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Original Article

Birmingham hip resurfacing: Short term results

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Abstract

Aim: Hip joint replacement provides a dramatic improvement in the quality of life of patients with hip arthrosis but this effect has not been fully achieved in young patients because of early failure with total hip arthroplasty with high activity level. A bone mass protective procedure such as hip resurfacing arthroplasty might be advantageous in young patients. Many options for hip resurfacing prosthesis are available. One of the most used is the Birmingham hip resurfacing prosthesis. The purpose of this investigation compared retrospectively the functional, clinical and radiological outcomes of patients who underwent Birmingham hip resurfacing arthroplasty by a single surgeon for various hip arthrosis.

Materials and Methods: Twenty-six hips of 22 patients (12 male, 10 female) were evaluated by using Harris hip score preoperatively and postoperatively. Anteroposterior, lateral and cross-table lateral radiographs of the pelvis and hips were evaluated with respect to component position, migration, and radiolucency postoperatively and at every follow up. Acetabular inclination and anteversion angle, implant-femoral shaft angle, varus and valgus positon, pseudotumor formation around the hip were evaluated by radiologist. Blood samples of patients were taken at last follow ups and evaluated for cobalt and chromium levels by using an inductively-coupled plasma mass spectrometer.

Results: Postoperative Harris hip scorewas found to be significantly higher than preoperative Harris hip score. Correlation between chromium ion and size of femoral component, cobalt ion and cup anteversion angle had inverse relationship. There was significant correlation between cobalt ion and gender; females had higher levels of cobalt ion than males.

Conclusion: In order to avoid ion load in Birmingham hip resurfacing, caution in selection of patients, avoidance of the use of small components, and attention to the surgical technique to ensure proper placement of the component angles are crucial.

Keywords: Hip resurfacing; ion levels; metal-on-metal

INTRODUCTION

Hip joint replacement provides a dramatic improvement in the quality of life of patients with hip arthrosis due to different etiologic causes, but this effect has not been fully achieved in young patients because of early failure with total hip arthroplasty with high activity level. With the longer life expectancy, implants should have a longer life expectancy. For this reason, it seems that a bone mass protective procedure such as hip resurfacing arthroplasty might be advantageous in young patients (1).

When the resurfacing prosthesis came on the agenda, it was thought to be the solution younger patients (1). The primary goal was to save time for a patient who would fit a traditional total hip arthroplasty. The most important advantages of resurfacing prosthesis compared to total hip prosthesis are biomechanical properties resemblinge normal hip joint biomechanics, better joint stability, better transfer of proximal femoral load transfer, preservation of bone density, easier revision, and improved wear profiles (2). The correct surgical technique in resurfacing prostheses is critical to achieve good functional results.

Many options for hip resurfacing prosthesis are available. There are important differences among these implants in terms of metallurgy, surface geometry, and the ability to detect acetabulum-femoral components. One of the most used is the Birmingham hip resurfacing prosthesis (3). In this study, we compared retrospectively the functional, clinical and radiological outcomes of patients who underwent BHR (Birmingham Hip Resurfacing) hip resurfacing arthroplasty by a single surgeon for various hip arthrosis.

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MATERIALS and METHODS

After Institutional Ethical Review Board approval, patients who were admitted to our clinic with a diagnosis of primary or secondary coxarthrosis from March 2008 to November 2012 were included in this study. The inclusion criteria were as follows: pain, limp and limitation of activities of daily living. The exclusion criteria were as follows: infection of hip joint; neurologic deficit in muscles around the hip; Hartofilakidis type 3 high dislocations; histories of any previous pelvic, periacetabuler and femoral osteotomies;leg length discrepancy greater than 3 cm; metal hypersensitivity; osteoporosis.

All surgeries were performed by same senior surgeon (M.U.) with the posterolateral approach(Figure 1) introduced by previous surgeons, under either spinal, epidural or general anesthesia following antibiotic prophylaxis with 1 g of cephalosporine 30 minutes before induction anesthesia. Acetabular reaming was performed until a size 2 mm smaller than original component size was achieved (Birmingham HipResurfacing, Smith & Nephew Orthopaedics, Warwick, UK). Acetabulum was positioned in 40- 45°of abduction and 15-20°of anteversion, to achieve press fit cementless fixation(Figure2). Additional rim screws were placed for dysplastic hips if primary stability couldn't be achieved adequately. Following acetabular fixation, femoral preparation was started with reaming of the femoral head and canal was opened for stem of the femoral component which was placed in a slight valgus or neutral position(Figure3). Although the femoral components (Birmingham HipResurfacing, Smith & Nephew Orthopaedics, Warwick, UK) were fixed with cement (Versabond TM Smith & Nephew) for all cases, cement was not placed around the metaphyseal stem. Surgical hemovac drain was placed with negative pressure after 30 minutes of being kept closed and was withdrawn within 24 hours. All patients received 4,000 IU of low molecular weight heparin (LMWH) (Clexane, Aventis Inc., Istanbul, Turkey) subcutaneously 6 hours postoperatively for the spinal anesthesia group or immediately after surgery for the general anesthesia group and received four doses of one gram of cephalosporine (Cefozin, Bilim Inc. Istanbul, Turkey)antibiotic prophylaxis during the 24 hours postoperatively. Thrombosis prophylaxis with LMWH continued to be used until 4 weeks after the surgery. The patients were encouraged to walk with walker and were allowed full weight bearing on postoperative day one. On average, the patients gave up their walkers at the 6th week. Follow-up was done routinely at the 6th week as well as the 3rd,6th and 12th months and annually afterwards.

All patients were evaluated by using Harris hip score preoperatively and postoperatively. Preoperative scores and last postoperative scores were compared and saved for all patients included in this study. Anteroposterior, lateral, cross-table lateralradiographs of the pelvis and hips were evaluated with respect to component position, migration, and radiolucency postoperatively and at every follow up. Implant-femoral shaft angle, varus and valgus positon were evaluated by radiologist by measuring the angle between the axis of the femoral stem and the center axis of the femoral shaft. Acetabular inclination angle was assessed by radiologist by measuring the angle between a line across the inferior pubic rami and a line across the opening face of the acetabular component software was used for measurements obtained from radiographs(Figure4). Acetabular anteversion angle was assessed by radiologist by measuring the angle between the line drawn perpendicular to the long axis plane of the body and a line parallel to the projected long axis of the acetabular opening software was used for measurements obtained from radiographs (Figure5). All patients were evaluated for pseudotumor formation around the hip with USG by single radiologist. Blood samples of patients were taken at last follow ups and evaluated for cobalt and chromium levels by using an inductively-coupled plasma mass spectrometer (ICP-MS). The analysis of blood samples was done by a single laboratory and blood samples were collected without contamination by metal needle, removing the first 3 ml.We compared Co and Cr ions with age, acetabular inclination angle, implant femoral shaft angle, size of acetabular component, size of femoral component, preoperative and postoperative HHS, cup anteversion angle and, follow up time. We only detected significant correlation between Cr ion and size of femoral component and between Co ion and cup anteversion angle.

Statistical Method

Statistical analysis of two groups was performed using the Mann Whitney, Kruskal Wallis, and Spearman correlation tests. The parameters suitability for normal distribution was assessed by Kolmogorov-Smirnov test. Significance was set at $p<0.05$. The power analysis was detected as 1 by post hoc test. Analyses were performed using SPSS v. 23 for Windows (SPSS Inc., Chicago, IL, USA) software.

RESULTS

Twenty-six hips of 22 patients (12 male, 10 female) meeting the criteria were enrolled in this study. Four patients (16.6%) were operated on bilaterally.Demographics of patients are seen in Table 1. Bilateral cases were operated on with an interval of a minimum of 3 months. The minimum follow up time was 22 months (mean: 53 months). The mean Acetabular inclination angle, Acetabular anteversion, and Implant femoral shaft angle were measured as 42.31°, 27.31°, and 136.27°, respectively. The mean Co and Cr ion concentration were 10.52±26.99, 17.68±3.92, respectively. The mean preoperative and postoperative HHS were 27.19±7.57 and 91±13.92,($p<0,05$) respectively. Postoperative HHS was found to be significantly higher than preoperative HHS ($p<0,05$). The most frequentfemoral head and acetabular cup size were 46(34%) and 54(26.9%), respectively (Figure6, Figure7).

Correlation between Cr ion and size of femoral component had inverse relationship($p<0.05$ rho=-0.420), which means that as a smaller head is used, higher Cr ion levels

are detected in the blood. Correlation between Co ion and cup anteversion angle had inverse relationship (p<0.05 rho=-0.397), which indicated thatthe expectancy of Co ion level in the blood is increased with decreasing cup anteversion. There was significant correlation between Co ion and gender. These results showed us that females had higher levels of Co ion than males (p<0.05).We didn't detect any correlations between the Co and Cr ion and femoral head size which was classified as ≤ 48 and >48 size. Also we didn't find any correlation between the Co and Cr ion and acetabular cup size which was classified as ≤ 50 and >50 size. But the sample size in the ≤ 50 group (n=4) was smaller than the >50 group (n=22). Therefore we believe that accurate judgment is not logical in view of inadequate sample size.

Table 1. Data of patients

	Mean (range)
Number of hips	**26**
Gender	
Male	10
Female	12
Age (years)	45.3 (27-62)
Side	
Right	15
Left	11
Diagnosis	
Osteoarthritis	4
DDH	7
Osteonecrosis	8
Post trauma	1
Inflammatoryarthritis	6
Hospitalstay(day)	4,4(3-7)
Size of acetabularcomponent	54.38(48-60)
Size of femoralcomponent	47.85(42-54)
Acetabularinclinationangle	42.31°(24°-73°)
Acetabularanteversion	27.31°(5°-46°)
Implantfemoralshaftangle	136.27°(106°-153°)
Metal ion	
Co (µg/L)	10.52(0,51-102)
Cr (µg/L)	17.68(7.9-26.1)
HHS	
Preop	27,1(18-44)
Postop	91(46-100)
Followup(month)	53(22-81)

DDH:Developmentaldysplasia of thehip
HHS: Harris hipscore

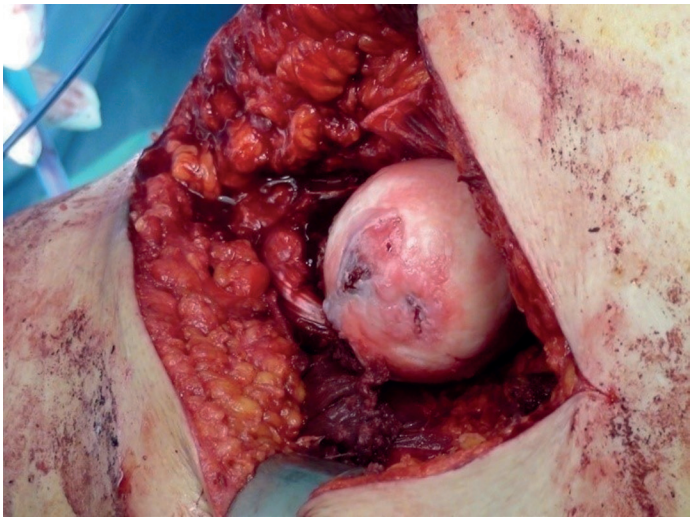

Figure 1. Posterolateral approach

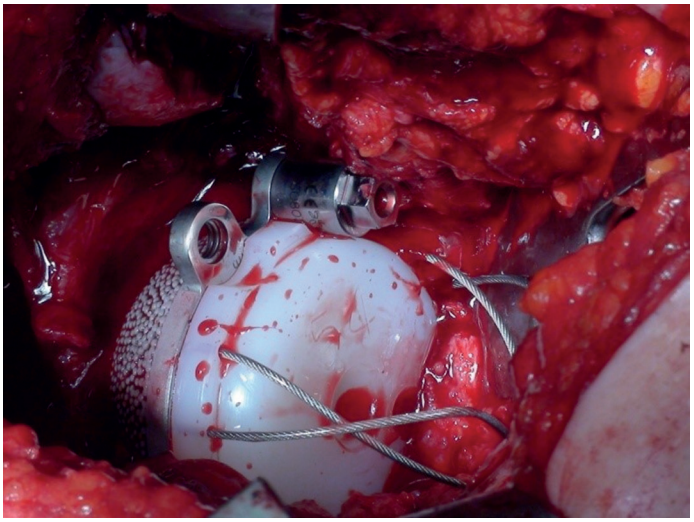

Figure 2. Acetabulum press fit cementless fixation

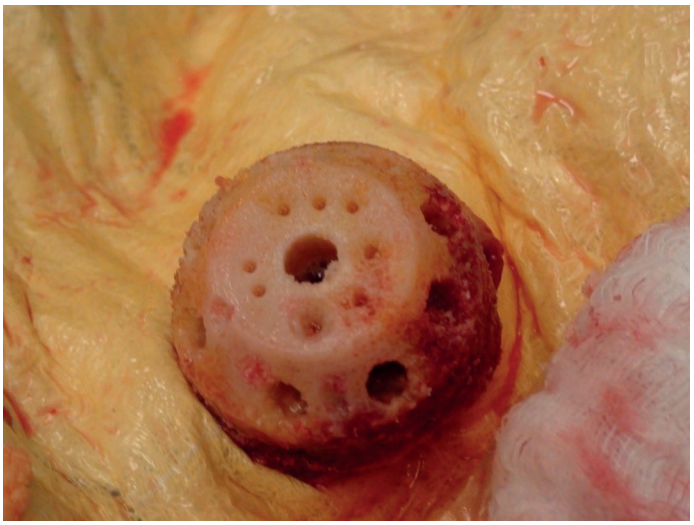

Figure 3. Femoral preparation

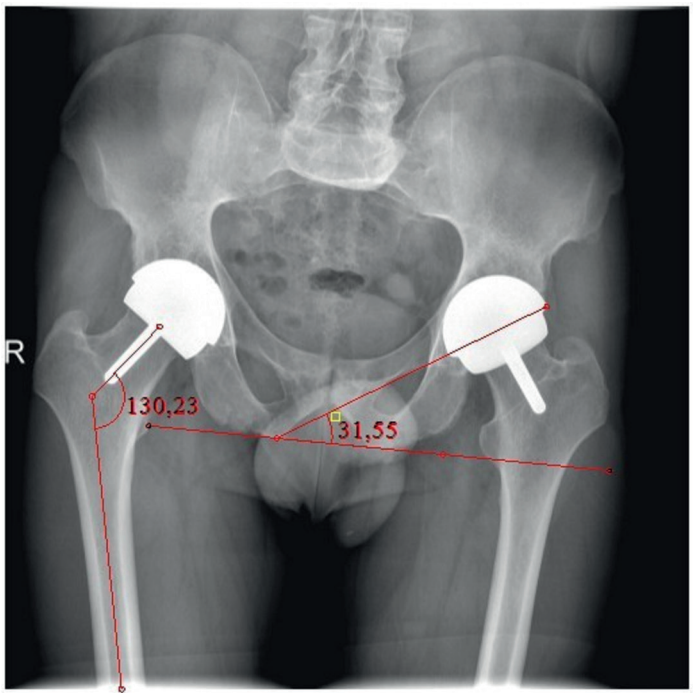

Figure 4. Implant-femoral shaft andacetabular inclination angle

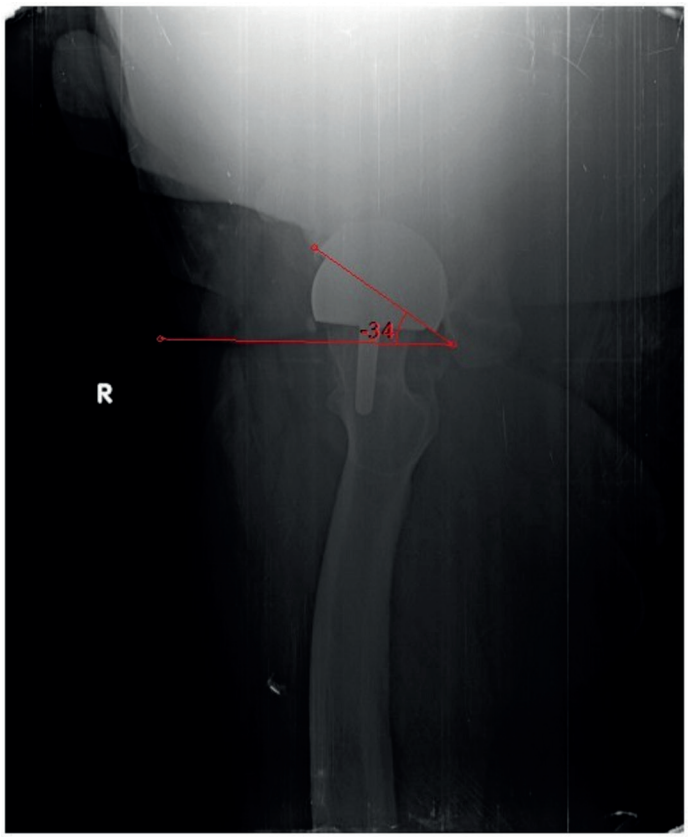

Figure 5. Acetabular anteversion angle

We didn't observe any osteolysis or component losson x-ray during the follow up. Also no pseudotumor was detected with hip USG by an experienced radiologist in our patients. We didn't have any complicationsduring the surgery or postoperative period like fractures, notching pulmonary thromboembolism, deep vein thrombosis, or superficial or deep infection. We didn't perform any revisions due to component failure or infection or other reasons.

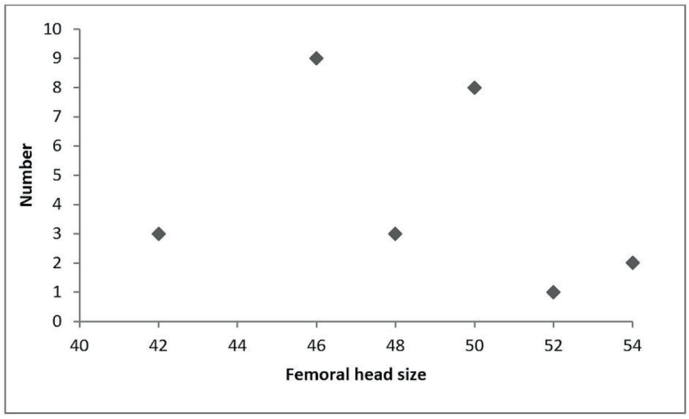

Figure 6. Femoral head size

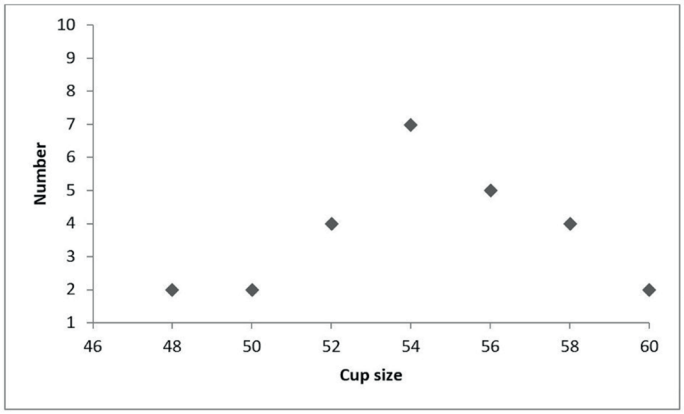

Figure 7. Acetabular cup size

DISCUSSION

Although hip resurfacing is a well-accepted option for young and active people with osteoarthritis of the hip, the current literature has debates because of short term failure which results from adverse reactions to metal debris (ARMD) causing pseudotumor and loosening of components. There are many long term studies in the literature. Mehra et al. performed 120 Birmingham Hip Resurfacings, with minimum of ten- years follow-up. The survival rate was 94.2% and mean Harris hip score was detected as 84.0 at last follow up (4). In another long term follow up study, Matharu et al reported outcome of 447 hips at mean 10.1 years follow up. The survival rate at 14 years and median University of California, Los Angeles (UCLA) score at last follow-up was reported as 94.1% (5). However even with a small patient population after minimum 22 months follow-up, no revisions were performed for failure due to the ARMD and mean Harris hip score was obtained as 91.1 in this study. Based on these results, it can be concluded that the postoperative

clinical outcomes of the patients who have undergone BHR surgery were successful and that the patients benefited from this operation.

Small femoral head diameter and consequently reduced head-neck ratio can cause edge loading and subsequent wear (6). Small component and localized bone loss greater than 1 cm in diameter are shown to be risk factors for loosening (7). Increasing the size of the femoral component increased the detection area by 49% and reduced the risk of loosening (8). Daniel et al. reported that use of femoral head size had no effect on whole blood metal ion levels (9). Parry et al. reported that there was an inverse relationship between component size and metal ion level (10). In our patients, correlation between Cr ion and size of femoral component had inverse relationship, which means that as a smaller head was used, higher Cr ion levels were detected in blood. Mehra et al. indicated that there was no effect of head size on the revision risk (11). We found a meaningful relationship between literature information and component-ion (Cr) load, and based on our work, we may propose to use large components for less ion loading.

It was recommended to place the acetabular component at 15 ° -30 ° anteversion and 35 ° -45 ° inclination (12). McMinn et al. reported that in order to prevent edge loading a 40° cup inclination angle and not more than 45 ° combined anteversion angle should be targeted (13). Langton et al. reported that ion levels increase in patients with anteversion angle less than 10 ° and greater than 20 ° (14). Tai et al. calculated the angle of inclination of the acetabular cup as 43 ° and the angle of anteversion as 19.3 ° in the measurements performed by computerized tomography. While they correlated separately with cobalt and chromium, they stated that there was no correlation (15). Although we wanted to obtain the recommended acetabular cup anteversion during surgical planning, we noticed that the measurements made were different and that these results had an effect on the metal ion burden. In this study, if the cup anteversion is decreased , the expectancy of Co ion level in the blood is increased, which means that correlation between Co ion and cup anteversion angle had inverse relationship. It is well known that deterioration of the femoral and acetabular anteversion could lead to metal debris formation, though measurement of combined anteversion is important for long term longevity of BHR.

In female patients, it is not clear that surface wear is an independent risk factor (16). Dysplasia etiology and small component may increase failure rates after resurfacing (16). Liu et al. indicated that women had a higher ion level and a higher risk of surface abrasion than men, even though they had the same component size and acetabular inclination angle (17). We found there was significant correlation between Co ion and gender and additionally female patients had higher levels Co ion than males. In the literature and in this study it could not be clarified why the ion level is higher in female patients.

There are several limitations of this study. Co-Cr ion values should be routinely measured at pre-operative and post-operative visits . In this study, we were able to evaluate patients only during the study period because of unavailability of routine ionic laboratory. Ultrasonographic pseudotumor evaluation may be inadequate in the hip resurfacing prostheses, due to high degrees of Co-Cr resulting from metal-metal surface abrasion and failure in different forms, such as adverse reactions due to the high level of metal wear debris. Pseudotumor evaluation should include computed tomography with 3D reconstruction or Mars MR. These 2 systems were not available during the study period so this led us to ultrasonography. The mean age of our patients seems to be younger compared to the literature. This was because the resurfacing prosthesis was not covered by insurance companies in elderly patients. As that problem no longer exists, we have recently preferred resurfacing prostheses for older patients with good bone quality and active life style. We will also share the results of these patients during the follow-up process.

CONCLUSION

In order to avoid ion load in BHR hip resurfacing arthroplasty, caution in selection of patients, avoidance of the use of small components, and attention to the surgical technique to ensure proper placement of the component angles are crucial.

Conflict of interest : The authors declare that they have no competing interest.

Financial Disclosure: There are no financial supports.

Ethical approval: This study was completed with the permission of the Chair of Yıldırım Beyazıt University Faculty of Medicine Clinical Research Ethics Committee (2014/149).

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