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One-Component Revision of Failed Hip Resurfacing from Adverse Reaction to Metal Wear Debris

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ABSTRACT

This study assessed the results of 90 one-component revisions for failed hip resurfacing due to adverse reaction to metal wear debris (76 acetabular, 14 femoral). Patients with a femoral head size 40–45 mm (n = 33) received a two-piece titanium meshed shell with a cross-linked polyethylene liner and patients with femoral head size 46–54 mm (n = 43) received metal-on-metal components. Patients with femoral head size >45 mm who wished a metal-polyethylene bearing received a dual mobility femoral prosthesis. The mean follow-up was 61 months and the procedure was successful in 97% of the patients. Three failures required re-revision; there was one deep infection. There were no dislocations. One-component revision is a reasonable alternative to revision to total hip arthroplasty.

An adverse reaction to metal wear debris (metallosis) occasionally occurs after metal-on-metal hip resurfacing [1–4]. The treatment options have been revision to another hip resurfacing prosthesis or conversion to total hip arthroplasty (THA). Previous reports describe a high rate of complications such as infection, dislocation, component loosening, diminished function, and periprosthetic fracture with revision to THA [1–3,5]. Some patients also have recurrent metallosis. Previous reports have noted a high failure rate with metal acetabular-only revision [1–3].

There have been more failures of metal-on-metal resurfacing prostheses with smaller femoral head sizes compared to larger sizes [6–10]. The author postulated that revising smaller-sized resurfacing acetabular prostheses from metal-on-metal to metal-on-polyethylene might salvage the hip resurfacing procedure. For larger-sized components, revision of the acetabular prosthesis maintaining a metal component might be effective. The author also postulated that using the dual-mobility prosthesis to maintain a natural femoral head size when revising the femoral component might improve outcomes. The dual mobility prosthesis also allows conversion from a metal-on-metal to polyethylene-on-metal joint by way of a one-component revision. One surgical goal of the revision procedure was to provide a stable hip by maintaining the pre-revision femoral size. The other goals of one-component revision surgery were to limit complications, improve functional outcomes, and reduce surgical effort for the patient and surgeon.

For some patients with a failed resurfaced hip, the advantages of hip resurfacing may remain important and they may elect to undergo a revision of the acetabular component of their resurfacing procedure rather than THA. The advantages of hip resurfacing include less resection of femoral bone, reduced risk of dislocation, better function, and a less-complicated revision to THA, if necessary [6,11,12]. If one-component revision can be performed more efficiently and with favorable outcomes, it can be an alternative to complete revision to THA.

There is very limited literature on acetabular-only revision following hip resurfacing. Seven acetabular-only revisions with favorable outcomes in each patient were reported in 2008 [5] but the senior author reported an additional three acetabular revisions in 2011 and noted there were three failures of the 10 revision procedures [1]. A 2010 report from the Australian joint replacement registry showed a 20% failure rate with acetabular-only revisions of failed hip resurfacing [2]. These reports, however, used only one-piece metal components. Previously, this author reported 25 hip resurfacing revisions with favorable outcomes using either metal or polyethylene acetabular prostheses [13].

This prospective study was conducted to determine the results and complications of one-component only revision surgery.

Patients and Methods

The institutional review board approved this study. This is a prospective study of 89 selected patients (90 hips) who presented for treatment of an adverse reaction to wear debris following metal-on-metal hip resurfacing. Inclusion criteria were the author's indications for revision surgery: (1) pain, (2) an effusion that was evident clinically or by imaging, (3) a progressive increase in clicking or clunking

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sensations from the hip, and (4) a feeling of vibration and/or instability [13] (Table 1). The decision to perform revision surgery was based on these clinical grounds rather than on elevated cobalt levels or radiographic evidence of component malposition in the absence of pain and mechanical symptoms. Component malposition is compatible with a satisfactory outcome in some instances. In this study, elevated blood cobalt levels (i.e., >7 μg/L) were considered as supportive evidence of an adverse reaction to wear debris. The indications for an acetabular-only revision were: (1) excellent initial functional outcome following primary hip resurfacing, (2) a healthy femur on imaging, (3) ideal femoral component position, (4) a well-fixed femoral component, and (5) an active patient. The indication for using a metal rather than a polyethylene acetabular bearing was based on the size the bearing surface. Patients with a femoral head component size ≤45 mm received a polyethylene acetabular revision prosthesis. Patients with a femoral head size of ≥46 mm received a metal acetabular revision prosthesis from the same manufacturer as the primary prosthesis. The indications for using the dual mobility prosthesis were: (1) a well-fixed and well-oriented acetabular component, (2) any concern about the health or security of the femur or position of femoral prosthesis, (3) patient desiring a metal-on-polyethylene bearing with a femoral head size > 44 mm. The dual mobility prosthesis is a bipolar prosthesis in which a large diameter mobile polyethylene head is snapped onto a small diameter fixed femoral head. The dual-mobility bearing articulates with any metal acetabular bearing and is fixed on the trunnion of any desired femoral stem.

The exclusion criterion for one-component resurfacing was concern about both the femoral and acetabular components. These patients were treated by revision to THA.

All patients had pre-revision radiographs. The position of the femoral component was determined by comparison to the femoral neck axis. Components that were in >5° of varus or valgus were considered to be in poor position. The method of Amstutz was used to determine the stability of the femoral component [6]. The acetabular cup position was assessed by measuring the lateral edge of the acetabular component relative to a horizontal reference line in the frontal plane. This abduction angle indicates the amount of lateral opening, typically between 30° and 60°. In the lateral plane, anteversion of the socket is measured by the angle created from a vertical line perpendicular to the horizontal plane and the edge of the acetabular component using a Johnson shoot-through lateral radiograph [14]. Typical values for anteversion are between 0° and 30°. Loose acetabular components were defined as components that had changed position or had radiolucent lines around more than 30% of the component. Spot welds and bone trabeculae through the metal indicated osseointegration. Blood cobalt levels were obtained preoperatively and repeated at final follow-up using the same laboratory (ARUP Lab, Salt Lake City, UT).

In all cases, the approach for revision surgery utilized the same approach as for the primary procedure. The posterolateral approach was used for 70 procedures, 3 patients had a direct anterior approach, and 17 had an anterolateral approach. The acetabular components were removed using hand chisels only, with care taken to preserve bone. Any retained component must be examined carefully for visual signs of damage.

Postoperatively, all patients underwent routine rehabilitation with full weight bearing allowed. No anti-dislocation braces were used and there were no additional precautions beyond those used after primary hip resurfacing surgery. Postoperatively, patients were followed radiographically at 2 weeks, 6 weeks, 6 months, and annually. The Harris Hip Scores were recorded prior to revision and at final follow-up [15].

Results

The author performed 90 (76 acetabular-only revisions and 14 dual-mobility, femoral-only) revisions in 89 patients with adverse reactions to wear debris following metal-on-metal hip resurfacing procedures. The patient demographics are shown in Table 2. The most common original diagnoses were osteoarthritis and dysplasia.

The one-component revision procedure was successful in 87 of the 90 (97%) revision procedures. For acetabular-only revision patients, the follow-up period averaged 65 months (range, 48–118 months) and for dual-mobility revision patients, the follow-up period averaged 41 months (range, 36–53 months). As a result of the acetabular-only revision, both the femoral and acetabular resurfacing components were retained in 73 of 75 patients (97%). There were no revisions or complications of any type with the dual-mobility prosthesis or with acetabular-only revision procedures using polyethylene.

All patients improved their Harris Hip Score by at least 12%, from a pre-revision average of 72.2 (±13) to an average of 93.2 (±9) at a mean follow-up of 61 months. The 21-point average improvement is clinically and statistically significant ($P < .0001$, paired t-test). Radiographic examination at regular intervals postoperatively showed that all components except one remained well fixed.

Table 1
Indications Leading to Revision.[a]

Pre-Revision Signs and Symptoms	Hips (n)
Pain, noise	30
Pain, noise, instability	18
Pain, noise, effusion	11
Pain, noise, cobalt	9
Pain, instability	4
Pain	3
Effusion, noise	3
Pain, cobalt, instability	3
Pain, noise, effusion, instability	3
Pain, effusion	2
Cobalt, noise, effusion	2
Cobalt, noise, effusion, pain	2
Pre-revision signs and symptoms	**Patients n (%)**
Pain	86 (96)
Noise	81 (90)
Effusion	36 (40)
Instability	34 (38)

[a] In this study, elevated blood cobalt levels (i.e., >7 μg/L) were considered as supportive evidence of an adverse reaction to wear debris.

Table 2
Patient Demographics.

Variable	Result
Revisions/re-revisions (n)	90/3
Male/female (n)	46/43
Mean age at revision surgery (years)	49.8 (32–71)
Primary diagnosis (n)	
Osteoarthritis	45
Dysplasia	36
Avascular necrosis	5
Fracture/trauma	2
Rheumatoid arthritis	1
Primary resurfacing components (n)	
Birmingham hip resurfacing system[a]	35
CONSERVE plus total resurfacing hip system[b]	32
Cormet hip resurfacing system[c]	7
ASR hip resurfacing system[d]	8
ReCap total hip resurfacing system[e]	4
Durom hip resurfacing system[f]	4
Mean time between index resurfacing and revision (months)	33.3 (16–59)

[a] Smith & Nephew, Inc., Memphis, TN, USA.
[b] Wright Medical Technology, Inc., Arlington, TN, USA.
[c] Stryker Orthopaedics, Mahwah, NJ, USA.
[d] DePuy Orthopaedics, Inc., Warsaw, IN, USA.
[e] Biomet, Warsaw, IN, USA.
[f] Zimmer, Inc., Warsaw, IN, USA.