The value of contrast and subtraction arthrography in the assessment of aseptic loosening of total hip prostheses: a meta-analysis

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CRD summary
This review concluded that subtraction arthrography is a sensitive technique for the detection of loosening of total hip prostheses, and that it offers added value compared with contrast arthrography, especially for the femoral component. These conclusions are supported by the data presented, but should be interpreted with caution given the possible limitations of the analysis and the likelihood that relevant studies have been missed.

Authors' objectives
To compare the accuracy of contrast and subtraction arthrography in the assessment of aseptic loosening of total hip arthroplasties.

Searching
PubMed and EMBASE were searched from 1975 to October 2004; the search terms were not reported. Only studies published in full in English were eligible for inclusion.

Study selection
Studies that assessed contrast-enhanced arthrography, with or without subtraction, in at least 10 patients with suspected aseptic loosening of total hip prosthesis in which the reference standard was surgery or at least 1 year's clinical follow-up, and that reported sufficient data to construct a 2×2 table of test performance, were eligible for inclusion. Studies had to report sufficient detail to be categorised as subtraction or contrast arthrography.

Most of the studies applied sufficient contrast material to cause pain or until an increase in resistance was felt; some studies mobilised patients before the arthrographic procedure. The mean prevalence of acetabular component loosening in the included studies was 68%; the mean prevalence of femoral component loosening in the included studies was 74%.

Two reviewers independently assessed studies for inclusion, with any disagreements resolved through discussion.

Assessment of study quality
Study quality was assessed according to the following criteria: application of standardised and valid reference standard performed independently of the index test; presence of verification bias; study design and research planning; source of patient population; patient characteristics; description of eligibility criteria; key characteristics of the index test.

Two reviewers independently assessed the quality of the studies, with any disagreements resolved through discussion.

Data extraction
The authors did not state how the data were extracted for the review, or how many reviewers performed the data extraction.

Methods of synthesis
Sensitivity and specificity were pooled separately for contrast and subtraction arthrography. Heterogeneity was assessed using the $\chi^2$ statistic. Spearman's rank correlation coefficient was used to measure the correlation between sensitivity and specificity. Correlation coefficients greater than -0.4 were considered to be evidence of an absence of correlation. In such situations a meta-regression analysis was conducted to evaluate the influence of prosthesis characteristics and methodological quality on diagnostic accuracy. A correlation coefficient less than -0.4 was considered to suggest that variation between the studies may be the result of differences in threshold. In such situations summary receiver operating characteristic (ROC) curves were fitted using the Moses-Littenberg model. A Galbraith plot based on the log
of the diagnostic odds ratio was constructed to detect outlying studies. Random-effects models were used to pool the studies.

**Results of the review**

Thirty studies were included (number of participants unclear). It appears that six of these studies were later excluded as they did not specify the type of arthrography conducted.

None of the studies met all the quality criteria. Only 2 studies used a prospective design; 8 studies enrolled consecutive patients. All included studies used a valid reference standard but in 10 studies not all patients received this reference standard. None of the included studies measured the reference standard independently of the index test.

Summary ROC plots suggested considerable heterogeneity across the studies in both sensitivity and specificity. There was no association between methodological quality and diagnostic performance.

**Acetabular components.**

Sensitivity was significantly higher ($p=0.0078$) for subtraction arthrography (10 studies) than for contrast arthrography (8 studies). The pooled sensitivity was $70\%$ (95% confidence interval, CI: 52, 84) for contrast arthrography and $89\%$ (95% CI: 84, 93) for subtraction arthrography. There was no difference in specificity between the techniques ($p=0.84$): the pooled specificity was $74\%$ (95% CI: 53, 87) for contrast arthrography and $76\%$ (95% CI: 68, 82) for subtraction arthrography. Sensitivity and specificity did not differ according to whether manual (7 studies) or digital subtraction (4 studies) was used ($p=0.65$).

**Femoral components.**

Sensitivity was significantly higher ($p=0.003$) for subtraction arthrography (9 studies) than for contrast arthrography (13 studies). The pooled sensitivity was $63\%$ (95% CI: 53, 72) for contrast arthrography and $86\%$ (95% CI: 74, 93) for subtraction arthrography. There was no difference in specificity between the techniques ($p=0.23$): the pooled specificity was $78\%$ (95% CI: 68, 86) for contrast arthrography and $85\%$ (95% CI: 77, 91) for subtraction arthrography. Since the studies only assessed digital subtraction a comparison with manual subtraction was not possible.

**Authors' conclusions**

Subtraction arthrography is a sensitive technique for the detection of loosening of total hip prostheses. It offers added value compared with contrast arthrography, especially for the femoral component.

**CRD commentary**

The review addressed a focused objective that was supported by clearly defined inclusion criteria. The search was limited to two databases and was restricted to studies published in English, with no further attempts to locate studies. It is therefore likely that relevant studies have been missed and the review may be subject to language and publication bias. Details of the search strategy used were not reported. The quality of the studies was assessed using appropriate criteria, but the results of this assessment were not reported in detail. Appropriate steps were taken to minimise bias and error in the study selection and quality assessment processes, but it is unclear whether such steps were also taken for the extraction of data. Details of the included studies were not reported, so it is not possible to comment on the generalisability of the findings. The description of the methods used to synthesise the studies was confusing, and it is unclear exactly what methods were used to pool the sensitivity and specificity or to carry out the regression analysis. The authors' conclusions are supported by the results but should be interpreted with caution given the likelihood that relevant studies have been missed and the possible limitations of the analysis.

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

The authors did not state any implications for practice or further research.

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