Evidence Review

ALBERTA BONE & JOINT INSTITUTE HEALTH

Topic: Metal-on-metal hip resurfacing cost-effectiveness

Background

The conventional method used to treat severe arthritic hip pain is with a total hip replacement (THR). The total hip prosthesis consists of three parts: an ultra-high molecular weight polyethylene (plastic) cup that replaces the hip socket, a metal or ceramic ball to replace the femur head, and a metal stem that is inserted into the shaft of the femur to add stability to the prosthesis. There is excellent long-term clinical data on the effectiveness of THR [1]. However, the treatment of younger patients with severe hip disease with a conventional THR presents a challenge. There is growing evidence to suggest that younger patients (particularly those with active lifestyles) experience high implant failure rates with the need for revision. Long-term results indicate that THR in younger patients may be associated with overall revision rates of up to 25-30% by 15 years [2], with specific subgroups of young active patients experiencing rates of 50% [3]. This contrasts with revision rates of below 5% at 10 years for older patients who receive THR [4]. Furthermore, younger patients that are expected to outlive the lifespan of the prosthesis often must wait and rely on non-surgical interventions before they reach an age that is considered appropriate for THR.

Metal-on-metal hip resurfacing arthroplasty is a newer, bone-conserving arthroplasty option for patients considered to be inappropriate candidates for conventional THR. This technique involves the replacement of the femoral head surface and acetabular cup with a metal surface. Hip resurfacing conserves femoral bone, maintains normal femoral loading and stresses, and because of bone conservation, if the femoral resurfacing fails, a THR can then be performed. Furthermore, since hip resurfacing is less invasive, it offers the prospect of quicker recovery and less thigh pain since there is no femoral stem insertion. Compared to THR, hip resurfacing devices have higher implant costs and there could be negative consequences of using metal-on-metal prosthesis, such as biological responses to metal ion dissociation. As with any new health care technology, the efficacy and cost-effectiveness of hip resurfacing needs to be diligently evaluated against the current standard (THR) to be able to guide policy towards optimal health care resource utilization.

To this end, one must ascertain whether the cost-effectiveness of hip resurfacing exceeds that of THR for patients who need a hip replacement. If so, under what conditions is hip resurfacing more cost-effective? What factors are involved in determining this relationship? The aim of this review is to answer these questions through a literature review on the cost-effectiveness of hip resurfacing in comparison to conventional THR.

Review design

The approach used in this review is to identify articles on costing and/or cost-effectiveness pertaining to hip resurfacing and THR procedures. Selected studies had to pass methodological quality control assessment for inclusion in this review.

Literature Search

Searches in MEDLINE, EMBASE, HealthSTAR and ECONLIT databases were conducted with the following search strategy:

> Search Term: (cost OR economic) AND (evaluation OR analysis OR factorial) AND (arthroplasty OR replacement OR resurfacing) AND hip AND English[la]

Studies included

- Bozic KJ et al. 2006. Use of cost-effectiveness analysis to evaluate new technologies in orthopaedics. The case of alternative bearing surfaces in total hip arthroplasty. J Bone Joint Surg Am. 88(4):706-14
- Wyness L et al. 2004. The effectiveness of metal on metal hip resurfacing: a systematic review of the available

evidence published before 2002. BMC Health Serv Res. 27;4 (1):39.

- McKenzie L et al. 2003. Metal on metal hip resurfacing arthroplasty. An economic analysis. Eur J Health Econ. 4(2):122-9.
- Antoniou J et al. 2004. In-hospital cost of total hip arthroplasty in Canada and the United States. J Bone Joint Surg Am. 86-A (11):2435-9
- Vale L et al. 2002. A systematic review of the effectiveness and cost-effectiveness of metal-on-metal hip resurfacing arthroplasty for treatment of hip disease. Health Technol Assess. 2002;6(15):1-109

Studies not included but of interest

- Fielden JM et al. 2005. Waiting for hip arthroplasty: economic costs and health outcomes. J Arthroplasty. 20(8):990-7.
- Bozic KJ et al. 2004. Economic evaluation in total hip arthroplasty: analysis and review of the literature. J Arthroplasty. 19(2):180-9. Review

Quality control

The quality of the selected studies was assessed by an independent reviewer. All included studies were found to have good methodologic quality and, therefore, were incorporated into this review.

Results

The cost-effectiveness of hip resurfacing has been estimated by Bozic et al. (2006) [5] and McKenzie et al. (2003) [6]. These reviews developed economic assessment models to predict cost-effectiveness based on three general inputs: costs, revision rates, and patient characteristics.

Implant cost

Based on published cost estimates in 2000, McKenzie et al. [6] reported that the average patient cost of a Birmingham hip resurfacing implant (including operating time, surgical costs and 1-year follow-up) was £5,515 (UK pounds sterling), which is more than the £4,195 per patient cost for a primary THR. This trend is also observed in the cost of the implants themselves within the Calgary Health Region (Birmingham hip resurfacing prosthesis: $5,500; THR (excluding ceramic-on-ceramic) prosthesis: $4,558). The average cost of THR arthroplasty in Canada has recently been reported to be USD $6,766 ± $119, with an average patient length of hospital stay (LOS) of 7.2 ± 4.7 days [7]. The higher cost of a resurfacing implant would increase the patient cost above THR costs, although this may be offset by shorter LOS following hip resurfacing. A recent American study [8] reported an average LOS following hip resurfacing of 3.2 days.

Revision rates

Currently, there are no published studies that report on hip resurfacing revision rates at over 10 years. In a systematic review on the effectiveness of resurfacing arthroplasty, Wyness et al. [9] report that only four studies were published before 2002 that had a minimum follow-up period of 2 years. Subsequent to those studies, Wyness et al. cite the findings of Daniel et al. (2004) who reported a hip resurfacing revision rate of 0.02% (1/440 hips) in a group of 378 patients with an average follow-up time of 3.3 years. When Wyness et al. considered all sources of data (published studies, industry reports, observational data), they reported hip resurfacing revision rates ranging from 0% to 14.3%. Analysis of that data indicates that high revision rates are reported in very small studies (sample size range: 19 to 66), and extremely low revision rates are associated with reports that have large sample sizes (sample size range: 1378 to 4424). For example, Midland Medical Technologies reports that the rate of revisions for Birmingham hip resurfacing is 0.6% (8/1382).

Patient age

Consideration of patient age is an important input in cost-effectiveness determination. Although hip resurfacing implants are more costly then THR, resurfacing in younger patients allows for a possible subsequent THR to be performed, thus 'buying time' for the patient. At a certain patient age where the lifespan of the implant is expected to exceed the patient's, the cheaper THR will provide a more cost-effective measure.

Cost-effectiveness models

With consideration of the above variables, Vale et al. (2002) [10] concluded in their systematic review that hip resurfacing could be cost-effective or even dominant to THR in patients less than 65 years of age if the revision rates of resurfacing were 20% lower than those of conventional THR.

The economic analysis of hip resurfacing performed by McKenzie et al. [6] also reached a similar conclusion; hip resurfacing becomes cost-effective as the revision rate of resurfacing decreases, and hip resurfacing is dominant when its revision rate is roughly 20% below that of the THR rate. These authors cite the lack of long-term follow-up studies on hip resurfacing as a significant problem wherein its revision rates relative to THR are speculative.

Recently, Bozic et al. [5] found the results of their cost-effectiveness estimation of hip resurfacing utilization to be highly sensitive to the three variables; age at the time of primary arthroplasty, reductions in the probability of revision

rates relative to conventional THR, and the cost of the alternative bearing device. These authors estimated the revision rates of hip resurfacing from the available published and unpublished source since there are no long-term data but, in general, it was presumed that revision rates of younger patients would be higher than their older counterparts. The estimation model calculated the relationship between age, implant cost and reduction in 20-year failure rates on cost-effectiveness at three different incremental costs of the alternative bearing surface above the cost of THR ($500, $2000 and $4000). According to their model, hip resurfacing that is an additional $2,000 above the cost of a conventional THR would be cost-effective over the individual's lifetime for a patient 50 years or younger if the resurfacing has a 19% reduction in the 20-year implant failure rate when compared to the failure rate for a conventional THR (see figure 1). Hip resurfacing that is an additional $2000 above conventional THR would not be cost saving for individuals over age of 63 even is the failure rate for hip resurfacing was 70% less than for conventional THR.

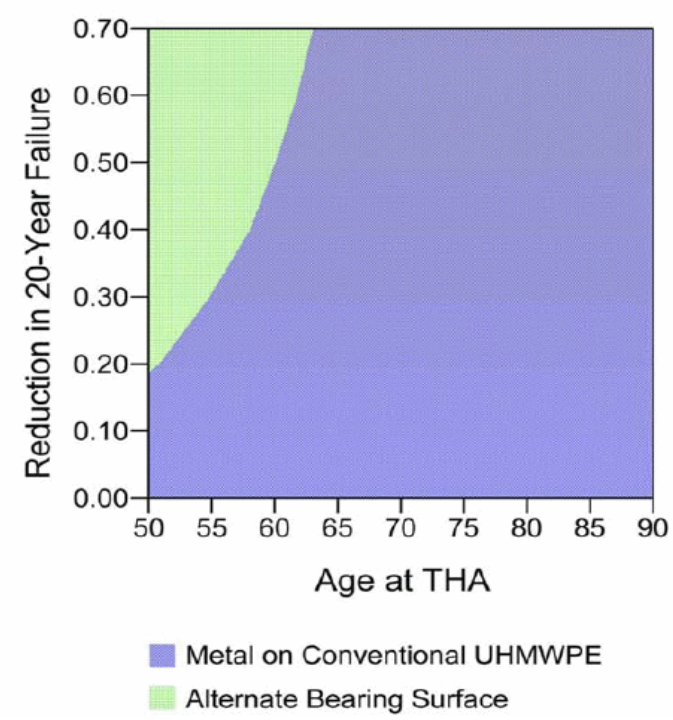

Figure 1. An alternative bear device (hip resurfacing) with an incremental cost of $2000 more than THR would be a cost-saving only for patients under 63 years of age for the range of revision reduction at 20-years (represented by green area on graph). Adapted from Bozik et al. [5]

Summary

Current evidence suggests that hip resurfacing may be a cost-effective alternative to THR. The cost-effectiveness of hip resurfacing can be modeled on a relationship between patient age, the implant's incremental cost, and the potential improvement in revision rates relative to THR. Because there are no long-term follow-up studies on hip resurfacing arthroplasty, researchers can only speculate at this point on the revision rates associated with hip resurfacing. Based on the findings of studies that have modeled this relationship, it is noted that hip resurfacing will be cost-effective at lower revision rates. The expected cost-savings from resurfacing of the hip will exceed that of THR for a greater range of patient age with decreasing revision rates relative to THR.

Limitations

This review focused on studies that directly compared cost-effectiveness of hip resurfacing and THR. Studies on patient-specific outcomes (e.g., health-related quality of life) following each procedure were not considered. Furthermore, the selection of English-only literature may represent a publication bias.

Reference List

1 Berry,D.J. *et al.* (2002) Twenty-five-year survivorship of two thousand consecutive primary Charnley total hip replacements: factors affecting survivorship of acetabular and femoral components. *J. Bone Joint Surg. Am.* 84-A, 171-177

2 Northmore-Ball,M.D. (1997) Young adults with arthritic hips. *BMJ* 315, 265-266

3 Joshi,A.B. *et al.* (1993) Long-term results of Charnley low-friction arthroplasty in young patients. *J. Bone Joint Surg. Br.* 75, 616-623

4 Fitzpatrick,R. *et al.* (1998) Primary total hip replacement surgery: a systematic review of outcomes and modelling of cost-effectiveness associated with different prostheses. *Health Technol. Assess.* 2, 1-64

5 Bozic,K.J. *et al.* (2006) Use of cost-effectiveness analysis to evaluate new technologies in orthopaedics. The case of alternative bearing surfaces in total hip arthroplasty. *J. Bone Joint Surg. Am.* 88, 706-714

6 McKenzie,L. *et al.* (2003) Metal on metal hip resurfacing arthroplasty. An economic analysis. *Eur. J. Health Econ.* 4, 122-129

7 Antoniou,J. *et al.* (2004) In-hospital cost of total hip arthroplasty in Canada and the United States. *J. Bone Joint Surg. Am.* 86-A, 2435-2439

8 Mont,M.A. *et al.* (2005) Resurfacing hip arthroplasty: comparison of a minimally invasive versus standard approach. *Clin. Orthop. Relat Res.* 441, 125-131

9 Wyness,L. *et al.* (2004) The effectiveness of metal on metal hip resurfacing: a systematic review of the available evidence published before 2002. *BMC. Health Serv. Res.* 4, 39

10 Vale,L. *et al.* (2002) A systematic review of the effectiveness and cost-effectiveness of metal-on-metal hip resurfacing arthroplasty for treatment of hip disease. *Health Technol. Assess.* 6, 1-109

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