Cemented, cementless, and hybrid prostheses for total hip replacement: cost effectiveness analysis

Pennington M, Grieve R, Sekhon JS, Gregg P, Black N, van der Meulen JH

Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

CRD summary
The objective was to assess cost-effectiveness of three types of prosthesis (cemented, hybrid and cementless) for elective total hip replacement in adults with osteoarthritis. The authors concluded that cemented prostheses were least costly but hybrid prostheses were the most cost-effective for most patient groups. The methodology and level of reporting was good. The authors' conclusions appear to be appropriate but sensitive to the assumption of maintained residual differences in postoperative quality of life between prosthesis types.

Type of economic evaluation
Cost-utility analysis

Study objective
To assess the cost-effectiveness of three types of prosthesis for elective total hip replacement in adults with osteoarthritis.

Interventions
Three interventions were assessed: cemented, cementless and hybrid prostheses. Hybrid prostheses were stated to consist of cemented stems and cementless cups.

Location/setting
UK/hospital

Methods
Analytical approach:
A Markov model was constructed to estimate lifetime costs and benefits associated with the three alternative prostheses for men and women aged 60, 70 and 80. Key inputs for the model were estimated from individual patient data obtained from three large national databases. The authors stated that the perspective was from the English NHS.

Effectiveness data:
The key effectiveness inputs in the model were the revision and re-revision rates for total hip replacement which were estimated using National Joint Registry for England and Wales (2003-2009) and hospital episode statistics (1997-2009) data. Where possible patient records from both sources were linked and these linked data were used to derive revision rates within the first five years by prosthesis type. Revision rates after five years and re-revision rates were based on data from hospital episode statistics only.

Monetary benefit and utility valuations:
Utility estimates were derived from preoperative records and EQ-5D data taken from a national programme that collected patient reported outcome measures in patients who underwent elective total hip replacement in the English NHS (2008-10); these data were linked to National Joint Registry data. The EQ-5D profiles were combined with health state preference values derived from the UK general population to produce utility index scores. Adjustment for observed preoperative differences was undertaken using both Genetic Matching (GenMatch) and regression techniques.

Measure of benefit:
The measure of benefit was quality-adjusted life-years (QALY). A discount rate of 3.5% was applied.

Cost data:
Direct medical costs included initial prosthesis, revision, operation theatre and hospital stay. The unit cost of each prosthesis was stated to have been taken from the prices paid by a typical NHS provider for the most popular implant systems, including all components and instrumentation. Prosthesis costs were calculated by weighting the price for each brand within the different types according to each brand's relative frequency. Costs of operation theatre and hospital stay were based on a national study modified by using the length of stay according to the prosthesis type observed in patient-reported outcome measures, joint registry and hospital episode statistics linked records. The cost of one day in hospital was assumed to be £225. Average total cost of a primary total hip replacement was multiplied by a factor that differed according to the reason for revision (1 or 2 stage; higher factor for two stage) to account for unit costs for revisions being generally higher than primary hip replacements. All costs were reported in 2010-2011 GBP (£). A discount rate of 3.5% was applied.

Analysis of uncertainty:
Sensitivity analysis was conducted to assess the effect of uncertainty around various model assumptions on results. Probabilistic sensitivity analysis was used to determine the probability that each prosthesis type was the most cost-effective at alternative willingness to pay thresholds for a QALY gain. Results were presented in tabular form and as cost-effectiveness acceptability curves.

Results
Results were presented for men and women and the three age groups separately (results for men and women aged 70 reported here).

For men aged 70, lifetime costs and QALYs were £6,912 and 8.46 QALYs for cemented prosthesis, £7,712 and 8.63 QALYs for cementless prosthesis and £7,516 and 8.75 QALYs for hybrid prosthesis. The incremental cost-effectiveness ratio (ICER) for a hybrid versus cemented prosthesis was about £2,100 per QALY.

For women aged 70, lifetime costs and QALYs were £6,837 and 8.99 QALYs for cemented prosthesis, £7,704 and 9.18 QALYs for cementless prosthesis and £7,486 and 9.25 QALYs for hybrid prosthesis. The ICER for a hybrid versus cemented prosthesis was about £2,500 per QALY.

Across all willingness to pay threshold values (£10,000 to £30,000) hybrid prostheses had the highest probability of being the most cost-effective alternative in all age subgroups except in women aged 80, where cemented prostheses were most cost effective. The results were sensitive to the assumption of continued quality of life (QoL) differences between prosthesis types.

Authors' conclusions
The authors concluded that cemented prostheses were the least costly alternative but for most patient groups hybrid prostheses were the most cost-effective.

CRD commentary
Interventions:
The interventions appeared to be appropriate. The authors justified the choice of interventions by stating that they were the three most commonly used types of prosthesis for total hip replacement.

Effectiveness/benefits:
The methods used to calculate revision and re-revision rates were reported clearly and were appropriate. A strength of the analysis was use of data from large national studies that provided detailed patient information representative of the target population of interest. However, some data were not available and some assumptions were required. A key assumption in the analysis concerned the duration of postoperative QoL differences between prosthesis types. The authors argued that although the sensitivity analysis demonstrated that if residual differences in postoperative QoL were assumed to last for only two years then the probability that cemented prostheses were cost-effective increased, evidence suggested that QoL improvements after hip replacement could persist for at least five years. Since the analysis did not include a scenario in which QoL differences were maintained for five years, it was not possible to assess how sensitive...
the results were to this alternative assumption.

Costs:
Costs were clearly reported and appropriate for the given perspective. Sources used to derive costs were reported clearly and were specific to the UK. Unit prices were stated and enabled comparisons. The price year was reported and this would aid reflation. Future costs were discounted appropriately.

Analysis and results:
A description of the model was provided but there was no diagram. Details of regression methods used to derive various data inputs seemed appropriate and were well reported. Results of the additional sensitivity analysis were reported clearly. Probabilistic sensitivity analysis was used and was the most appropriate method to assess the effect of parameter uncertainty on results. Appropriate distributions were applied to the model parameters (which were clearly reported in a technical appendix) and appropriate techniques were used to account for correlation between terms.

Concluding remarks:
The methodology and level of reporting was good. The authors' conclusions appear to be appropriate but sensitive to the assumption of maintained residual differences in postoperative QoL between prosthesis types.

Bibliographic details

PubMedID
23447338

Original Paper URL
http://www.bmj.com/content/346/bmj.f1026

Indexing Status
Subject indexing assigned by NLM

MeSH
Aged; Aged, 80 and over; Arthroplasty, Replacement, Hip /economics /methods /mortality; Bone Cements /therapeutic use; Cost-Benefit Analysis; Durapatite /therapeutic use; Female; Great Britain; Humans; Male; Markov Chains; Osteoarthritis /economics /surgery; Prostheses and Implants /economics; Quality of Life; Time Factors; Treatment Outcome

AccessionNumber
22013010204

Date bibliographic record published
15/03/2013

Date abstract record published
25/07/2013