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Mid-Term Results of Metal-on-Metal Hip Resurfacing for Treatment of Osteoarthritis Secondary to Developmental Dysplasia of the Hip: A Minimum of 8-Years of Follow-Up

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

DE **Yuxing Qu**
C **Tao Jiang**
B **Hong Zhao**
B **Yi Gao**
D **Chong Zheng**
A **Jianda Xu**

Department of Orthopaedics, Changzhou Traditional Chinese Medical Hospital, Affiliated to Nanjing University of Traditional Chinese Medicine, Changzhou, Jiangsu, China

Corresponding Author: Jianda Xu, e-mail: milidoc3@163.com
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Background: Metal-on-metal resurfacing arthroplasty is an attractive alternative to conventional total hip arthroplasty in patients with osteoarthritis secondary to developmental dysplasia of the hip (DDH). The purpose of this study was to assess the mid-term clinical outcome and mid-term survivorship of Metal-on-metal resurfacing arthroplasty in patients suffering from osteoarthritis secondary to DDH.


Material/Methods: Between May 2003 and Dec. 2005, 15 operations using ASR™ and 19 using Corin were performed in 29 patients to treat advanced osteoarthritis secondary to DDHs. There were 6 males (20.7%) and 23 females (79.3%), with an average age of 47.2 years (range, 36–64 years). Clinical and radiographic results were observed. All patients were followed up at the 1st, 2nd, 3rd, 6th, and 12th months after surgery and annually thereafter.

Results: The overall survival was 88.2% at a minimum follow-up of 8 years, but the survival was 91.2% after excluding the infections as the cause of component loosening and failure. The mean Harris hip score improved from 48.27±3.13 (range, 14–71) to 89.63±3.42 (range, 65–100) at latest follow-up. The flexion was from 75.14±8.05° to 107.21±9.34. Only 4 failed because of deep infection, femoral neck fracture, and aseptic loosening.

Conclusions: Metal-on-metal resurfacing arthroplasty showed perfect results at a minimum of 8-years of follow-up in our study, and may be a reasonable option for osteoarthritis secondary to developmental dysplasia of the hip (DDH).

MeSH Keywords: **Follow-Up Studies • Hip Dislocation, Congenital • Hip Prosthesis • Osteoarthritis, Hip**

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Background

Developmental dysplasia of the hip (DDH) is an important cause of childhood disability, and the most common cause of secondary osteoarthritis (OA) in young adults. It is reported that DDH underlies up to 9% of all primary hip replacements and up to 29% of those in people aged 60 years and younger [1]. Conventional total hip arthroplasty (THA) for DDHs has success in pain relief and activity improvement. However, total hip arthroplasty requires complex reconstruction and has a less reliable outcome when compared with the results in patients with primary degenerative osteoarthritis [2].

Hip resurfacing offers an attractive alternative to conventional total hip arthroplasty in patients with DDH [3,4]. Hip resurfacing preserves the size of the femoral head close to normal and near normal biomechanical function, enables an excellent range of motion, minimizes the risk of postoperative dislocation, results in less blood loss, and makes rehabilitation easier [5–7].

However, there are few studies in the literature evaluating the functional outcome and longevity of the articular surface replacement (ASR™, DePuy Orthopedics, Inc., Warsaw, IN; Corin Medical Ltd, Cirencester, United Kingdom) for treatment of osteoarthritis secondary to Developmental Dysplasia. Our aim was to prospectively assess mid-term clinical outcomes of our experience using metal-on-metal hip resurfacing for treatment of osteoarthritis secondary to developmental dysplasia and identify the potential causes of early failures.

Material and Methods

Between May 2003 and Dec. 2005, 15 operations using ASR™ and 19 operations using Corin were performed in 29 patients to treat advanced osteoarthritis secondary to DDHs. The indication of age is patients younger than 60 years and active patients older than 60 years, who had excellent bone quality on their radiographs. Among the 29 selected patients, there were 6 males (20.7%) and 23 females (79.3%) with an average age of 47.2 years (range, 36–64 years). The mean body weight was 64.7 kg (range, 47–82 kg) and the mean BMI is 24.6 kg/m² (range, 20.4–27.1 kg/m²). According to Crowe Classification [8], 21 hips were classified as Crowe type I and 13 hips as Crowe type II. Unilateral hip resurfacing was performed in 24 patients and bilateral hip resurfacing was performed in the other 5 patients.

All operations were performed by the same surgeon. Each surgical procedure was done in lateral position through a posterolateral approach without trochanteric osteotomy. The hip was dislocated and the femur prepared. The operation could be

finished successfully with the preparation of the femoral head and acetabulum following routine procedures [9]. The femoral head was downsized when possible, trying not to notch the femoral neck. The acetabular components were implanted with cementless fixation and the femoral side was implanted with cemented fixation. The excised extensors were anatomically sutured after the prosthesis was implanted in place and no drainage was used in the incision.

Evaluation method

All patients were followed up at the 1st, 2nd, 3rd, 6th, and 12th months after the operation and annually thereafter. The Harris hip score was used to evaluate the surgical results [10], and were determined preoperatively and postoperatively at each follow-up examination. The clinical result was excellent if Harris score was higher than 90, good if it was 80–89, fair if it was 70–79, and poor if it was less than 70. The hip score at latest follow-up was used to grade the functional result. Clinical examinations to final follow-up were all available. Evaluation of pain was carried out by patients with the use of a 10-point visual analog scale. Complications were recorded at the same time.

The radiological assessment during each follow-up session and pre-operation included a standing anteroposterior radiograph of the pelvis with the X-ray beam centered at the pubic symphysis and a lateral radiograph of the operated hip joint. All the plain films were evaluated by 1 orthopedic surgeon. The Immediate postoperative radiograph was considered as the original plain film. The abduction angle of the acetabular component and the stem shaft angle of the femoral prosthesis were measured. The femoral component was considered malpositioned if it was 5° more horizontal (varus) than the medial trabecular system of the proximal femur [11]. The acetabular component was considered malpositioned if the abduction angle was greater than 65° or less than 30°.

Failure was defined by removal or revision of the prosthesis or consideration for revision based on reduction in function of the hip with radiographic evidence of loosening of the components, such as change in position of either the femoral or acetabular component or extensive radiolucent lines around the acetabular component and resorption of bone.

Statistical analysis

The changes in preoperative and postoperative hip scores were compared for statistical significance using the t test. Kaplan-Meier survival analysis was used at the deadline of the follow-up corresponding to 95% confidence limits. All calculations were performed with SPSS version 13.0 software and $p < 0.05$ was considered significant.

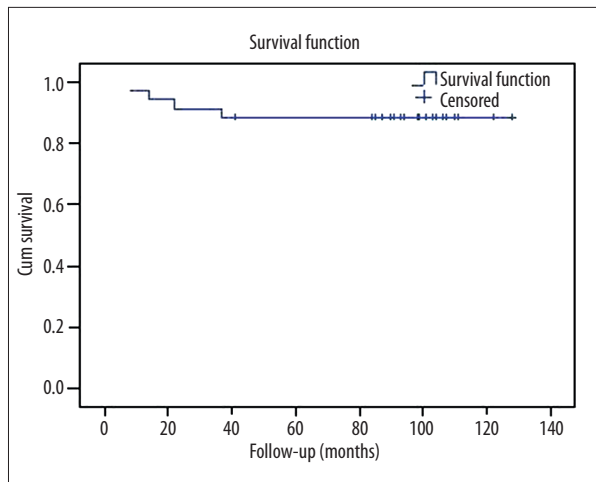


Figure 1. Kaplan-Meier survival plot for osteoarthritis secondary to DDHs treated with metal-on-metal resurfacing arthroplasty.

Results

Clinical outcomes

The overall survival was 88.2% at a minimum follow-up of 8 years (Figure 1), but the survival was 91.2% after excluding the infections as the cause of component loosening and failure. The mean Harris hip score improved from 48.27 ± 3.13 (range, 14–71) to 89.63 ± 3.42 (range, 65–100) at latest follow-up. Flexion improved from a mean of $75 \pm 8.05^\circ$ (range, 20° – 98°) to a mean of $107 \pm 9.34^\circ$ (range, 85° – 128°) between preoperative and postoperative evaluations (Table 1). Most patients experienced no pain and 3 hips (8.8%) had occasional pain in the first 6 months postoperatively, but the pain relieved at 1 year after the operation. The Figures 2 and 3 showed a patient with no pain and an excellent range of movement.

Until the deadline of the follow-up, a total of 4 failures (11.8%) occurred in these patients. One (2.9%) of the failures was due to an infection, 1 (2.9%) was due to a femoral neck fracture, and 2 (5.9%) were due to aseptic femoral component loosening. All 4 patients required revision to a conventional total hip arthroplasty.

Of the 29 patients, 17 maintained an equal limb length postoperatively. Eleven patients had less than 1.5 cm (0.6–1.5 cm) shorter limb length, and only 1 case had 2.2 cm change in the length of operated legs compared to the preoperative length. However, all these limb length discrepancies disappeared after their surgery by implanting the socket prosthesis in the true acetabular location, restoring the hip rotation center and appropriately increasing the neck-shaft angle.

Radiography outcomes

The evaluation methods mentioned previously yielded the following radiographic evaluations: postoperative radiographs revealed technical errors in 2 patients, 1 of which had a malpositioned femoral component with greater than 5° more varus postoperatively measured versus the medial trabecular system and the other malpositioned acetabular components with the larger abduction angle (Table 2); radiography showed narrowing of the femoral neck after the operation in 6 patients (Figure 4).

Complications

The most common complications seen at any time during the follow-up included deep infection, periprosthetic fracture, and dislocation. Of these patients, 1 patient had a deep infection with *Staphylococcus aureus* at 15 months after surgery, and 1 had femoral neck fracture from playing basketball (Table 3). There was no nerve palsy or deep vein thrombosis in our series.

Discussion

Metal-on-metal total hip resurfacing appears to be an effective alternative to conventional total hip arthroplasty in patients with osteoarthritis secondary to developmental dysplasia of the hip. Hip resurfacing offers several functional benefits over THA: the size of the femoral head and neck remains close to normal, the resurfaced hip is stable and capable of an excellent range of motion, and the joint retains a greater degree of normal biomechanical function. Resurfacing provides adequate pain relief and improved level of function and activity in younger patients who warrant a hip replacement. The patients in the current study showed a marked improvement in Harris hip score and flexion. The overall survival was 88.2% at a minimum follow-up of 8 years, but the survival was 91.2% after excluding the infections as the cause of component loosening and failure. We found no significant complications due to high ion levels in blood or metallosis. The implant survival and the functional outcomes score are comparable to those observed in other patients managed with metal-on-metal surface arthroplasty [12,13].

In this study, the traditional posterolateral approach was used to perform the hip resurfacing arthroplasty, and no secondary avascular necrosis after resurfacing of the femoral head occurred. The low incidence of secondary avascular necrosis in this series supports the use of the posterior approach despite historical concerns [14]. With recent dramatic improvement of hip arthroplasty technology, the trochanteric osteotomy for wider exposure has been avoided in consideration of its common complications. One study compared the posterolateral and direct lateral approaches for complications, and

Table 1. Clinical outcome of preoperative and postoperative evaluations.

Variable	Preoperative	Postoperative	P-Value
Harris hip score	48.27±3.13	89.63±3.42	0.017
Flexion	75.14±8.05°	107.21±9.34	0.039



Figure 2. A woman had metal-on-metal resurfacing arthroplasty (ASR™, DePuy Orthopaedics, Inc., Warsaw, IN) for more than 8 years. There is no pain and an excellent range of movement: (A) abduction, (B) squat, (C) flexion, (D) extension.

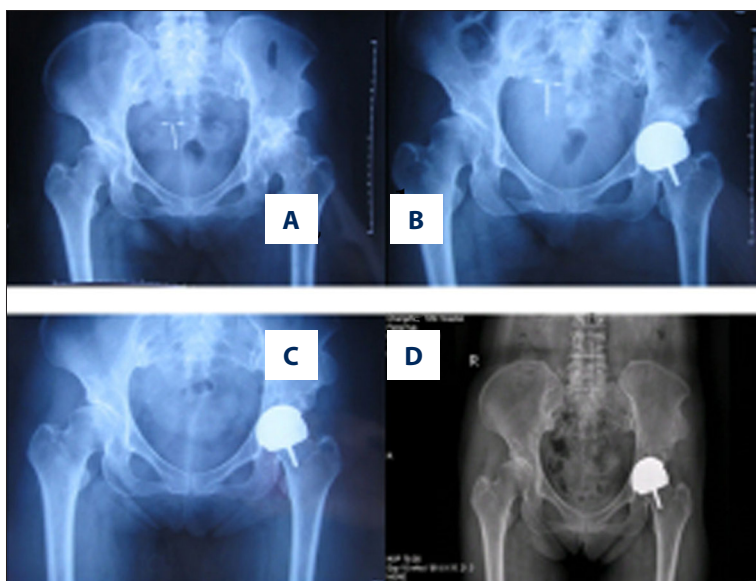


Figure 3. The same patient as in Figure 1: (A) The preoperation X-ray (B) postoperation X-ray (C) postoperation X-ray at 1 year follow-up (D) postoperation X-ray at 8 year follow-up.

reported that both approaches offer excellent pain reduction and return to function with no difference in survival or in the incidence of complications [15].

Although it has advantages, several complications can arise, such as femoral neck fractures, aseptic loosening, infection, and metal hypersensitivity. Risk factors resulting in aseptic loosening of

Table 2. Radiographic findings after hip resurfacing.

Radiographic finding	Number of hips (%)	Comments
Femoral component malpositioned	1	>65° varus postoperatively
Acetabular component malpositioned	1	The abduction angle >65°
Acetabular and femoral components malpositioned	0	
Notched femoral neck	0	
Femoral component incompletely seated	0	
Femoral neck fracture	1	
Deep infection	1	

Table 3. Complications of hip resurfacing procedures.

Complications	Number of patients	Comments
Deep infection	1	<i>Staphylococcus aureus</i>
Dislocation	0	
Periprosthetic fracture (hips)	0	
Femoral neck fractures	1	
Intraoperative femoral neck fracture	0	
Femoral nerve palsy	0	
Deep vein thrombosis	0	
Sciatic palsy	0	

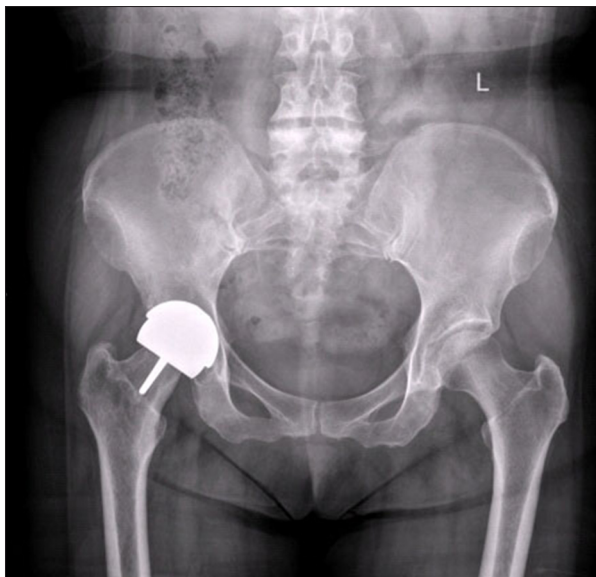


Figure 4. Radiography showed narrowing of the femoral neck with no sign of revision (arrow).

the femoral component have been identified, such as large femoral head cysts, female sex, younger age, higher body mass index (BMI), and smaller component size in males [16,17]. A total

of 4 hips underwent a revision (11.8%), and the reasons for failures were infection in 1, femoral neck fracture in 1, and aseptic femoral component loosening in 2. Femoral neck fracture is a rare complication after hip resurfacing, occurring at reported rates of 0% to 7%. Femoral components placed in 5° valgus have a factor of 6.1 reduction in the relative risk of an adverse outcome [18,19]. These findings emphasize that sufficient and careful preoperative planning is essential to improve the outcomes and longevity of surface arthroplasty. The main issues were the location of the true acetabulum with its ideal coverage and fixation, the exact match of the acetabulum and femoral prosthesis, and the length discrepancy of both legs [20]. In our experience, the aseptic femoral component loosening in 2 patients occurred at the early stage of performing surface arthroplasty, which was similar to those in previous reports, indicating that a higher rate of complications occurs at the beginning of the learning curve when first performing surface arthroplasty.

Our study has certain limitations. Due to a relatively small sample size, our study was an initial retrospective analysis of patients. Pathologic specimens of failed cases were not available to show the reasons for failure. Finally, because this was a single patient series, there were no patients or groups available for direct comparison.

Conclusions

Although greater technical challenges exist in osteoarthritis secondary to developmental dysplasia of the hip and there is a long learning curve, metal-on-metal resurfacing arthroplasty showed perfect results at a minimum of 8 years of follow-up

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in our study, and we expect to have results from longer follow-up in the future.

Conflict of interest

None.