Birmingham hip resurfacing arthroplasty
A MINIMUM FOLLOW-UP OF FIVE YEARS

We report the survival at five years of 144 consecutive metal-on-metal resurfacings of the hip implanted between August 1997 and May 1998. Failure was defined as revision of either the acetabular or femoral component for any reason during the study period. The survival at the end of five years was 98% overall and 99% for aseptic revisions only. The mean age of the patients at implantation was 52.1 years.

Three femoral components failed during the first two years, two were infected and one fractured. A single stage revision was carried out in each case. No other revisions were performed or are impending. No patients were lost to follow-up. Four died from unrelated causes during the study period.

This study confirms that hip resurfacing using a metal-on-metal bearing of known provenance can provide a solution in the medium term for the younger more active adult who requires surgical intervention for hip disease.

Hip arthroplasty in the younger and more active patient remains a challenge for the orthopaedic community. The excellent results achieved in an elderly and inactive population are generally not replicated in the younger group. In addition the expectations of a younger arthritic population have changed over the past decade such that modern prosthetic design must address both the low demand requirements of an elderly patient and the work and leisure aspirations of the younger patient.

Resurfacing of the hip has promised to offer a solution for several decades, but hitherto has failed to deliver one. Failure has generally resulted from excessive wear because of the necessarily large diameter of the femoral head. Design, fixation and bearing performance are all interrelated. Deficiencies in these areas are apparent soon after implantation and exposed in survival analyses. Historically, few resurfacing devices have had an acceptable survival analysis at five years.

The modern era of resurfacing of the hip began in 1991 and, after several pilot studies, it became clear by 1996 that a metal-on-metal device with a hybrid fixation could produce acceptable results. The Birmingham hip resurfacing (BHR) arthroplasty (Midland Medical Technologies Ltd, Birmingham, UK) became available in July 1997. It incorporated favourable design features gleaned from experience with 500 metal-on-metal resurfacings of a variety of designs. In addition, cast-in beads were used on the acetabular cup’s outer surface. Since 1997 there have been no alterations to the design or manufacture of the components. The current design is a high-carbon cast chrome-cobalt device with a stemmed spherical component designed for cemented fixation and a hydroxyapatite porous-coated acetabular component for uncemented press-fit fixation.

There has been one recent report of good early results of resurfacing arthroplasty. This paper reports a consecutive series of resurfacings of the hip using the BHR that have now reached a minimum of five years after implantation.

Patients and Methods

The inclusion criteria for the study were all patients who underwent a BHR procedure between August 1997 and May 1998, performed by one surgeon (RBCT). The decision to offer the patient resurfacing of the hip was based upon age, quality of bone and the patient’s expectations of their post-operative 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 judged by plain radiographs and an expectation that they would return to an active lifestyle, including some sports. Operative con-
sent was fully informed and included issues of metallurgy, metal ions, revision options and routine aspects of hip arthroplasty. Patients who did not normally reside in the UK were excluded from the study because of difficulties with follow-up.

The study comprised 130 patients. Of these, 14 (11%) had received bilateral BHRs, for a total of 144 hips (37 women, 107 men; 85 left hips, 59 right hips). The mean age at operation was 52.1 years (17 to 76). The diagnoses are summarised in Table I. Three arthroplasties failed during the follow-up period. Peri-operatively, there were two superficial wound infections which settled with antibiotic therapy. There were no dislocations, proven deep vein thromboses or pulmonary emboli. Four patients (four hips) died from unrelated causes but with their BHR still in place. These are not included in the remainder of the analyses.

**Operative technique.** A standardised pre- and post-operative regimen was used for all patients. Surgery was performed in a clean-air laminar-flow environment under hypotensive general anaesthesia using a posterior approach with the patient in a lateral position. The external rotators were released from the piriformis to the tendon of gluteus maximus. A posterior capsulectomy was affected and the femoral head was dislocated. It was delivered into the wound by further anterior capsular release and the neck diameter was then measured in order to determine the size of the components to be used. The head was retracted anterosuperiorly without further releases and acetabular exposure was enhanced with the use of two posteriorly-placed Judd nails and an inferiorly-placed Hohman retractor. The acetabulum was reamed with hemispherical reamers in 2 mm increments usually starting with a 42-mm reamer and continuing to within 2 mm of the desired size. A trial component undersized by 1 mm was used. The acetabular cup was impacted until fully seated. The femoral head was then prepared in sequential steps in order to accommodate the cemented head with its stem in slight valgus alignment. Simplex low-viscosity cement (Howmedica International, Limerick, Ireland) was used for all operations. Reduction of the components was performed and the soft tissues were closed in layers. For the duration of the study two suction drains were used. Surgical time was normally 30 minutes.

All patients received three doses of an intravenous cephalosporin. Warfarin was used for thromboprophylaxis. Indometacin was used on an ad hoc basis in order to prevent the formation of heterotopic bone. Patients were allowed to weight-bear fully after surgery but were encouraged to walk with two walking sticks for a period of two weeks, progressing to a single stick for a further two weeks unless it was felt that a more conservative regimen was prudent.

**Follow-up.** Patients were reviewed at six weeks and then annually, when anteroposterior (AP) radiographs of the pelvis were taken. Post-operative medical and surgical complications were recorded. All deaths occurring in the study period were analysed to establish if there was any relation to the resurfacing. Patient details were recorded including age, gender, side, diagnosis and whether they had undergone previous hip surgery. Patients were also reviewed in a clinic for this study, where it was documented if they had undergone a revision procedure or any further surgery to the hip. The range of hip movement, whether they were working and whether they were playing sport were recorded. A plain AP radiograph of the pelvis was taken and the radiological appearance and the presence of any heterotopic bone formation were assessed. Patients completed an Oxford hip score for both hips which is expressed as a percentage of the questions answered. Where patients were unable to attend for clinical review they were contacted by post and telephone. All data analysis was carried out using the R statistical package (open source software).

**Results**

Two patients sustained deep infections within the first two years (Fig. 1). This resulted in femoral loosening in one patient and a subcapital fracture in the other. In both cases *Staphylococcus epidermidis* was implicated. One patient was elderly and diabetic and required a post-operative wound incision and drainage. The second patient had no risk factors and presented with acute pain on weight-bear-

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**Table I. Summary of hip diagnoses**

<table>
<thead>
<tr>
<th>Pathology</th>
<th>Number of hips</th>
<th>(%    )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osteoarthritis</td>
<td>125</td>
<td>(87%)</td>
</tr>
<tr>
<td>Avascular necrosis</td>
<td>10</td>
<td>(7%)</td>
</tr>
<tr>
<td>Developmental dysplasia</td>
<td>3</td>
<td>(2%)</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
<td>2</td>
<td>(1%)</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>(3%)</td>
</tr>
</tbody>
</table>
Both hips were revised in a single stage to a conventional cemented total hip replacement. One patient had a late, aseptic, subcapital fracture which appeared to be avascular in origin. The timing of this fracture was unusual, occurring nine months after the index procedure. There was no pre-operative avascular necrosis, intra-operative superolateral neck notching or history of trauma. Histology confirmed avascular necrosis in the neck. At the time of implantation, suction venting of the lesser trochanter was not undertaken routinely. Subsequently this technique has been used in order to reduce both systemic and local emboli which may in turn prevent local necrosis and fracture.

A Kaplan-Meier survival analysis (Fig. 2) showed a survival rate of 98% (95% confidence interval [CI] 92 to 100) at the start of the sixth year (21 hips) and 99% (95% CI 96 to 100) excluding the two septic failures. The five-year AP pelvic radiographs of 107 (76%) hips were available to the study. Thirty of these (28%) showed evidence of heterotopic bone (Brooker grade 1 in 19 hips, grade 2 in 7 hips, grade 3 in 4 hips). No radiograph of a resurfacing which had not been revised showed signs of loosening (Fig. 3). There was no evidence of osteolysis nor of trabecular compression at the tip of stem which might indicate migration of the femoral component.

It was possible to assess the outcome of 117 (85%) of those unrevised hips using the Oxford hip score (median 2.1%, interquartile range 0 to 10.4). A total of 117 patients (130 hips) were playing sport and 111 (121 hips) were in employment.

Discussion
Historically, resurfacing of the hip has not enjoyed a good reputation and its re-introduction has met with some understandable scepticism. Pilot studies in the last decade have shown promise and although it has been shown that the femoral head remains viable fixation of the socket continues to be a problem. Hybrid fixation with a cemented head and cementless socket gives good short-term results. The introduction of an integrally cast-in bead system has two advantages, enhanced bony ingrowth and the ability to avoid post-casting heat treatments, thereby avoiding carbide depletion of the substrate metal.

The overall cumulative survival at five years is 98% and the aseptic survival rate of 99% falls within the guidelines of the National Institute for Clinical Excellence. When assessing a new prosthesis, examination of those which have failed is often more instructive than discussing survivors. True secondary avascular necrosis after resurfacing of the femoral head is an entity but probably only occurs in about one to two per thousand cases. The low incidence of secondary avascular necrosis in this series supports the use of the posterior approach despite historical concerns.

Our results for the Oxford hip score are superior to other reports published for total hip replacement. Dawson et al. published median figures for a seven-year follow-up of 30% and 35% for Charnley (Johnson & Johnson Medical Ltd, Ascot, UK) and Hi-nek prostheses (Corin Medical,

Fig. 2
A Kaplan-Meier survival plot, including the three failures, with 140 hips entered at time zero. The shaded area represents the 95% confidence limits, the lower limit is calculated by Peto’s method.

Fig. 3a
Radiographs showing bilateral a) pre-operative osteoarthritis in a 51-year-old man and b) follow-up at five years.

Fig. 3b
Cirencester, UK) respectively. This compares with the 2% which we report. This agrees with the findings of Pollard et al.18 In addition, the high rates of return to employment and pre-symptomatic levels of sport confirm that the BHR has met patient expectations.

In conclusion, the aim of this series is to present the survival of consecutive patients with a minimum of five years follow-up using a metal-on-metal hip resurfacing. The Birmingham hip resurfacing arthroplasty has remained unaltered over a six-year period. Its medium-term survival complies with independently set standards but, more importantly, it adds to the surgeon’s repertoire in managing the younger and more active patient with hip disease.

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References