A systematic review of the effectiveness and cost-effectiveness of metal-on-metal hip resurfacing arthroplasty for treatment of hip disease
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Authors' objectives
To assess the effectiveness and cost-effectiveness of metal-on-metal hip resurfacing arthroplasty (MOM) in comparison with watchful waiting, total hip replacement (THR), osteotomy, arthrodesis, and arthroscopy of the hip joint.

Searching
The Cochrane Database of Systematic Reviews, DARE, the Cochrane Controlled Trials Register, MEDLINE, PREMEDLINE, EMBASE, HealthSTAR, CINAHL, NHS EED, AMED, websites and relevant audit databases were searched for studies evaluating MOM (published from 1990 to 2001), and observational studies of osteotomy, arthrodesis and arthroscopy (published from 1998 to 2001). A search was also carried out for RCTs and systematic reviews of RCTs for THR (published from 1999 to 2001). The search terms were reported in full.

Study selection
Study designs of evaluations included in the review
The predefined inclusion criteria for MOM were: randomised controlled trials (RCTs) and comparative observational studies of MOM versus any comparator, with no restriction on follow-up; single-prosthesis observational studies with a minimum follow-up of 2 years.

The predefined inclusion criteria for THR were RCTs with a minimum follow-up of 5 years, and systematic reviews of such trials.

The predefined inclusion criteria for watchful waiting, osteotomy, arthrodesis and arthroscopy were observational studies with a minimum follow-up of 5 years (10 years for osteotomy).

Specific interventions included in the review
The interventions were MOM, THR, osteotomy (12 variants), arthrodesis, arthroscopy of the hip joint and watchful waiting.

Participants included in the review
For MOM, there were 327 hips from 310 patients (mean age: 36 to 48.7 years) (data from published studies), plus 4,455 patients (mean age: 49.2 years) (data from outcome database);

for watchful waiting, 84 patients (mean age: 50 years);

for THR, 91 patients (mean age less than 66 years) (data from RCT);

for osteotomy, 684 hips (patients' mean age: 18.8 to 55 years);

for arthrodesis, 9 hips (patients' mean age: 13.4 years); and

for arthroscopy, 523 patients (age not stated).

Outcomes assessed in the review
The predefined outcomes were classed as short term and long term. There were 5 short-term outcomes (including serious complications and time to return to normal activities) and 6 long-term outcomes (including revision rates, functional results, number of pain-free patients and quality of life).

How were decisions on the relevance of primary studies made?
Two reviewers screened all abstracts identified from the literature search. Retrieved papers were assessed using predefined inclusion criteria, although the authors did not state how this was done.

**Assessment of study quality**
A methodological quality tool was developed from a published checklist for evaluating orthopaedic studies. Groups of studies (RCTs, comparative observational studies, single-prosthesis observational studies) were evaluated for clarity of question and outcome, description of intervention, description of population, control of bias in design, duration of follow-up, and statistics and analysis. A published quality tool was applied to systematic reviews. Two reviewers independently assessed the papers for validity. Any unresolved disagreements were referred to an arbiter.

**Data extraction**
Two reviewers independently extracted the data into a form developed for the review. Any unresolved disagreements were referred to an arbiter.

**Methods of synthesis**
How were the studies combined?
A narrative synthesis of the studies was undertaken.

How were differences between studies investigated?
Differences between the studies were described.

**Results of the review**
A total of 28 studies were accepted. The 23 published studies comprised one RCT (THR), 19 single-intervention observational studies (four MOM, one THR, 12 osteotomy, one arthrodesis, one watchful waiting), and three systematic reviews (THR). The five unpublished studies comprised three industry submissions (MOM, one of which contained an economic evaluation) and two hospital outcome databases (1 MOM, 1 arthroscopy).

No studies comparing the effects of MOM with the other interventions were available. Only limited evidence, based on indirect comparisons, was therefore provided. Over a 3-year follow-up period, 0 to 14% of the patients who received MOM required a revision, while those managed by watchful waiting avoided an immediate operation, but had a 30% chance of an operation over 3 years. THR was associated with revision rates of 10% or less over a 10-year follow-up period, while revision rates for osteotomy were between 2.9 and 29% over a period of 10 to 17 years. The estimated revision rates for patients receiving arthroscopy were slightly higher than those for MOM. No data were identified on revision rates following arthrodesis. MOM patients experienced less pain than those managed by watchful waiting; data from one study suggested that 91% of the patients were pain-free at 4 years. This compares with an estimate of 84% at 11 years for THR, 22% for arthrodesis at 8 years, and fewer patients pain-free following arthroscopy. Similar data for osteotomy were unavailable.

**Cost information**
An industry submission contained an economic evaluation; the review of cost-effectiveness was based on this single comparison of MOM with THR and watchful waiting. Other sources included the NHS national schedule of reference costs for arthroscopy and osteotomy. The cost of MOM for a patient younger than 65 years was estimated to be £5,515 (2000 to 2001). Other estimated intervention costs were £4,195 for THR, £6,027 for revision THR, £951 for arthroscopy and £2,731 for osteotomy. The cost per patient for watchful waiting was estimated to be £642 per annum. The results for patients younger than 65 years at treatment showed that, owing to the assumptions about MOM revision rates and the lower cost of THR, MOM was more costly than THR for the same or fewer benefits. Within a 20-year follow-up period, MOM generated cost-savings in comparison with the watchful waiting alternative for the same or more benefits.

**Authors' conclusions**
The low quality of life experienced by young people with hip disease who have been advised to delay undertaking THR means that if MOM can be proven to (i) have lower revision rates than THR over an extended period, and (ii) result in better outcomes from subsequent THR, then such a procedure could possibly be considered cost-effective or even preferable. If MOM revision rates are sufficiently below those for primary THR, then MOM could possibly be judged cost-effective for older people who are more active and may outlive a primary THR.

**CRD commentary**

The review question appears to have been well focused and the review was generally conducted according to a comprehensive protocol. The database and internet searches were extensive, although there was no mention of searches of reference lists, handsearches, or personal contact with researchers, any of which may have enlarged the pool of relevant studies. The decision to confine the analysis to a narrative description was justified by the absence of direct comparators for MOM, and the wide dissimilarities between MOM patients and some patient groups receiving comparison interventions. The authors took clinical differences between the comparator groups, such as age and preoperative diagnosis, into consideration and their analysis was suitably cautious.

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

**Practice:** The authors did not state any implications for practice.

**Research:** Controlled studies with long-term follow-up comparing MOM with any of the comparators (but principally watchful waiting and THR) are needed. Any comparison with watchful waiting is hampered by the absence of long-term data on MOM, health outcome data following revision, and virtually any data on watchful waiting. Research is required to define more clearly what watchful waiting entails and how its outcomes compare with those of other comparators, especially MOM.

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