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ORIGINAL STUDY

Clinical and functional outcome of the Birmingham Hip Resurfacing

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The Birmingham hip resurfacing (BHR) arthroplasty has shown good medium-term results in the centres that have been involved in its development.

A retrospective cohort study analyzing the clinical and functional outcome of 297 metal-on-metal BHR arthroplasties at an independent hospital was performed.

At medium-term follow-up, 4 patients had died, 8 patients were lost to follow-up (2.7%), and 6 hips (2.0%) had undergone revision surgery. The mean Harris hip score (HHS) increased from 56.2 preoperatively to 96.4 at follow-up.

The BHR resulted in a very high postoperative HHS and enabled active patients to return to work and engage in sports. With an acceptable revision rate of 2.0% and an overall survival rate of 97.1% at five years, our results were similar to those of the designer centers.

Keywords : hip ; arthroplasty ; resurfacing ; outcome ; results.

INTRODUCTION

Resurfacing arthroplasty of the hip joint has been an attractive concept, particularly in younger, more active patients. Since the introduction of the third-generation bone-conserving metal-on-metal hip resurfacing in the early 1990s, modifications in the surgical techniques and implant design have led to an overall improvement of the results and fewer complications (*6,17,19*). Known benefits are preservation of femoral bone stock, reduced proximal stress shielding, low-wear friction couple, enhanced stability, and improved revision options (*18,19*). The promising results reported in the initial studies have widened the indications and the age range, leading to higher expectations in an already high-demand group (*3,4,23*). Because demographic studies predict a growing demand for joint replacement in the younger and active population over the next decades, a better knowledge of the clinical and functional postoperative outcome of hip resurfacing is essential (*11*).

The Birmingham hip resurfacing (BHR) arthroplasty, which was introduced in 1997, shows good clinical medium-term results in the centres that have been involved in its development (*4,6,21*). Most

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of the independent series published have either small patient populations or short follow-up periods (*7,13*). We report a retrospective cohort study of 297 consecutive metal-on-metal BHR arthroplasties (Midland Medical Technologies Ltd, Birmingham, UK and Smith & Nephew Orthopaedics, Warwick, UK) performed at an independent hospital, with a 2 to 8-year follow-up. The clinical and functional outcome, the overall patient satisfaction and the survival rate are addressed.

PATIENTS AND METHODS

A total of 297 hips in 272 patients (181 male and 91 female) were operated on between February 2001 and June 2006. All these patients had incapacitating mechanical hip pain, resistant to conservative treatment. The cause of pain was primary osteoarthritis in 278 hips (93.6%), osteonecrosis in 16 hips (5.4%), and rheumatoid arthritis in 3 hips (1.0%). Surgery was performed on 161 right and 136 left hips. The mean age at surgery was 52.9 years (range : 14.4-74.4 years). Three patients already underwent previous surgery of the index hip (1 acetabular osteosynthesis, 1 periacetabular Ganz osteotomy, and 1 osteosynthesis of a femoral neck fracture). A single surgeon operated on all patients. A standardized posterior approach as advocated by McMinn was used in each case (*14*). All patients received a high-carbon cast chromium-cobalt BHR prosthesis. The stemmed femoral component was fixed with low-viscosity cement and was combined with an uncemented hydroxyapatite porous-coated acetabular component.

Inclusion criteria were age, quality of bone and the patients' expectations of their postoperative activity level. In general, the operation was offered to men under the age of 65 years and women under the age of 60 years, with normal bone stock on plain radiographs. However, in some cases of older high-demand patients with good bone stock, an intra-operative decision was made to perform a resurfacing arthroplasty.

Exclusion criteria were a body mass index of > 40, radiographically confirmed osteoporosis and malignancies.

Sizes were determined intraoperatively by measuring the femoral neck diameter. Femoral sizes vary from 38 mm to 58 mm, with 4-mm increments. Intermediate sizes (2-mm increments) were not available at the time of inclusion. Although the acetabular component is 6 mm or 8 mm larger than the femoral component, we aimed for the smallest component in order to preserve the acetabular bone stock. Two patients received a dysplasia cup, which was fixed with one or two locking screws.

Postoperatively, all patients followed the same regimen, with immediate full weightbearing and limitation of adduction for 6 weeks. Indomethacin 25 mg, 3 times a day, was given for 12 days to prevent periarticular ossification (*22*). No physiotherapy after discharge from the hospital was advised.

All patients were preoperatively evaluated by an independent investigator and completed a Harris hip score (HHS) questionnaire (*9*). Postoperatively, the patients underwent a clinical and radiological evaluation after 6 weeks, 3 months, 12 months, and then at 1-year intervals.

At the latest follow-up, a questionnaire was completed containing the HHS, the validated Dutch Hip Disability and Osteoarthritis Outcome Score (HOOS) (*5*), the University of California Los Angeles (UCLA) activity score (*25*), theVisual Analogue Scale (VAS) pain score (*8*), and questions about complications, activities of daily living (ADL) and satisfaction. Approval was obtained from the Ethics Committee. Mobility and range of motion were evaluated clinically.

An independent statistician performed a statistical analysis. R- statistical software was used (*10*). The t-test was used where possible. For the postoperative scores, a Wilcoxon rank sum test was used because a non-normal distribution was recorded. A Kaplan-Meier survival analysis at five years follow-up was performed.

RESULTS

A total of 297 BHRs were implanted in 272 patients. At the latest follow-up, 4 patients had died of causes not related to the arthroplasty (1 acute myocardial infarction, 1 colon cancer, 1 breast cancer, 1 aorta aneurysm). Six patients no longer lived in Belgium and were lost to follow-up. Two patients were satisfied with their prosthesis and did not undergo revision surgery but refused to give informed consent. Six hips (2.02%) in 5 patients were revised, leaving 279 hips in 257 patients for functional and clinical evaluation. The mean duration of follow-up was 3.8 years (range : 2.2 years-7.4 years).

The mean preoperative HHS was 56.2. This score was not significantly different between male (56.86 (range : 14-95)) and female (54.90 (range : 18-91)) patients (t-test : $p = 0.31$).

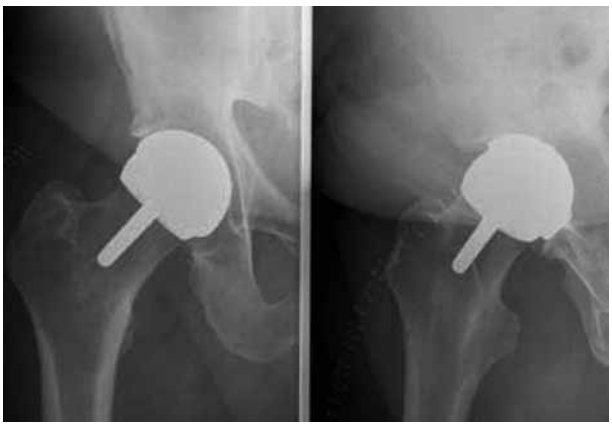

Fig. 1. — Postoperative radiograph of the Birmingham hip resurfacing.

At the latest follow-up, the mean HHS was 96.3 due to the large number of patients with a score of 100. In the male and the female group, the mean HHS was 97.0 (range : 53-100) and 95.1 (range : 50-100), respectively. Despite this small difference, a Wilcoxon rank sum test indicated that the median scores in the two groups were significantly different ($p = 0.03$). The 95% confidence interval for mean improvement of the HHS was [38.26 - 42.09], indicating a significant difference between the mean preoperative HHS and the mean postoperative HHS (paired t-test, $p < 0.0001$) (Fig. 2). Although the postoperative scores were significantly higher in the male group, a statistically non-significant (t-test ; $p = 0.9559$) difference in the HHS increase between male (40.11) and female (40.23) patients could be noted. A regression analysis revealed no effect of preoperative HHS, patient age or sex on the postoperative HHS (Fig. 3).

An analysis of the postoperative HOOS revealed scores of 91.59 for the pain component, 87.07 for symptoms, 90.50 for ADL, 80.18 for sport and recreation, and 84.11 for quality of life. The overall postoperative HOOS averaged 433.22. A Wilcoxon rank sum test showed no significant differences between the male and the female group for pain ($p = 0.06$), ADL ($p = 0.08$), sport and recreation ($p = 0.06$) and quality of life ($p = 0.06$) sub scores. Only for the symptom subgroup was a significantly better result found for the male group ($p = 0.0005$) (Fig. 4 a & b).

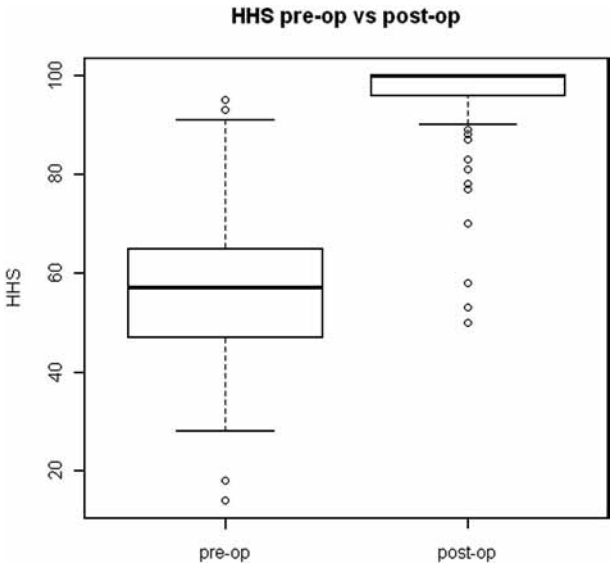

Fig. 2. — Preoperative and postoperative Harris hip scores (HHS). The mean preoperative HHS was 56.20. The mean postoperative HHS was 96.35 due to the large number of patients with a score of 100.

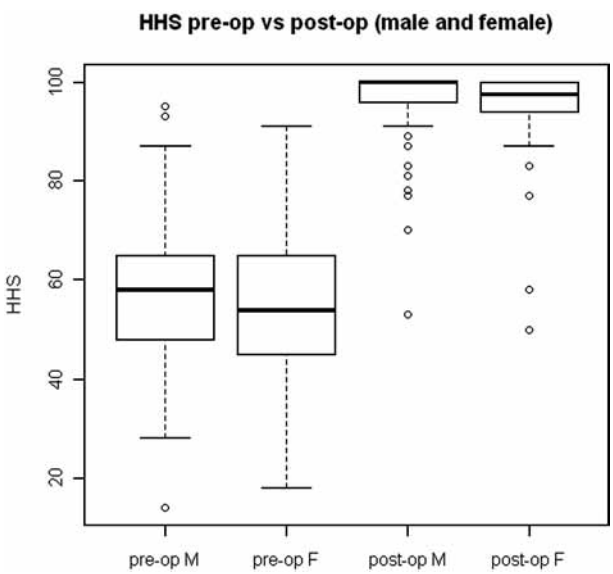

Fig. 3. — Preoperative and postoperative HHS for men and women. Postoperative scores were significantly higher in the male group. A statistically non-significant (t-test ; $p = 0.9559$) increase of the HHS between male (40.11) and female (40.23) patients could be noted.

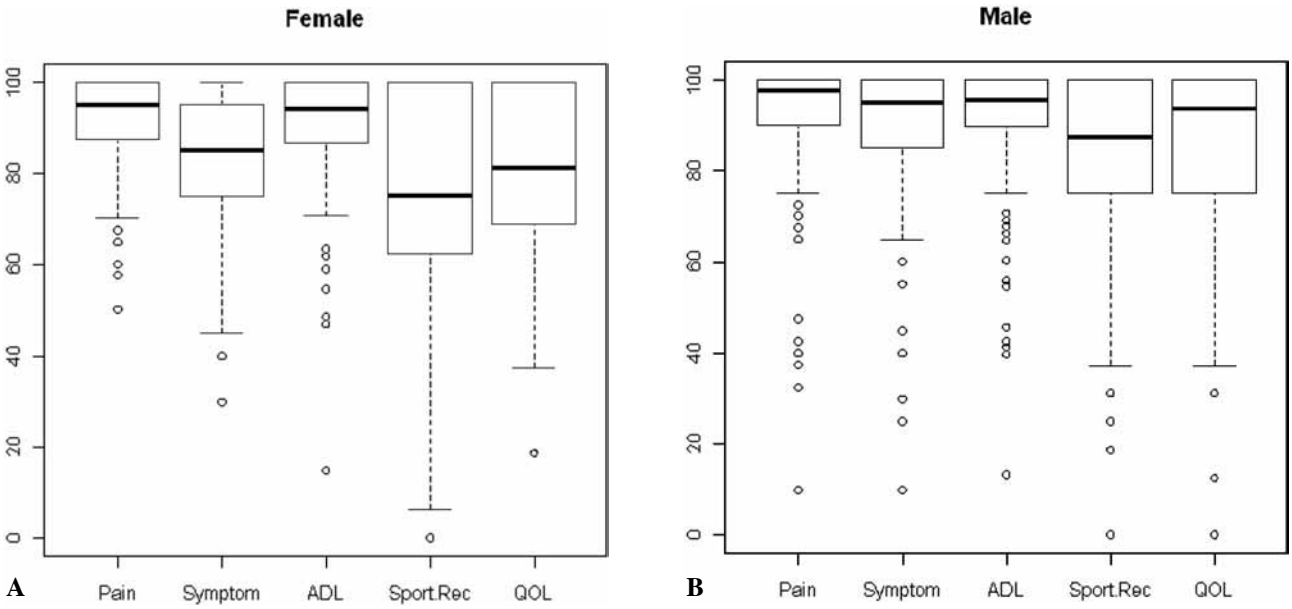

Fig. 4. — Postoperative HOOS for pain, symptoms, activities of daily living, sport and recreation, and quality of life for men (a) and women (b). A Wilcoxon rank sum test showed a significantly better result for the male group ($p = 0.0005$) in the symptom subgroup. There was no significant differences between the male and the female group for pain ($p = 0.06$), ADL ($p = 0.08$), sports and recreation ($p = 0.06$) and quality of life ($p = 0.06$) sub scores.

Fifty-eight percent of the patients practised sports on a regular basis, but 79.4% reported a UCLA activity score of 7 or more ; 15.6% of the patients reported at least one episode of squeaking. The mean VAS score for pain was 0.63 (SD = 1.26). The VAS score for satisfaction with the procedure and the VAS score for the question "if they would undergo the same procedure for the other side if it should be necessary" were 9.39 and 9.46 out of 10, respectively.

Minor complications, such as persistent mild muscle tenderness, mild groin or scar pain and slight trochanteritis, were noted in 12 hips (4.15%).

In 7 hips (2.42%), major complications not requiring revision surgery were encountered (1 dislocation in a Down-syndrome patient which required open reduction, 1 ischial nerve entrapment which required release of the quadratus femoris muscle sutures, 2 early deep infections which required lavage and 2 pulmonary embolisms).

Six hips (2.02%) in 5 patients (5 hips in female patients with a 46-mm femoral head size and 1 male patient with a 50-mm femoral head size) required revision surgery. One patient with rheumatoid arthritis treated with immunosuppressants, developed a late (35 months postoperatively) deep infection and required two-stage revision surgery. One male patient with severe persistent pain required revision surgery due to malposition of the acetabular component. Two patients required revision surgery due to osteonecrosis and one patient had to undergo bilateral revision due to aseptic lymphocytic-vasculitis-associated lesions (ALVAL) (*2*). The prosthesis in this patient was converted to a zirconium oxide-on-polyethylene friction couple. Four revisions in 3 patients were performed at our centre. Logistic regression revealed no effect of age at surgery and preoperative HHS on the probability of revision. Female patients were more likely to require revision surgery (OR : 9.7 ; 95% confidence interval [1.1-461.8]). A Kaplan-Meier survival analysis rate of 97.1% (95% confidence interval [0.9415-0.9997] or with Peto's method : [0.9221-0.9997]) at five years follow-up was calculated (Fig. 5).

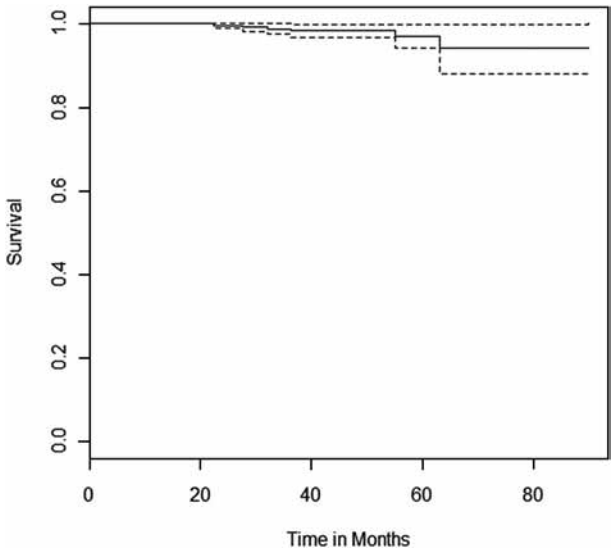

Fig. 5. — A Kaplan-Meier survival rate of 97.1% (95% confidence interval [0.9415-0.9997]) at five years follow-up.

DISCUSSION

Because demographic studies predict a growing demand for joint replacement in the younger and active population over the next decades, a better knowledge of the clinical and functional postoperative outcome of hip resurfacing is essential. The BHR arthroplasty has shown good clinical medium-term results in the implant designers' centres (*4,16,21*). The present retrospective cohort study of 297 consecutive metal-on-metal BHR arthroplasties with a 2 to 8-year follow-up reports the clinical and functional results obtained at an independent hospital.

The overall postoperative HHS score of 96.35 is slightly higher than in some other studies (*1,20*). We noted a similar increase in HHS in female and male patients. The postoperative HOOS was also not significantly different between the two groups. In younger patients, it is important that the activity level can be maintained. Only three patients could not return to their previous occupation. Fifty-eight percent were able to resume sports activities postoperatively, and 79.4% had a UCLA activity score of more than 7. This is higher than in some studies (*1,2*) and comparable to others (*4*). The VAS score for satisfaction with the procedure and the VAS score for the question "if they would undergo the same procedure for the other side if it should be necessary", indicate that the high expectations of this population have been fulfilled.

With an acceptable revision rate of 2.0% and an overall survival rate of 96.7% at five years follow-up, our results are similar to those of the implant designers' centers (*4,16,21*). The mean age of patients undergoing a revision was similar to that of the overall group. In contrast with results reported in other studies, no revisions were performed in patients with the smallest implant sizes (*1,19*).

One patient with histologically documented ALVAL had to undergo a bilateral revision to a zirconium oxide-on-polyethylene friction couple 25 and 28 months after the initial surgery. Although the prevalence of ALVAL in patients who have had a metal-on-metal hip resurfacing arthroplasty appears to be less than 1%, more clinical data are needed to determine the true prevalence of this complication (*12,15,24*). Bilateral implantation of a metal-on-metal prosthesis with a short interval between both procedures may lead to a bilateral revision when the patient develops an ALVAL reaction.

Although femoral neck fractures are a common indication for revision surgery (*1,19*), none occurred in our series. This contrasts with other studies in which more fractures were seen during the learning curve of this procedure (*23*).

There are some limitations to our study. First, annual scoring of the patients was not performed. Had this been done, it would have given us a better idea of the postoperative progression or failure over time. Secondly, no analysis of the radiographs taken at 1-year intervals was performed, as this was not the aim of the study. Finally, because of the retrospective nature of the study, only limited preoperative data were available for comparison with the results at the latest follow-up.

In conclusion, metal-on-metal hip resurfacing arthroplasty appears as a good solution for the younger patient with osteoarthritis of the hip. It provides good pain relief and good function for ADL. Patients are able to lead an active life and practice sports at the level they aimed for preoperatively. The postoperative benefits are the same in

men and women, although the revision rate is higher in female patients. The satisfaction rate confirms that we have been able to meet the expectations in this high-demand group. More studies and a longer follow-up are necessary to determine the durability of this successful type of hip arthroplasty.

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