Comparison of patient-reported outcomes between hip resurfacing and total hip replacement

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This study compared the demographic, clinical and patient-reported outcomes after total hip replacement (THR) and Birmingham Hip Resurfacing (BHR) carried out by a single surgeon. Patients completed a questionnaire that included the WOMAC, SF-36 scores and comorbid medical conditions. Data were collected before operation and one year after. The outcome scores were adjusted for age, gender, comorbid conditions and, at one year, for the pre-operative scores. There were 214 patients with a THR and 132 with a BHR. Patients with a BHR were significantly younger (49 vs 67 years, p < 0.0001), more likely to be male (68% vs 42% of THR, p < 0.0001) and had fewer comorbid conditions (1.3 vs 2.0, p < 0.0001). Before operation there was no difference in WOMAC and SF-36 scores, except for function, in which patients awaiting THR were worse than those awaiting a BHR.

At one year patients with a BHR reported significantly better WOMAC pain scores (p = 0.04) and in all SF-36 domains (p < 0.05). Patients undergoing BHR report a significantly greater improvement in general health compared with those with a THR.

Severe arthritis of the hip requiring arthroplasty is commonly due to osteoarthritis (OA),1 which is one of the ten leading causes of years lost to disability which have been identified in the World Health Organisation (WHO) review of the global burden of disease.2 It is reported as the fourth highest cause of disability for females and the eighth for males. The impact on the quality of life is considerable, with patients reporting a dramatically worse physical and mental health status than in the normal population.3

The success of total hip replacement (THR) in improving the quality of life is well documented,4 and comorbidity as an important predictor of outcome is well recognised.4,6 In patients under 65, who may outlive the life of the prosthesis, hip resurfacing is emerging as a viable option, but the literature to support this claim is limited.7 Early data from the National Joint Registry of England and Wales suggest that hip resurfacing carried a greater risk of revision.7 However, in centres with high volumes where patients are carefully selected, the results of hip resurfacing in younger, more active patients with good bone quality have been excellent in terms of survival, functional outcome and patient satisfaction.8-11

Conservation of bone is potentially the greatest advantage of hip resurfacing, as it allows more options for revision surgery in the case of failure.12 Hip resurfacing may provide the solution to improving the quality of life in younger patients wanting to maintain an active lifestyle.13 There are several studies comparing resurfacing with THR in terms of cost-effectiveness,14 survival15 and the biomechanical and radiographic outcomes.16,17 However, the outcome measures used in these studies rely on a biomedical research model which assumes that a technically successful result is all that matters. The inclusion of patient-reported measures to evaluate fully the success of arthroplasty is essential to understand the impact on the quality of life.18

Patient selection for hip resurfacing differs from THR in that age, gender, and other comorbid medical conditions all have an impact on patient-reported health status.1,5,6 The aim of this study was to compare the demographic, clinical and patient-reported outcomes of a large cohort of patients undergoing hip resurfacing and THR.

Patients and Methods

Patients undergoing primary THR or hip resurfacing using the Birmingham Hip Resurfacing (BHR) implant between July 2003 and December 2006 by a single surgeon (JPH) consented to be part of the hospital joint registry. The surgeon had over five years’ experience with the BHR and had carried out 249 cases.
before July 2003, thus minimising any bias in patient selection or technical factors. All operations were performed through a standard posterior approach. The local joint registry, which provides an ongoing audit of all lower limb joint replacements, is part of our routine monitoring of patients, and therefore ethical committee approval was not required.

Data were collected within six weeks before operation by independent research staff, and follow-up by postal questionnaire one year after. The pre-operative questionnaire included demographic details, height, weight and comorbidity. These self-administered comorbidity questions have been validated with a medical record-based comorbidity instrument as well as with subsequent health status and healthcare utilisation. The body mass index (BMI) was calculated as weight (kg) divided by height (m$^2$). At each evaluation two health status scales were administered, namely the Western Ontario and McMaster University Osteoarthritis Index (WOMAC), a disease-specific measure of pain, stiffness and function, and the Short-Form 36 (SF-36), a generic measure of health status. We transformed WOMAC scores to a scale of 0 to 100 for each domain (100 = best). The standardised method of calculating the SF-36 domains was used so that each of the eight subscales had a score of 0 to 100 (100 best).

At the one-year assessment, there were in addition four questions on patient satisfaction that used a four-point Likert response format ranging from very satisfied to very dissatisfied. This scale has been validated for use on THR patients. They were also asked if they would have the operation again and responded either yes, no, or unsure.

Demographic and clinical factors were compared between the THR and BHR populations using Student's t-test and chi-squared analysis where appropriate. In order to improve precision in assessing whether there was a difference between the WOMAC and SF-36 scores, it is important to consider factors known to be independent predictors, which include age, gender, comorbid medical conditions and, most importantly at follow-up, the pre-operative score. In our study, we improved the precision of calculating mean scores by adjusting for these variables using multivariate regression analysis. We used general linear models to adjust for age, gender and the number of comorbid conditions at the pre-operative assessment, and then calculated adjusted mean scores by type of operation. This method of analysis allowed us to determine whether there was a significant difference between the THR and BHR groups after the variables known to have a possible effect on outcome had been controlled. A similar method was used with the follow-up scores at one year, where the model also adjusted for the pre-operative score. Only patients with complete pre-operative and follow-up data were included in the model from which adjusted mean scores at one year were calculated.

Satisfaction questions were compared using chi-squared analysis with a significance level set at $p < 0.05$. All data were anonymised before analysis, for which SAS version 9.1 was used (SAS Institute Inc., Cary, North Carolina).

**Results**

Between July 2003 and December 2006, 214 of 252 patients with a THR (85%) and 132 of 152 with a BHR (87%) consented to participate in the hospital registry and completed the pre-operative questionnaires. At one year questionnaires were returned by 283 of 346 (82%) of the patients. The 63 who did not return them were significantly younger than those who did (56 vs 61, $p = 0.008$), but there was no significant difference in terms of gender ($p = 0.08$) and the type of surgery ($p = 0.16$).

The BHR patients were significantly younger than those with a THR (49 vs 67 years, $p < 0.0001$), were more likely to be male (68% vs 42% of THR, $p < 0.0001$), and reported fewer comorbid conditions (1.3 vs 2.0, $p < 0.0001$; Table I). There was no significant difference in BMI between the groups. The primary diagnosis was osteoarthritis (Table I).

At the pre-operative assessment, THR patients reported significantly worse WOMAC function (Table II, $p = 0.025$) and SF-36 physical functioning (Fig. 1, $p = 0.032$) scores, but after adjustment there was no difference in the other WOMAC and SF-36 domains. At one year, patients with a BHR reported significantly better WOMAC pain scores (Table II, $p = 0.043$) and after adjustment, all domains of the SF-36 were significantly better (Fig. 2, $p < 0.05$) than those with a THR. One patient in the BHR group had a deep-vein thrombosis and in the THR group there was one death due to respiratory failure and four dislocations during the first year of follow-up.

There was no significant difference in the overall level of satisfaction or satisfaction with pain relief one year after surgery between the groups (Fig. 3, $p = 0.55$). However, a significantly higher proportion of BHR patients were satisfied compared to those with a THR in terms of return to daily activities around the house (Fig. 4, $p = 0.035$). There was a trend for BHR patients to be more satisfied in terms of their return to recreational activities, but this did not reach statistical significance ($p = 0.057$). There was no difference between the groups in response to the question as to whether they would undergo surgery again, knowing what their outcome had been at one year with over 90% saying that they would have the operation again).

**Discussion**

This study confirms that patients undergoing hip resurfacing were more likely to be male, younger, and have less comorbidity. All these factors have been shown to be associated with better patient-reported health status, and it was essential to adjust for them when comparing the two groups. At the pre-operative assessment only the function scores of the WOMAC and SF-36 were significantly higher in BHR patients than in THR patients; this difference was sustained at one year, but was not statistically significant. Conversely, the 100 (100 best). 25

100 (100 best). 25
different, with those with hip resurfacing reporting less functional limitation. At one year there were highly significant improvements in all WOMAC scores for both groups, and only the WOMAC pain score was significantly better in the hip resurfacing group compared with patients with a THR. However, the adjusted mean difference between the pain scores was only five points, and would not be considered clinically important at an individual level.28 Conversely, the adjusted means were significantly different for all the SF-36 health domains, with patients with a hip resurfacing reporting significantly better health than those with a THR. In the physical domains of the SF-36 these differences were in the range of nine to 17 points, and for the mental health domains seven to 11 points, indicating differences that would be clinically important at an individual level.29 These findings are important, as they confirm that, before surgery, patients undergoing resurfacing are describing similar levels of pain, limitation of function and impact on their general health status to those with a THR. When compared with the normal data for different age ranges, it is clear that the impact on the quality of life at 50 years of age is much greater than at 70.25 The younger group is more likely to still be working, and the

Table I. Demographic and clinical characteristics of total hip replacement (THR) and Birmingham hip resurfacing (BHR) groups

<table>
<thead>
<tr>
<th></th>
<th>THR (n = 214)</th>
<th>BHR (n = 132)</th>
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</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (sd)</td>
<td>67 (23 to 91)</td>
<td>49 (22 to 70)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (%)</td>
<td>90 (42)</td>
<td>90 (68)</td>
</tr>
<tr>
<td>Diagnosis (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Osteoarthritis</td>
<td>194 (91)</td>
<td>110 (83)</td>
</tr>
<tr>
<td>Rheumatoid/inflammatory arthritis</td>
<td>5 (2)</td>
<td>4 (3)</td>
</tr>
<tr>
<td>Avascular necrosis</td>
<td>8 (4)</td>
<td>4 (3)</td>
</tr>
<tr>
<td>Hip dysplasia</td>
<td>5 (2)</td>
<td>6 (5)</td>
</tr>
<tr>
<td>Fracture neck of femur</td>
<td>1 (0.5)</td>
<td>-</td>
</tr>
<tr>
<td>Perthes' disease</td>
<td>1 (0.5)</td>
<td>5 (4)</td>
</tr>
<tr>
<td>Slipped upper femoral epiphysis</td>
<td>-</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Post-traumatic osteoarthritis</td>
<td>-</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Comorbid conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Mean (sd)</td>
<td>2.0 (1.4)</td>
<td>1.3 (1.1)</td>
</tr>
<tr>
<td>Body mass index</td>
<td>27 (5)</td>
<td>28 (5)</td>
</tr>
</tbody>
</table>

* p < 0.0001
† p = 0.043

Table II. Adjusted mean Western Ontario and McMaster’s osteoarthritis index scores pre-operatively and at one-year assessment by Birmingham hip resurfacing (BHR) and total hip replacement (THR) groups. Scores adjusted for age, gender and number of comorbid medical conditions and, at one-year, also for the pre-operative score

<table>
<thead>
<tr>
<th></th>
<th>THR (n = 214)</th>
<th>BHR (n = 132)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-operative scores</td>
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<tr>
<td>Pain</td>
<td>34</td>
<td>39</td>
</tr>
<tr>
<td>Stiffness</td>
<td>36</td>
<td>37</td>
</tr>
<tr>
<td>Function</td>
<td>33</td>
<td>39*</td>
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<tr>
<td>One-year scores</td>
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<td></td>
</tr>
<tr>
<td>Pain</td>
<td>88</td>
<td>93*</td>
</tr>
<tr>
<td>Stiffness</td>
<td>80</td>
<td>83</td>
</tr>
<tr>
<td>Function</td>
<td>80</td>
<td>85</td>
</tr>
</tbody>
</table>

* significantly better, p < 0.05

Fig. 1

Adjusted mean pre-operative SF-36 scores for the total hip replacement (THR) and Birmingham hip resurfacing (BHR) groups. Pre-operative scores adjusted for age, gender and the number of comorbid medical conditions. The radar graph is scaled so that the central point is 0 and each gridline is a 20-point increment, 100 maximum for the outer gridline (physical functioning significantly different, p = 0.017).
psychosocial implications of their disability can affect their mental health status.

Patients with resurfacing reported similar levels of satisfaction with pain relief, but significantly higher satisfaction with their functional outcomes. This may be due partly to differences in restoration of gait between the groups. A gait analysis study has shown that patients with resurfacing had more normal kinematics and function in the hip than standard patients with a THR, with the walking speed after hip resurfacing being comparable to normal.30

In 2001, the WHO published the International Classification for Functioning, Disability and Health,31 which identified the importance of measuring beyond biomedical outcomes and how psychosocial factors can influence both activity and the ability to participate in everyday activities. Using this framework we can evaluate how comprehensively the outcome measures we use assess the patient.32 This classification highlights the limitations of outcome studies that rely primarily on biomechanical and radiological measurements, which predominantly assess body functions and structures and provide limited information about activity and the impact on quality of life. Conversely, patient-reported measures, such as the WOMAC20,21 and the SF-3622-24 cover all three components of the classification, and include more detailed questions about activity and participation, as well as measuring aspects of body function and structure.33

Several studies have compared patient-reported outcomes between hip resurfacing and THR patients using the Harris Hip Score, the University of California, Los Angeles activity score and a variety of satisfaction measures.15,34,35 All demonstrated that both operations result in highly significant improvements in scores, with little difference between the groups after adjustment for age, gender and pre-operative status. None of the previous studies included the SF-36, and only Pollard et al34 used a more generic measure of health status (EuroQol), which, in keeping with our findings, showed a significantly greater improvement in the resurfacing group.

Our study identified differences in demographic and clinical factors between hip resurfacing and THR, such as age, gender and comorbid medical conditions, which may have an impact on patient-reported health status. By adjusting for these factors, we were able to demonstrate that there was little difference in disease-specific (WOMAC) scores between the two groups, either before or one year after operation. Conversely, despite the general health status...
being similar between the groups before operation, patients with hip resurfacing had significantly greater improvement in their general health status.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References


