The Birmingham Hip Resurfacing: 5-year clinical and radiographic results from a District General Hospital

B. Ollivere · S. Duckett · A. August · M. Porteous

Received: 3 May 2009 / Revised: 17 May 2009 / Accepted: 18 May 2009 / Published online: 9 June 2009
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Abstract We prospectively examined the functional and radiographic outcomes of a serial cohort of 104 Birmingham Hip Resurfacings in an independent centre. Final follow-up was to a mean of 61 months, and six cases were lost to follow-up. Excellent results were obtained in 91%, but obese patients had significantly ($p < 0.03$) poorer post-operative outcomes. Whilst there were no cases of neck fracture neck narrowing of up to 20 mm was noted. Radiolucent lines were present in a single zone in 9.4% (9/96) acetabular and 3.1% (3/96) femoral components. However, no components were definitely loose and there were no revisions for any reason during the period of the study. This independent series confirms that the Birmingham Hip Resurfacing gives excellent early clinical results and little early evidence of radiographic failure. The high rate of neck narrowing gives us cause for concern and we would recommend regular radiographic follow-up.

Introduction

The Birmingham Hip Resurfacing (BHR) (Smith & Nephew, London, UK) is a second-generation hip resurfacing introduced into practice in the UK in 1997. Hip resurfacing accounts for 10% of primary hip arthroplasty [1]. Developed as an evolution of the McMinn prosthesis the BHR is a hybrid cobalt-chrome polar metal-on-metal bearing with a stemmed femoral component and a hemispherical hydroxyapatite-coated acetabular compo-

nent. The design of the prosthesis with a large head and low surface roughness is thought to allow articulation through thick film lubrication potentially reducing wear and friction [2].

Early reports from the originating centre [3, 4] demonstrated greater than 98% survival at five years. Further independent series confirmed good results of the BHR in independent series [5]. To date, outcome data on the BHR has been encouraging, but survival rates in the registries do not match those of traditional total hip replacements (THRs) [1, 6]. Recently concerns have been raised about pseudo-tumour formation [7] and early failure associated with malposition of the components [8, 9].

This study aims to evaluate the mid-term results of the BHR in an independent District Hospital, with revision as a primary endpoint and secondary outcome measures of clinical and radiological failure.

Materials and methods

A series of 104 consecutive, non-selected primary total hip resurfacings were performed between June 2001 and February 2004 in a single centre. All of the patients received a BHR performed in a standard manner. Preoperative preparation included digital templating of standardised radiographs. Prophylactic antibiotics were administered on induction.

All operations were performed by one of two senior consultant hip surgeons. Patients were positioned in a lateral position and procedures were performed through a standard posterior approach. An extended release including detachment of the gluteus maximus tendon and circumferential capsulotomy was performed in order to facilitate exposure of the femoral head. Intraoperatively a jig was used to confirm the size and position of the femoral

B. Ollivere (✉) · S. Duckett · A. August · M. Porteous
Department of Trauma & Orthopaedics, West Suffolk Hospital,
Bury St Edmunds, UK
e-mail: ben@ollivere.co.uk

component, and the femoral head and acetabulum were prepared with reamers in a standard manner. The femoral component was cemented with Simplex cement with added colistin and erythromycin (Howmedica International, Limerick, Ireland). The acetabulum was prepared with serial reamers to 2 mm smaller than the definitive component in order to obtain a good press fit.

Patients underwent a standardised post-operative course and were managed according to an arthroplasty care pathway. All patients received two further doses of prophylactic antibiotics and post-operative enoxaparin (Sanofi-Aventis, Paris France) while inpatients and six weeks oral aspirin following their discharge from hospital. Patients were mobilised the day following surgery and received individual daily physiotherapy.

Patients were recruited at the time of surgery and prospectively followed with clinical review at six weeks, one, three and five years. At clinical review all patients underwent examination, were scored using a modified Harris hip score (HHS) [10] and standardised anteroposterior and lateral radiographs were performed. Radiographs were taken with patients positioned supine. The anterior superior iliac spines were equidistant from the table top, their femora internally rotated and their heels separated.

The radiographs were assessed for component position, neck narrowing [11] and loosening by two independent observers using the criteria of Hodgkinson et al. [12] and Amstutz et al. [13]. Satisfactory component position was defined as a cup abduction angle of less than 45° [9], the absence of femoral notching and satisfactory seating of both components.

The radiographs were classified as: well fixed, possibly loose or definitely loose according to previously published criteria [7, 14]. The survival of the prosthesis was calculated using these definitions and assessed at five years.

Statistical analysis was performed using Fisher's exact test for categorical data and a two-tailed *t* test for parametric continuous data. Comparison of paired HHS was performed using a Wilcoxon matched pairs test. A *p* value of less than 0.05 was defined as significant in all cases. Survival analysis was performed using the Kaplan-Meier method.

Results

Of the 104 BHRs (94 patients), six were lost to follow-up and the remaining patients continued to survive at our final review, leaving 98 BHRs. No patients had been revised at the time of final follow-up.

The mean follow-up was 61.2 months (range: 38–76). The patients had a mean age of 56 (range: 36–68, SD 6.6) and a mean body mass index (BMI) of 27 (range: 19–43, SD 19.6). Preoperative modified HHS was 44.2 (Figs. 1 and 2).

Outcomes Mean HHS improved significantly ($p < 0.0001$) from 46 preoperatively to 90 post-operatively and there was no significant ($p = 0.09$) change over the next five years. Of the patients, 91% obtained an excellent result, 5% good, 3% fair and 1% poor results [15]. Patients with a BMI > 30 had a significantly ($p < 0.03$) lower post-operative functional score as compared with normal patients. There was no significant correlation between age, sex or component size and functional outcome.

Survivorship There were no revision procedures during the period of the study. As no cases were observed to have failed survival analysis gives 100% survival, and a 95% confidence interval cannot be calculated (Fig. 3). A worse case survivorship analysis treating loss to follow up as failure is given (Fig. 3).

Radiographic findings Radiographs were available for review in all 98 patients. The acetabular component abduction angle was less than or equal to 45° in 93% (91/98) of cases. There were no cases of femoral notching or poor component seating. Radiolucent lines were present in a single zone in 9.4% (9/96) acetabular and 3.1% (3/96) femoral components. One acetabular component had two zones of progressive radiolucent lines. However, no components were classified as definitely loose.

Osteolytic lesions were identified in three acetabular and three further femoral components. No patients demonstrated any radiographic evidence of avascular necrosis (AVN) or pedestal sign formation. The mean neck narrowing was 8 mm (range: 0–20 mm). There were no cases of femoral neck fracture or deep infection. There was no significant correlation between any observed variable and neck thinning.

Fig. 1 Harris hip scores functional component

Fig. 2 Harris hip scores pain component

Discussion

The use of metal-on-metal (MoM) hip resurfacing arthroplasty has become increasingly popular since its introduction in 1997. Both the MoM bearing surface and resurfacing are established concepts. However, previous designs of MoM hips and resurfacings were withdrawn due to high failure rates [16–19]. These high failure rates were attributed to suboptimal manufacturing processes, equatorial loading and metallosis [20].

Our five year survival of 100% is comparable to previously published series [4, 5]. It is interesting to note that although not all patients had ideal component positioning none of the arthroplasties failed. Poor component position, especially abduction angles in excess of 45° , have been identified as a risk factor for poor outcome and early revision surgery [9]. In our series 93% of components were radiographically satisfactory, though none of the 7% of patients with acetabular components implanted with an abduction angle of greater than 45° have gone on to require revision surgery. It has been argued that the accuracy of component position may be improved through the use of computer guidance [21, 22] although not all authors have found navigation effective [23].

The cited advantages of the BHR over conventional total hip arthroplasty (THA) include conservation of femoral bone stock, reduced stress shielding [24] and non-violation of the femoral shaft. It has also been argued that improved function results from the more accurate restoration of biomechanics [25, 26] with the additional advantage of lower dislocation rates. In our series there was a significant improvement in hip scores post-operatively when compared

with preoperative scores. This improvement was maintained over the follow-up period.

In our series patients with a BMI of more than 30 had significantly lower post-operative HHS. This is consistent with the findings of Le Duff et al. [27] who also found poorer post-operative scores in obese resurfaced patients. Whilst this may be specific to the BHR, it is equally possible that this is a reflection on the activity levels of the patients rather than the performance of the arthroplasty. As this finding is consistent in traditional primary [28] and revision [29] hip arthroplasty, this appears the more likely explanation.

Early reported complications with the BHR include femoral neck fracture, AVN, pain and metallosis [30]. Although it has been argued a trochanteric flip approach [31] may reduce the rates of AVN, our patients were operated on through a posterior approach and we did not observe any of these complications in our series. We did however observe radiographic neck thinning of up to 20 mm. This finding gives us cause for concern although the clinical relevance of neck narrowing remains uncertain [11].

Radiolucent lines were observed in 9.4% of acetabular components and 3.1% of femoral components, but we did not observe component subsidence on serial radiographs. This finding may be of concern as previous authors have reported radiolucencies in only 3% of patients [5]. In one case an acetabular component showed progressive lucency in two zones, which may represent early component loosening.

This independent series shows that the results of the BHR are reproducible and comparable to those reported in the originating centre. The BHR gives excellent early clinical results, and there is little early evidence of radiographic failure. The high rate of neck narrowing gives

Fig. 3 Worst case Kaplan-Meier survivorship

us cause for concern and we would recommend regular radiographic follow-up.

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