Birmingham hip resurfacing: Five to eight year results

Aleksi Reito · Timo Puolakka · Jorma Pajamäki

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Abstract Hip resurfacings have been performed in our hospital since May 2001, and in this retrospective study, we analysed the clinical and radiological outcome of the first 144 prostheses (126 patients). One hundred and seven patients have visited our hospital for regular follow-up examination; 16 are not in regular follow-up and were sent a Harris Hip Score (HHS) questionnaire. Three patients live abroad. Mean follow-up was six years. One patient was lost during follow-up. Four prostheses have been revised. The six year cumulative survival rate was 96.7%. Two female patients required revision for aseptic lymphocyte-dominated vascular associated lesions (ALVAL) and two male patients due for femoral head necrosis. Both reoperated female patients had cup inclination $>60^\circ$. Mean HHS in the follow-up was 95.3, and mean patient satisfaction 2.53 on a scale 0–3. Neck thinning $>10\%$ was seen in seven hips and impingement in 12 hips.

Introduction

The idea of hip resurfacing and all-metal bearings was combined successfully by McMinn and Birmingham hip resurfacing (BHR) was introduced in 1997 [1] The results of these second-generation hip resurfacings suggest their

outcomes to be comparable with total hip replacements (THRs) but also have aroused some concern regarding short- to medium-term follow-up [2, 3] Hip resurfacing can be recommended as primary treatment for young active patients who have an isolated hip-joint disease and good bone quality of the proximal femur. In women, a young patient is usually considered to be <55 years old and among men <65 years old [2]. In the published hip resurfacing studies, mean patient age is 50–55 years on average [4–8]. Hip resurfacings have been performed in our hospital district since May 2001. We retrospectively studied the results of the first 126 patients (144 hips).

Patients and methods

A total of 126 patients received 144 BHR (Smith and Nephew, Warwick, UK) arthroplasties between May 2001 and May 2003. Patient demographics are described in Table 1. One hundred and seven patients (122 hips) visited our hospital for follow-up examination at least once, and one was lost to follow-up. Both anteroposterior and lateral radiographs of the hip and anteroposterior radiograph of the pelvis were taken prior to each visit. Clinical outcome was assessed by the Harris Hip Score (HHS). Patient satisfaction was rated on a scale of 0–3 (0=poor, 1=fair, 2 = good, 3=excellent). This information was not available at the latest examination for six patients, but their radiographs were available for analysis.

The available radiographs were studied for radiolucency, osteolysis, and heterotopic ossification. Radiolucency and osteolysis around the femoral component were classified as shown in Fig. 1 and on the acetabular side as described by Charnley [9]. Heterotopic ossification (HO) was assessed by the Brooker scale [10]. Any findings indicating

A. Reito · T. Puolakka · J. Pajamäki (✉)
Coxa Ltd, Hospital for Joint Replacement,
Biokatu 6,
33520 Tampere, Finland
e-mail: j.pajamaki@coxa.fi

A. Reito
e-mail: aleksi.reito@uta.fi

T. Puolakka
e-mail: timo.puolakka@coxa.fi

Table 1 Patient demographics

	Men	Women
Patients	82	44
Prosthesis		
Left side	36	24
Right side	36	12
Bilateral	10	8
Diagnosis		
OA	76	31
CHD	8	15
Fracture	0	4
Legg-Perthes	3	0
Caput necrosis	3	1
Other	2	1
Mean age (range)	52.1 (22 to 71)	50.7 (15 to 68)
Preoperation HHS (range)	52.2 (28 to 83)	50.7 (24 to 83)

OA osteoarthritis, CHD congenital hip disease, HHS Harris Hip Score

impingement were examined and categorised to anterior, cranial or posterior or any combination of these. Stem-shaft angle (SSA) and neck width were also measured. Neck width was determined as indicated in Fig. 1. Neck thinning >10% was considered as significant. Acetabular inclination was calculated against the horizontal line between ischial tuberosities. In case cup shadow overlapped the femoral component, the centre line of the cup opening was assessed, as in Fig. 2.

Sixteen patients living outside our hospital district have not been in regular follow-up. A letter consisting of HHS without the motion part was sent to them. Satisfaction and any possible indication for hip revision were also requested. Follow-up radiographs of these patients were not available for analysis. Three patients live abroad. The operations were performed by four different surgeons from our

hospital. The posterior approach was used in every case. Simplex antibiotic bone cement (Stryker, Mahwah, NJ, USA) was used to fix the femoral component.

Results

Mean follow-up was six (4.7–7.8) years (Fig. 3). There were 82 men and 44 women in the patient cohort. Four of the 122 hips in regular follow-up have been revised. Fourteen patients approached by letter returned the questionnaire, and one patient were contacted by phone. All 15 patients still had a functioning prosthesis. The cumulative survival rate at a mean of six years was 96.7% [95% confidence interval (CI) 95.0–98.4]. Cumulative survival rate at mean six years was 97.7% for men and at mean five years 95.2% for women. Two failures occurred in men and two in women. Information concerning the revised prostheses is shown in Table 2.

Mean preoperative HHS of the cohort was 55.0 (24–83). In the latest follow-up, HHS was 95.3 (52–100) on average. Preoperatively, the mean range of motion was 120° and in follow-up improved to 242° on average. Paresis of the peroneal nerve on the operated side was diagnosed in two patients, of whom one also had paresis of the femoral nerve. Three prostheses evinced squeaking, of these, two were revised. During the follow-up, no luxation or infection was detected. Nine patients who returned the questionnaire reported to have no pain with a good functional outcome. Five patients experienced pain: three of them considered it mild; one complaining of moderate pain. Overall patient satisfaction was 2.53 on a scale 0–3. Radiological findings are listed in Table 3. Neck thinning >10% was seen in seven patients. Mean SSA was 137°. Mean abduction angle of the acetabular component was 48.0° (35–67°). Mean abduction angle of

Fig. 1 a) Radiological division of anteroposterior radiograph (AP) and definition of neck width. b) Radiological division of lateral radiograph (Lat)

Fig. 2 Definition of cup inclination in two different situations

Fig. 3 Anteroposterior radiographs of the hip of a 53 year old man: **a** 2 months postoperatively and **b** 7.5 years postoperatively, with excellent satisfaction

Table 2 Revised patients

Patient	Age	Gender	Time to revision	Aetiology	Operation	New bearings	Result
1	47	Female	5.9 years	ALVAL	Cup/stem revision	COC	Pain free
2	58	Male	3.8 years	Neck fracture due to head necrosis	Stem revision	MOM	Squeaker
3	62	Male	4.0 years	Malposition due to head necrosis	Stem revision	MOM	Mild pain
4	53	Female	3.8 years	ALVAL	Cup/stem revision	MOP	Pain free

ALVAL aseptic lymphocyte-dominated vascular associated lesions. *COC* ceramic-on-ceramic, *MOM* metal-on-metal, *MOP* metal-on-polyethylene

Table 3 Radiological findings

	Number (%) hips
Radiolucency	
AP3	1 (0.9%)
AP5	1 (0.9%)
Osteolysis	
AP1	1
AP5	1
Lat1	2
Lat5	3
AP1–AP5	1
Lat1–AP1	1
Heterotopic ossification	
Brooker I	9 (7.8%)
Brooker II	1 (0.9%)
Brooker III	5 (0.3%)
Brooker IV	1 (0.9%)
Impingement	
Anterior	10 (8.7%)
Posterior	1 (0.9%)
Anterocranial	1 (0.9%)

AP anteroposterior, *Lat* lateral

the cups in the revised group was 55.9°. Abduction angles of the cup in our two ALVAL patients were 64° and 61° (Fig. 4). Two other women had inclination >60°, and both had neck thinning >10%.

Discussion

The mid-term survival of 96.7% of BHR prosthesis in our study is comparable with survival rates published in other

studies in which survival was reported to be between 95.8% and 99.1%, with a mean five to six years [5–8]. Eskelinen et al. reported the results of total hip arthroplasties in patients ≤55 years old for osteoarthritis from the Finnish Arthroplasty register [11]. The seven year cumulative survival rate of 1,893 proximal porous-coated uncemented stems and 1,999 porous-coated press-fit uncemented cups implanted between 1991 and 2001 was 95% for each component separately. Our results were superior compared with these results.

Neck fracture and aseptic loosening of femoral or acetabular component are the most common reasons for failure in hip resurfacings in Australia [2]. Aseptic loosening did not occur among our patients. One male patient sustained late neck fracture after 3.8 years, which in revision was found most likely to be caused by head necrosis. Steffen et al. analysed the prevalence and risk factors of neck fracture among 822 patients (842 hips) [12]. No significant risk factors were found, but a retrieval analysis of 11 fractured hips showed necrosis in nine. All these cases occurred during the first three postoperative months. Surgical technique that damaged the extraosseous blood supply to the femoral head was probably not the cause of failure, which is in accordance with the findings of Steffen et al. [12, 13]. The second head necrosis in our study occurred also in a male patient in whom the femoral component migrated into varus soon after operation, perhaps due to the surgical procedure affecting circulation to the femoral head. However, after appearing to stabilise in that position, revision was necessary only four years after operation. In addition to impairing vascularity of the femoral head, thermal damage is known to be associated with osteonecrosis and femoral head failure [14]. In the study of Campbell et al., thermal osteonecrosis was seen with aseptic loosening of the femoral component [14]. In some of these cases, osteonecrosis healing was seen, which

Fig. 4 Anteroposterior radiographs of a 47-year-old woman with cup inclination of 61°: **a** 2 months postoperatively, **b** 3.8 years postoperatively, **c** after revision for to aseptic lymphocyte-dominated vascular associated lesions (ALVAL)

indicates that failure due to osteonecrosis might not necessarily be short term. Acetabular loosening was not observed in our failed resurfacings.

The type of surgical approach used in the resurfacing operation may influence blood supply to the femoral head and hence contribute to prosthesis survival [15]. The posterior approach has been the most popular, and we used it in all our patients. Myers et al. reported no difference in survival between posterior and direct lateral approach with BHR [16]. Beaulé et al. studied the influence of the trochanteric slide osteotomy approach in the outcome of hip resurfacing [15]. They reported a reoperation rate 18.3% and do not consider using this approach routinely. Pitto, however, reported results contrary to Beaulé et al. and recommends the trochanteric slide osteotomy approach to be used routinely [17].

Only recently have pseudotumours and ALVAL possibly due to hypersensitivity to orthopaedic metals been described as a adverse outcome of cobalt–chromium (CoCr)-bearing surfaces used in hip resurfacings. Great abduction angle is known to lead to wear-related higher metal ion levels, which may lead to pseudotumours [18]. Also in our study, ALVAL patients had significantly higher inclination of the acetabular component compared to unrevised patients. Two men and two women had an inclination angle $>60^\circ$. They all had HHS 100, but both women had a neck thinning $>10\%$. In the study of Hart et al., hips with unexplained pain had acetabular inclination of 55° on average [22]. The authors did not specify type of prosthesis used. Our study suggests that in BHR, cup inclination $>60^\circ$ is a major risk factor for ALVAL and neck thinning, especially in women. Ollivere et al. described seven ALVAL cases in 463 patients [19]. In another study, the prevalence of pseudotumours was estimated as 1% at five years [20]. In our study, two of the four revised hips had findings strongly indicating ALVAL. In both cases, joint fluid was blood stained, macroscopic metallosis was present and the synovium appeared irritated. The first patient had pain in the groin area. The second patient had a palpable lump in the groin area and diffuse hip pain. Both hips evinced some kind of noise. In summary, both patients presented the most typical symptoms associated with ALVAL and pseudotumours and—notably—both patients were women. The proportion of women in studies pertaining to ALVAL and pseudotumours is 77% (47.4–100%) on average [19–23]. Ollivere et al. determined the risk ratio of female gender for ALVAL as 4.94 (95% CI 1.33–18.31) [19]. Neck thinning $>10\%$ was seen seven hips (6.1%). Heilpern et al. and Hing et al. reported prevalence of neck thinning $>10\%$ as 14.5% and 27.6%, respectively [5, 24]. The method used by Heilpern et al. for measuring neck thinning differed from ours. They did not specify any factor for neck thinning. Hing et al. reported that valgus position of the femoral component had a significant influence. In

our patients with considerable neck thinning, the mean SSA was 134. Our findings indicating impingement were seen in 12 hips (10.4%). Most could be classified as anterior. Clinical significance of impingement still remains unclear. There are no studies clarifying the aetiology and significance of impingement in long-term survival. In a recent study, Ball et al. reported the incidence of posterior femoroacetabular impingement (PFAI) to be 20% among 57 patients (69 hips) [25]. Their findings are quite contrary to ours, with only one case of impingement being posterior. As in our patients with impingement, HHS was between 86 and 100, and patients expressed no complaints. It can therefore be concluded that the clinical relevance of impingement after this follow-up period does not seem to be significant. In the study of Ball et al., no pain was associated with PFAI.

Our results, along with other published studies, show encouraging results for the mid-term survival of BHR. MOM hip resurfacing can still be considered as a good treatment for young patients fulfilling the indications for the operation. Good operative technique avoiding malpositioning of components is crucial. Steep abduction angles of the cup should be avoided, especially in women, among whom the wear-related adverse outcomes appear to be more frequent. Consideration is also advocated when selecting suitable female patients for resurfacing operation. Further investigation is needed regarding the long-term role of asymptomatic femoroacetabular impingement and its relationship with component orientation.

Conflict of interest The authors declare that they have no conflict of interest.

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