two reviewers independently screened studies for relevance; any disagreements were resolved by consensus.

Assessment of study quality
Two authors independently assessed study quality in relation to the use of a valid reference standard performed independently of the index test, verification bias, patient characteristics and selection details, and the characteristics of the index test.
Data extraction
Two reviewers independently extracted data for the review. In addition, 2x2 contingency tables were constructed and the sensitivity, specificity, and diagnostic odds ratio (DOR) were calculated.

Methods of synthesis
How were the studies combined?
The overall mean sensitivity and specificity, with 95% confidence intervals (CIs), were calculated using a random-effects model for each diagnostic technique. Summary receiver operating characteristic (ROC) curves were provided.

How were differences between studies investigated?
Heterogeneity was assessed using the method described by Midgette, Stukel and Littenberg, the chi-squared test, Fisher's exact test or the Fleisch method. Spearman's rank correlation was used to measure the correlation between sensitivity and specificity when heterogeneity was observed. Outliers were identified using a Galbraith plot. Subgroup analyses to investigate the impact of imaging protocols, publication data and characteristics of the implant were planned. Univariate meta-regression was used to evaluate the impact of the prosthesis used, contrast media, and internal and external criteria for diagnostic accuracy.

Results of the review
Thirty-two studies met the inclusion criteria (n not reported).

Only 4 studies were prospective; only one of these interpreted the index test and reference standard independently. In 14 studies not all patients underwent a valid reference standard. Only 7 studies included a consecutive patient population. There was no correlation between study quality and the diagnostic accuracy of any of the diagnostic tests evaluated. In all studies the results of the index test were used to select patients to undergo the reference test.

Plain radiography (17 studies): the overall mean sensitivity and specificity were 82% (95% CI: 76, 87) and 81% (95% CI: 73, 87), respectively.

Subtraction arthrography (9 studies): the overall mean sensitivity and specificity were 86% (95% CI: 74, 93) and 85% (95% CI: 77, 91), respectively.

Nuclear arthrography (10 studies): the overall mean sensitivity and specificity were 85% (95% CI: 75, 91) and 83% (95% CI: 75, 89), respectively.

Bone scintigraphy (15 studies): the overall mean sensitivity and specificity were 85% (95% CI: 79, 89) and 72% (95% CI: 64, 79), respectively.

Significant statistical heterogeneity was found for the meta-analyses of plain radiography, subtraction arthrography and nuclear arthrography.

The results of the subgroup analyses and sensitivity analyses were reported.

Authors' conclusions
The diagnostic performance of the imaging techniques was not significantly different; plain radiograph and bone scintigraphy had greater efficacy and lower risk of patient morbidity.

CRD commentary
The review question was clear in terms of the intervention, reference standard and outcomes. A limited search was undertaken which, considering the poor indexing of diagnostic studies, might have led to studies being missed. There is also the potential for language bias since only English language studies were included. Each stage of the review was conducted in duplicate, thereby reducing the potential for error and bias.
There were insufficient study details provided to adequately assess the generalisability of the results and differences between the studies. Appropriate outcome measures were calculated. Heterogeneity was evaluated extensively. The main conclusion and implications for practice seem to have been based on the authors' clinical opinion; data supporting the increased efficacy and lower morbidity of plain radiograph and bone scintigraphy were not presented. Given the limitations stated, and the paucity of good-quality evidence, the results should be treated with caution.

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

Practice: The authors stated that since there was no significant difference in diagnostic accuracy, plain radiography would be the first choice due to its low morbidity and cost; the authors did not evaluate these outcomes in the review. They went on to state that bone scintigraphy may be chosen as an additional technique as it is noninvasive in comparison with arthrographic techniques.

Research: The authors stated that methodological quality needs to be improved in future studies.

**Bibliographic details**

**Indexing Status**
Subject indexing assigned by NLM

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**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.