



## Survival of the Birmingham hip resurfacing in young men up to 13 years post-operatively

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**The aim of this study was to determine the medium to long term survivorship of the Birmingham Hip Resurfacing prosthesis in an independent series of young men. The medical records and radiographs of all men aged 55 and under who had undergone Birmingham hip resurfacing by the senior author were reviewed. Patients who had not attended recent follow-up or had been previously discharged were contacted by telephone. Between 1999 and 2011 a total of 147 hips were resurfaced in 155 patients (mean age 47 years (19 to 55)) with minimum 5 year follow-up (mean 8.2, range 5 to 13.9 years). Eleven hips were revised giving overall cumulative survival of 88.8% at 13 years. In conclusion, this independent, single surgeon series demonstrates acceptable survival of the Birmingham Hip resurfacing in young men. It remains a valid option in certain cases but we believe alternative bearings are more suitable for most patients.**

**Key words :** hip resurfacing ; metal-on-metal ; hip arthroplasty ; survivorship.

early failure of conventional total hip replacements (THR) in young active male patients (10, 37).

Hip resurfacing using metal-on-metal (MoM) bearings has several proposed advantages over traditional total hip replacement in young, active patients. Males in particular may potentially benefit from preservation of femoral bone stock, low wear, increased stability, and ability to perform impact activities.

Following encouraging early results the use of MoM bearings increased in popularity and a number of MoM resurfacing versions were developed by other manufacturers (14). At the same time the indications expanded to include active older patients and females (27).

The BHR is the most widely used resurfacing implant, with more than 140 000 having been implanted worldwide (31), and has been shown to be of good design and metallurgy. Unfortunately other designs have not performed as well and MOM bearings have come under scrutiny in recent years due to high failure rates associated with some devices.

### INTRODUCTION

The Birmingham Hip Resurfacing (BHR; Smith and Nephew, Warwick, United Kingdom) was introduced in 1997 to address the problem of

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Following the alert issued by the Medicines and Healthcare products Regulatory Agency (MHRA) (32) and the recall of the Articular Surface Replacement (ASR) device by DePuy in September 2010, concern increased about the use of MoM hip resurfacing in both the orthopaedic community and the general public. Metal on metal hip resurfacing procedures represented 10% of all primary hip replacements in the UK in 2006 compared to just 1% in the latest NJR report (12,34).

Excellent 10 year survival has been reported from the designing surgeons (8,26,38). However, the results from independent centres have been more variable (1,2,13,15,33). The Birmingham Hip Resurfacing (BHR) implant is recognised as one of the best performing resurfacing implants, but has been associated with higher failure rates in certain groups of patients, notably women and patients with smaller femoral heads. The best results are seen in younger men with larger femoral head diameters with most authors now advocating its use be restricted to this patient group (6,16,30).

The purpose of this study was to determine the medium to long term survivorship of the BHR in an independent series of young men aged 55 years or younger.

## METHODS

We retrospectively reviewed the medical records and radiographs, from a prospectively collected database, of all male patients aged 55 and younger who had undergone hip resurfacing using the BHR by the senior author (GVJ). There were no exclusions. Hospital clinical governance committee approval was granted and patient consent given. Patients were fully informed of the options available including lack of long-term results. Ethical approval was not required as no new treatment intervention was initiated.

Patients with known osteoporosis and presence of head cyst >2cms on pre-operative radiographs or intra-operatively, received conventional hip replacement. All procedures were performed by the senior author at one of three local hospitals (one public (NHS) and two independent). A posterior approach was used in all cases and the components

implanted according to the standard operative technique.

Ten dysplasia implants, which is an acetabular component permitting supplementary bolt fixation, and two bridging implants (larger outer diameter with supplementary bolts) were used.

The median size of the femoral component was 50mm (range 42 to 58) which was the most common size, being used in 39% of all cases. Implant size was not recorded in 9 cases.

Standard local post-operative protocols were followed with immediate full weight bearing. TED Anti-Embolism stockings (Kendall Healthcare Company, USA), calf pumps and latterly Dalteparin (for 35 days), were used for thrombo-prophylaxis.

Local departmental policy was to review patients postoperatively at 6 weeks and then at 3-4 months, 1 year and 5 years with xrays, at which point they were discharged if the implant was functioning well and the patient happy.

Following concerns regarding the high failure of some MoM implants, De Puy's recall of the ASR in 2010 and discussions at the British Hip Society meeting in March 2011, all patients were sent a questionnaire in May 2011 and invited to attend a dedicated clinic for clinical and radiological review.

All patients expressing any concerns or symptoms relating to their hip underwent further investigation including blood metal ion levels (cobalt and chromium), inflammatory markers and radiographs. Cross-sectional imaging in the form of ultrasound scanning was performed as Metal Artefact Reduction Sequence MRI was not available locally. Ultrasound was considered positive if there was evidence of a thick-walled fluid collection or solid extra-articular mass adjacent to the hip joint.

Those patients who did not return the questionnaire were sent a reminder letter and subsequently contacted by telephone to establish implant survival and again offered outpatient clinic review. Survival for the BHR in patients who had died (all from unrelated causes) was established by review of hospital records and by contacting their GPs to establish whether the hip had been revised. Unfortunately validated outcome scores were not performed and detailed clinical assessments not recorded in a standardised fashion. Implant survival

Table I. — Clinical details of the 11 patients who underwent revision of their BHR.

Patient	Age	Primary Indication	Head size	Time to revision	Year of revision	Reason for revision
1	47	OA	50	2 years	2005	Infection
2	51	OA	48	4 months	2006	Neck fracture
3	38	Perthes	54	9.8 years	2012	Pain, ARMD
4	51	OA	50	5.7 years	2012	Non-specific pain
5	54	OA	54	8.7 years	2012	Pain, ARMD
6	50	OA	50	4.5 years	2012	Neck fracture
7	37	OA	46	6.7 years	2012	Pain, raised metal ions, ARMD
8	53	OA	50	4.1 years	2012	Pain, neck resorption, raised metal ions, ARMD
9	55	OA	50	7.5 years	2012	Pain, raised metal ions
10	53	OA	48	4years	2013	Pain, ARMD

ARMD. Adverse Reaction to Metal Debris

for the whole cohort and separately for patients aged under 50 and 50 to 55 years was established with revision or last follow-up (including death as last follow-up) as the endpoint.

Statistical analysis was performed by an independent statistical consultant. Kaplan-Meier survival analysis was used to estimate the implant survival. The Mantel-Cox log rank test was used to compare age groups. A p-value  $\leq 0.05$  was considered statistically significant.

## RESULTS

Between 1999 and 2011, a total of 749 BHRs were performed in all patients. Of these, 179 prostheses were implanted in 155 male patients aged 55 years and younger (mean age 47 years (19 to 55)) and 147 had follow-up of at least five years.

126 patients (144 hips) returned the questionnaire. Of these 45 patients (51 hips) reported no problems or concerns and did not wish to return for outpatient review. 81 patients (93 hips) attended clinic for assessment and had radiographs of the pelvis and hip. There was no evidence of radiographic implant loosening in any of these patients.

Of the remaining patients, 22 (26 hips) were contacted by telephone. All stated they had no problems with their BHR and had undergone no

reoperations. Three patients (4 hips) died from unrelated causes without revision at 0.6, 6, 8 and 9 years. Four patients (5 hips) could not be traced and were lost to follow-up. The mean follow-up, excluding revisions and those lost to follow-up was 8.2 years (5 to 13.9).

40 hips were referred for US evaluation. These were considered normal in 29 cases and abnormal in 11 due to the presence of fluid collections around the hip. Metal ion levels were tested in 61 symptomatic or concerned patients. Chromium ions were raised above 7ppb level set by MHRA in 19 cases. Cobalt levels were below the 7ppb threshold in all cases. Overall averages for chromium and cobalt ion levels in those tested were 5.9 ppb (range 1.2-12.3 ppb) and 2.5 ppb (range 0.7-6.8 ppb) respectively.

Eleven hips (6.1%) have been revised at a mean of 5.5 years (0.4 to 9.8) from implantation. The primary diagnosis for all revised cases was osteoarthritis except one case of Perthes. No hips underwent reoperation for any reason other than revision. There was no association with head size and revision. Indications for revision are shown in table 1. The term ARMD has been used when US findings of fluid collections were confirmed intraoperatively at revision with evidence of metallosis and soft tissue destruction. There were two

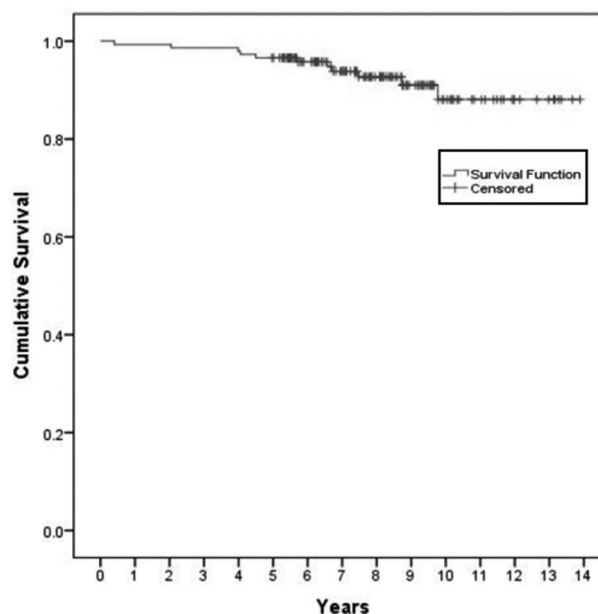
femoral neck fractures occurring at 5 months and 4.5 years post-operatively, in both cases the cup was retained with implantation of an uncemented stem and large modular metal head. There were two cases of deep infection successfully treated with two-stage revision at 2 and 6.6 years post-operatively. Of the remaining seven revisions, six were performed due to persistent pain in addition to either raised serum metal ion concentrations (cobalt and chromium ions) and/or fluid collections seen on ultrasound scanning of the symptomatic hip. One hip was revised for pain only, with normal metal ions and no signs of loosening or ARMD intraoperatively. Despite his pain remaining unexplained, his symptoms resolved following revision to ceramic on ceramic THR.

Figure 1 shows the overall cumulative survival up to 13 years (minimum 5 year follow-up), with re-operation for any cause as an endpoint, was 88.8% (95% CI : 81.6%-96.0%). A total of 84 BHRs were implanted in patients aged less than 50 years at the time of surgery with four revisions. Kaplan-Meier analysis showed 13 year cumulative survival of 90.9% (95% CI: 80.8%-100%). In comparison seven of the 63 BHRs performed in patients aged 50 to 55 were revised giving a cumulative survival of 86.5% (95% CI : 75.9%-96.2%) at 13 years in this group. See Figure 2. This was not a significant difference (log-rank test,  $p = 0.160$ ).

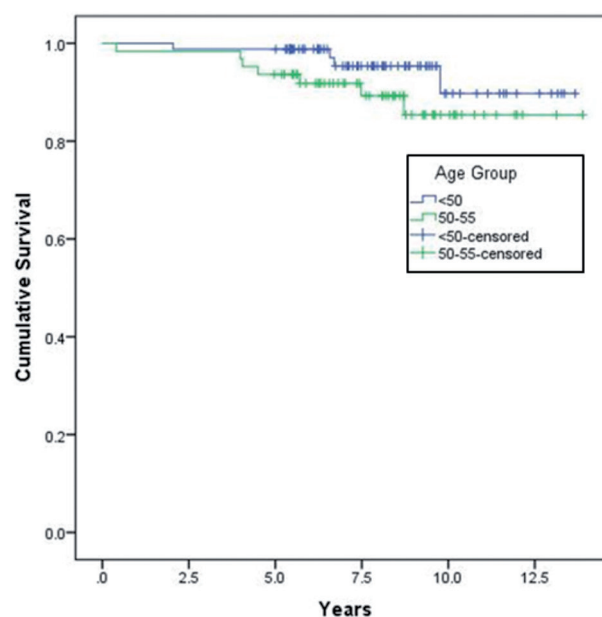
## DISCUSSION

The long-term survival for conventional THR in young and active patients has been unsatisfactory and while re-operation rates following THR are low, many previous studies have demonstrated inferior survival and clinical performance in patients younger than 55 years (3,11,18). Younger patients are presumed to place more demands on their implant due to higher activity levels (36). The optimum choice of implant/bearing surface in this group remains controversial.

Despite a trend towards the use of uncemented implants in younger patients (34). The majority of Registry data and published literature suggests cemented THRs fare better (5,21,28,39). The most recent review of the Finnish Arthroplasty Register



**Fig. 1.** — Kaplan-Meier survival curve for all Birmingham Hip Resurfacings with min 5 year follow-up ( $n = 147$ ). Revision for any indication was used as the endpoint for survival, with 11 hips revised in total.



**Fig. 2.** — 50 years ( $n = 84$ , 4 revisions) and men aged 50-55 years ( $n = 63$ , 7 revisions).

included 3,668 THRs in patients under the age of 55, implanted between 1987 and 2006. The 15-year survival in the best performing cementless group

was 62% (95% CI : 57-67) which was worse than that of cemented THRs (71% ; CI : 62-80). They conclude that the “outcomes of total hip arthroplasty appear relatively unsatisfactory for younger patients in Finland” (24).

Ceramic on ceramic (CoC) bearings are becoming more popular and a systematic review of CoC THRs recently highlighted much improved outcomes using newer implants compared to older designs (17). Several independent reports of contemporary CoC THRs have reported encouraging results with ten year survival rates above 95% (7,29), including one series of patients aged  $\leq 55$  years ( $n = 120$ ; mean age 45 years, 10 year survival 96.5%) (4).

Hip resurfacing has been seen as a bone preserving procedure which represents a pre-THR, as failure is likely into the second decade. It is therefore perceived as a means to delay THA in the younger patient with hip arthritis or as an option for the more active individual (10). BHR is chosen in active individuals because a higher level of activity post THA is not advised and can be damaging to the implant. While femoral bone stock is preserved, this is not the case for the acetabular component and indeed can prove difficult to remove when well fixed. Furthermore, now that large head MOM THR is no longer an option, in the event of a femoral neck fracture or isolated femoral loosening, the acetabular component would need to be revised as well.

Whether a patient can maintain a high level of function post BHR is still open to debate. Although several series have reported substantial improvements in activity levels and functional hip scores after hip resurfacing (10,13,22,26). A systematic review of outcomes following BHR suggested the procedure has “not shown the results that the theoretical concepts suggest or the manufacturer of the device has advocated” (19).

A review of the literature comparing hip resurfacing with THA (25) reported similar or better clinical outcomes and more natural gait pattern after hip resurfacing. However, Killampalli et al. (20) reported no differences in functional scores in young patients treated with hip resurfacing compared with THA at a minimum 5-year follow-up.

We report the survivorship of BHR in an independent series of young men. The present study includes all men aged 55 years or younger receiving a BHR by the senior author for all indications. The results show an overall cumulative survival at 13 years of 89% which is lower than other series which have shown survival rates of around 94% and upwards at ten years in men (6,9,16,30,26). However, several other centres, which have not published 10 year results, have also reported higher revision rates using the BHR at shorter-term follow-up; including Bisshop et al. (2) (five year survival 87.5%) and Berend (9.6% revision rate at 43 months) (1).

It is possible the higher revision rate seen in our series may be partly due to a lowering of the threshold for revision following the MHRA report and re-call of the ASR. This led to a great deal of anxiety amongst many of our patients. This is supported by the fact that 9 of the 11 revision procedures were performed in 2012 and 2013 after patients were called back for review and informed of the potential problems with MOM bearings. In addition, aside from the four cases revised for infection/fracture none of the other seven implants were found to be loose at revision operation.

We acknowledge several limitations of our study. Firstly the group of 179 BHRs represents only 26% of the total number of hip resurfacing procedures performed by the senior surgeon. The departmental policy had been to discharge patients at five years post-operatively if there were no concerns, and no arrangements were in place for longer-term follow-up. Following the MHRA alert, a questionnaire and information leaflet was sent to all patients who had received a hip resurfacing or MOM THR. Unfortunately a significant number of patients did not respond to this. It was therefore not possible to establish survivorship for the whole cohort due to the high number of patients lost to follow-up. The indications for hip resurfacing have narrowed and several authors have recommended hip resurfacing be restricted to young, active men. It was therefore, felt appropriate to focus efforts on contacting the 29 male patients aged 55 years and under who failed to return the questionnaire.

Secondly we do not have PROMS data for these patients however we have previously reported



good functional outcomes in the first 117 hips at 7 years follow-up (23). Thirdly radiological analysis at the latest follow-up was not available for just under half the hips, as not all patients attended for clinical review, but were instead assessed using questionnaires or telephone interview. It is possible that some hips might have radiological evidence suggestive of failure despite functioning well. The true incidence of ARMD in our series may therefore be higher than reported. Other studies reporting ten-year survival have similarly struggled to obtain complete radiological follow-up (6,30).

Despite these limitations, this study represents an independent single surgeon cohort of BHRs from a prospectively collected database with only 2.6 % patients lost to follow-up. Survival analysis into the second decade is important to determine the long-term outcome of any implant (35) and we believe this study adds valuable information in this regard.

In conclusion, this independent, single surgeon series has demonstrated survival of the BHR in young men into the second decade which is slightly lower than some series but just falls within accepted rate suggested by NICE (1% failure rate per year). While hip resurfacing remains a valid option for some patients, we no longer believe the benefits are sufficient to support its continued use as first option for most young male patients. We now favour a ceramic on ceramic bearing using uncemented hydroxyapatite coated components for this demanding patient group.

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