A systematic review of the clinical effectiveness and cost-effectiveness and economic modelling of minimal incision total hip replacement approaches in the management of arthritic disease of the hip


CRD summary
This review found that, compared with standard total arthritic hip replacement (THR), minimal incision THR had small advantages in terms of blood loss and operation time and a possible shorter stay in hospital and quicker recovery. Further data are needed to inform decision making. The conclusions of this generally well-conducted review were appropriately cautious given the lack of data, particularly on long-term outcomes.

Authors' objectives
To assess the clinical and cost effectiveness of minimal incision approaches to total hip replacement (THR) for arthritis of the hip. This abstract focuses on the clinical effectiveness and mentions cost only briefly.

Searching
The authors searched a range of named electronic databases from 1966 to 2007 and a selection of systematic reviews and conference proceedings. They examined key surgical journals, looked at relevant websites and consulted experts in the field (professional organisations and manufacturers). Reference lists of included studies and recent conference proceedings were examined to find other relevant studies. The search strategy was provided. The authors searched for published and ongoing studies. They applied no language restrictions to the search, but only studies reported in English, Chinese or Japanese were included in the review.

Study selection
Studies of adults undergoing THR for arthritis were eligible for inclusion. Studies that focused primarily or solely on patients undergoing total hip arthroplasty for other reasons, such as osteoporosis, fracture or tumour, were excluded. Studies of minimal (one or two) incision THR compared with standard THR, or single mini-incision compared with two incision, were eligible for inclusion in the review. Revision surgery, hip resurfacing and computer modelling surgery were excluded. The authors examined outcomes relating to clinical performance, safety, resource utilisation and patient-centred measures. Eligible study designs were: randomised controlled trials (RCTs); quasi-RCTs; prospective non-randomised studies with concurrent comparisons and matched pair studies; and retrospective comparative studies with prospective design or total population recruitment. Long term data were obtained from national registries and single surgeon case series with a minimum follow up of three years and multiple-surgeon case series with a minimum follow up of one year. The mean age of included participants ranged from 55.6 to 73 years. There were similar numbers of men and women. Most included studies compared single mini incision with standard incision. Two reviewers independently assessed studies for inclusion in the review using a specially developed study eligibility form. Any disagreements were resolved by discussion.

Assessment of study quality
Two reviewers independently assessed methodological quality using the Delphi criteria list, which investigates aspects such as randomisation, allocation concealment, blinding procedures and the use of intention-to-treat analysis. Any disagreements were resolved through discussion.

Data extraction
For trials with multiple publications, only the most up to date or complete data for each outcome were included. Two reviewers independently extracted data using a standard data extraction form. Discrepancies were resolved by discussion with involvement of a third reviewer where necessary.

Methods of synthesis
Meta-analyses were performed with the RCT data only. Dichotomous data were combined using the Peto odds ratio method. Continuous data were combined using the inverse variance weighted mean differences (WMD) with a fixed effect model with 95% confidence intervals (CIs) calculated. $X^2$ and $I^2$ tests were used to assess statistical
heterogeneity. Where there was evidence of heterogeneity, a random-effects model was applied for continuous outcomes and possible reasons for heterogeneity were explored. Where a quantitative synthesis was inappropriate, or not feasible, a narrative synthesis of results was provided. Subgroups based on the following were pre-specified: age, gender, deformity, muscularity and body mass index (BMI) and operative approach (posterior or anterior).

**Results of the review**

Fifty-five reports of 42 studies were included in the review. Thirty-two studies compared single mini-incision THR with standard THR (nine RCTs, 17 non-randomised comparative studies, six case series and one registry). One RCT compared two mini-incision THR with standard THR and nine studies compared two-mini incision with single mini-incision THR (two RCTs, five non-randomised comparative studies and two case series). The total number of participants was unclear.

The RCTs were of moderate quality with the majority having fewer than 200 patients and a follow up period of less than one year. No subgroup analyses were undertaken due to lack of data.

Single incision THR: all seven trials and eight of 11 comparative studies favoured the mini-incision group in terms of intraoperative blood loss: Pooled RCT WMD = -56.59mL (95% CI: -71.63, -41.55). Duration of operation and length of hospital stay were also statistically significant: WMD = -3.70 (95% CI: -5.67, -1.74) for duration and -0.50 (95% CI: -0.83, -0.18) for stay. Length of hospital stay was no longer statistically significant using a random effects model. Time using walking aids (days) was significantly shorter: WMD = -3.40 (95% CI: -5.23, -1.57). Presence of limp was less likely with single incision THR; OR = 0.31 (95% CI: 0.11, 0.91). No outcomes favoured standard incision. For all remaining outcomes there was either no evidence of a difference or insufficient information.

Two-incisions THR: data were sparse but the only outcomes to favour two incisions were length of hospital stay and short-term condition-specific quality of life. With the exception of nerve injury and duration of operation, which favoured single incision, all other outcomes had either no evidence of a difference or insufficient information.

**Cost information**

Costs of mini-incision THR are similar at one year when compared with standard THR (£7,060 versus £7,350 for standard THR). Over a 40-year time horizon the costs were £11,618 for mini-incision and £11,899 for standard THR. Mini-incision was less costly and provided slightly more QALYs in the one-year and 40-year analyses. At 40 years the mean QALYs were 8.463 for standard THR and 8.480 for mini-incision. At the 40-year analysis mini-incision THR was found to have a 55 per cent probability of being cost-effective at a willingness to pay of £50,000.

**Authors’ conclusions**

Compared with standard THR, minimal incision THR has small perioperative advantages in terms of blood loss and operation time. A shorter stay in hospital and quicker recovery may also be advantages.

**CRD commentary**

This review had defined inclusion criteria for population, intervention, comparator and study design. A variety of study designs were included to take account of safety outcomes. Meta-analysis was based appropriately just on the RCTs that provided the least biased results. Searching encompassed a wide range of sources. Attempts were made to find ongoing trials in addition to those already published. A number of studies were excluded based on language, but the extent of language bias could not be ascertained given the lack of an excluded studies list. A validity assessment was performed on the trials and comparative studies; a summary was provided. Study details were presented in full. The use of meta-analysis appeared appropriate and the authors were careful to assess any heterogeneity observed. Attempts were made to reduce the possibility of bias and errors through the use of a second reviewer in the selection, data extraction and quality assessment. The conclusions of this generally well-conducted review were appropriately cautious given the lack of data, particularly on long-term outcomes.

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

Research

The authors stated that long-term outcomes of mini-incision needed to be assessed. A large RCT would be the ideal
design alongside an economic evaluation. Registries would be useful in assessing short-term complications and operator issues, but they are subject to selection bias. Reliable surrogate outcomes for long-term observation should be collected. There needs to be consensus on definitions concerning minimally invasive techniques. Further research on robotic guidance and computer navigation techniques may also be worthwhile, as might research relating to operative approach from different locations (posterior, anterior). Trials on two minimal incision THR were not recommended given the lack of enthusiasm for and low use of the technique in current UK practice.

Practice

The authors stated that the clinical relevance of a small reduction in loss of blood and operation time is uncertain and a matter of judgement. When advising patients of benefits of mini-incision, they should be made aware of the uncertainty of longer-term outcomes. It was possible that longer-term outcomes would be similar, so there was no evidence to suggest that the use of minimal incision should be restricted. Given the similarities between minimal incision and standard THR, the adoption of minimal incision THR would involve relatively small changes compared with the adoption of other minimally invasive procedures. However, minimal incision may be technically more challenging, so rates of revision and dislocation may be higher. Appropriate training was needed for patient selection and technical aspects. Initial training in mini-incision operations should occur in high-volume orthopaedic centres. Surgeons performing THRs should perform a minimum number annually to maintain their expertise. If the use of minimally invasive surgery increased, this may reduce the number of cases of standard THRs available for the training of junior surgeons. Given the lack of data on the two minimal incision procedure and its current low use in the NHS, there was no basis for further adoption of the technique.

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the reliability of the review and the conclusions drawn.