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Isolated Polyethylene Exchange versus Acetabular Revision for Polyethylene Wear

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Abstract Polyethylene wear and osteolysis are not uncommon in THA mid- and long-term. In asymptomatic patients the dilemma faced by the orthopaedic surgeon is whether to revise the cup and risk damage to the supporting columns and even pelvic discontinuity or to perform isolated polyethylene exchange and risk a high rate of postoperative recurrent instability and dislocation that will necessitate further surgery. We retrospectively reviewed 62 patients (67 hips) who underwent revision arthroplasty for polywear and osteolysis. Thirty-six hips had isolated polyethylene exchange, while 31 had full acetabular revision. The minimum followup was 2 years (mean, 2.8 years; range, 2–5 years). Three of 36 hips with a retained cup grafted through the cup holes failed within 5 years due to acetabular loosening. One of 31 hips with full revision underwent re-revision for aseptic cup loosening at 5 months postoperatively. Although we do not recommend prophylactic revision of all cups for polywear and osteolysis, the patient may be warned of the possibility of an approximate 10% failure rate when retaining the acetabular component. We do, however, advocate cup extraction in the following situations: damage to the locking mechanism, erosion of the femoral head through the liner and into the cup damaging the metal, and a malpositioned component that may jeopardize the stability of the revision.
Level of Evidence: Level II, prognostic study. See the Guidelines for Authors for a complete description of levels of evidence.

Introduction

Total hip arthroplasty (THA) is one of the most successful procedures performed for various hip disorders, including degenerative joint disease, rheumatoid arthritis, osteonecrosis, and degenerative changes secondary to developmental dysplasia [5, 7, 20, 21]. The result is a greater demand for THA with the number of operations expected to double in the next decade [8–10]. Although contemporary materials and enhanced bearing surfaces have improved the durability of THA, failure secondary to instability, malpositioning, infection, aseptic loosening, and polyethylene wear is inevitable.

Polyethylene wear and osteolysis occurs frequently and the surgeon must decide whether to exchange the polyethylene alone or revise the acetabular cup instead, especially in the presence of a well-fixed acetabular component [15, 18]. Several authors have advocated revising the acetabular component due to reportedly high rates (15% to 30%) of postoperative instability and dislocation with isolated polyethylene exchange [1, 2]. On the other hand, other investigators support retaining the acetabular shell in part due to the lower dislocation rates in their series, which they attributed to the use of the anterolateral and direct lateral approaches [16, 19].

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Each author certifies that his or her institution has approved the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

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We hypothesized polyethylene exchange without or with bone grafting has a satisfactory outcome for treating polywear and osteolysis as compared to complete acetabular revision.

Materials and Methods

We retrospectively reviewed 62 patients (67 hips) in whom 36 hips (54%) had polyethylene exchange and 31 hips (46%) had complete acetabular revision. We searched our joint registry database to identify patients who underwent revision THA at our institution from 2002 to 2004. The study population included 35 women (56.5%) and 27 men (43.5%) with an average age of 62.4 years (range, 31–88 years) and average body mass index (BMI) of 28.7 (range, 19–53). Primary THA was performed for degenerative osteoarthritis, dysplasia, avascular necrosis, rheumatoid arthritis, and posttraumatic arthritis. Revision surgery was performed at an average of 12.4 years (range, 2–23.8 years) after the index THA. Patients were followed for a minimum of 2 years (mean, 2.8 years; range, 2–5 years). There were no patients lost to followup during this period. We had prior Institutional Review Board approval.

Demographic data and time to revision were recorded from the medical records (Table 1). We obtained the type of implant, liner elevation, and size of femoral head from the operative records. The type of cups used in the poly-exchange group were 25 Universal cups (Biomet, Warsaw, IN), three Howmedica Osteonics cups (Stryker, Mahwah, NJ), three Duraloc cups (DePuy, Warsaw, IN), three Reflection cups (Smith & Nephew, Memphis, TN), and two Converge cups (Zimmer, Warsaw, IN).

All patients underwent revision arthroplasty using direct lateral approach and under regional anesthesia. Bone graft

Table 1. Demographic, surgical, and clinical factors of patients with isolated polyethylene exchange versus full acetabular revision

Continuous variables	Polyethylene exchange		Complete acetabular revision		p value
	Mean	Range	Mean	Range	
Age	65.5	40–85	58.8	31–88	0.035
BMI	27.3	19.6–44.6	30.5	19.2–52.7	0.051
Estimated blood loss	351	50–1400	603	50–2300	0.028
Operative time	105	30–262	120	62–240	0.183
Time to revision	13.1	7.7–23.7	11.4	2–23.8	0.093
Categorical variables	**Values**	**Percentage**	**Values**	**Percentage**	**p value**
Gender					0.461
Female	17	50.7%	18	63.2%	
Male*	16.5*	49.3%	10.5*	36.8%	
ASA I	2	5.6%	3	9.7%	
ASA II	22	61.1%	12	38.7%	
ASA III	11	30.6%	16	51.6%	
ASA IV	1	2.8%	0	0	
Osteoarthritis	31	86.1%	24	77.4%	
Avascular necrosis	3	8.3%	1	3.2%	
Posttraumatic arthritis	1	2.8%	2	6.5%	
Acetabular dysplasia	0	0	2	6.5%	
Spondyloepiphyseal dysplasia	0	0	2	6.5%	
Rheumatoid arthritis	1	2.8%	0	0	
Patients/hips	**Polyethylene exchange**		**Complete acetabular revision**		
Operated hips	**36**	53.7%	**31**	46.3%	
Operated patients*	**33.5***	54%	**28.5***	46%	
Total hips in cohort	**67**				
Total patients in cohort	**62**				

Five patients had bilateral revision surgery, two in each group, and *one male patient had only polyethylene exchange in one hip and complete acetabular revision in the other hip.

was used in 15 of 31 (48%) patients undergoing revision of the acetabular component. In most of these patients the acetabulum could be reamed to accept a larger diameter acetabular component, obliterating the osteolytic lesion. Of the 36 hips that underwent isolated polyethylene exchange, allogenic bone graft was impacted through the cup holes in 32 hips. In the remaining four hips, either the size of osteolysis was not deemed large enough to require bone grafting or an access point to introduce the graft could not be found. Complete acetabular revision was performed in the remaining 31 hips for wear and osteolysis and for several other reasons. The locking mechanism was damaged in two cases, and the size of the cup precluded the alternative of cementing a polyethylene liner into these well-fixed cups. The femoral head had eroded into the metal shell in eight cases. The orientation and position of the acetabular component was less than optimal for a stable construct in six cases, in which preoperative evaluation showed no apparent malpositioning of the acetabulum, but intraoperatively the cup was in neutral position in four patients and retroverted in the other two patients, although these patients did not complain of any preoperative instability. Incompatibility of the old shell with newer-generation polyethylene liners was encountered in five cases, and the acetabular component was poorly attached after removing the screws in 10 cases. Allograft was inserted into the acetabulum in 12 of 31 hips. Prophylactic antibiotics were administered to all patients within 1 hour of surgery. Femoral head sizes 28 mm and 32 mm were the most frequently used, while one hip received a 36-mm and four a 22-mm head. A high wall, 10°, and 20° elevated liners were inserted in the majority of cases with the exception of 10 patients who received a nonelevated liner. Autogenic blood was routinely transfused intraoperatively in all patients who had donated their own blood preoperatively, while allogeneic transfusion was deemed necessary in only two cases. Drains were not used in any patient.

Two of the authors (CR, WJH) independently reviewed all preoperative and followup radiographs for signs of loosening, osteolysis, and implant malposition. There were no differences in opinion between the two reviewers. The survival time of the implant construct was taken from the time of revision. Postoperative complications including infection, wound drainage, and mechanical failure were documented.

The means of patient age, BMI, and longevity in years of initial arthroplasty until revision for polywear were calculated and compared using t-test, while Chi square test was used to compare the gender distribution between the two groups of patients. Given the low number of patients who underwent re-revision, a Fisher exact test was used to compare the failure rates between the two cohorts. All analyses were performed using SPSS software (version 13; SPSS, Inc., Chicago, IL).

Results

We found no difference ($p = 0.62$) in failure rates between the patients who had full acetabular revision and those who had only polyethylene exchange. Three of 36 acetabular components retained were bone grafted through the cup holes and loosened at 20, 31, and 53 months after the index revision. These three patients, all of whom had a Universal cup (Biomet, Warsaw, IN) with ongrowth surface, had extensive superior and medial osteolysis. The implantation times of the three cups were 25.5, 16.8, and 17.5 years respectively. Two hips were reconstructed using allograft and an upsized Trident porous-coated cup (Stryker, Mahwah, NJ), while the third had a tantalum trabecular metal-coated cup (Zimmer, Warsaw, IN) with trabecular mesh augments for proper fixation and support.

Among the 31 hips with complete acetabular revision, one cup loosened and the patient underwent another revision at 5 months after index revision surgery. The patient had received allograft during the index revision but was reconstructed during the second operation using only an upsized tantalum trabecular metal-coated cup (Zimmer, Warsaw, IN).

Discussion

Polyethylene exchange with bone grafting for polywear and osteolysis renders itself as a relatively simple and benign operation compared to revising a well-fixed acetabular component. The dilemma faced by surgeons treating patients with osteolysis and well-fixed acetabular components, therefore, is when to choose polyethylene exchange alone versus revising the acetabular component. The high incidence of dislocation reported in two series [1, 2] after isolated polyethylene exchange has prompted some surgeons to choose revision of the acetabular component in most cases [1–3]. Other investigators have advocated the opposite and recommend more conservative measures such as bone grafting through the cup holes to preserve bone stock and halt the progression of osteolysis [6, 12, 19]. These studies consisted of a relatively heterogeneous population that included patients who presented with instability and recurrent dislocation that biases the surgical intervention and postoperative results. Given that there is still no general consensus or specific guideline indicating whether a well-fixed acetabular shell should be revised or retained, we set out to answer this question with a more homogenous population of patients who presented

with only polywear and osteolysis as their primary indication for surgery.

Some caveats must be kept in mind when scrutinizing our results. To reduce possible biases that may have influenced the surgeon's decision in favor of removing the acetabular component we excluded patients with instability or dislocation or gross loosening of their components associated with concomitant polywear and lysis. The two cohorts were not matched and it is plausible that factors such as BMI, activity level, age, and degree of osteolysis may have influenced the outcome. Because of the relatively small sample size, we were not able to perform meaningful analyses to evaluate the influence of each factor. In addition, the reason for low incidence of dislocation (none in this cohort) after isolated polyethylene exchange in our patients may relate to the type of surgical approach, direct lateral in this case. Thus the findings of this study may not be directly applicable to patients undergoing similar procedures using posterior approach which is associated with a higher incidence of instability [11].

We found a similar acetabular failure rate after revision THA for isolated polyethylene exchange compared to complete acetabular revision for polyethylene wear and osteolysis in uncemented cups. Although bone grafting was implemented in accordance with the recommendations in the literature to halt osteolysis [6], acetabular cup loosening may have resulted, possibly due to inadequate retroacetabular bone stock. On the other hand, the acetabular failure rates of early-generation porous-coated implants have been reported to range between 5% to 24% at 10 to 15 years followup [4]. Therefore, the acetabular components in the polyethylene exchange group may have failed due to their advanced implantation age, which approached 20 years after index surgery.

A recent investigation by Lie et al. [13] reported a higher cup revision rate in patients who underwent isolated polyethylene exchange compared to previous studies. However, the incidence of postoperative dislocation and cup loosening was similar to the group that had acetabular revision in their series. Furthermore, some of their patients may have undergone polyethylene exchange or cup revision for instability, malpositioning, and loosening without the associated polywear and osteolysis factor [13]. The question still remains to be answered.

To extract the acetabular components in every case of polywear and osteolysis implies relying on the retroacetabular bone stock quality. Maloney et al. [14] first reported treating retroacetabular osteolysis with revision of the well-fixed cup and bone grafting. They observed large medial wall defects, extensive damage to the anterior and posterior columns, and in some cases pelvic discontinuity. To fill the substantial bone defects created after revising the acetabular component, cages and allografts are sometimes necessary although these are associated with lower survivorship and poor outcome [17]. The addition of bone graft through the acetabular holes may increase the overall quality of the defect with infilling and remodeling. Therefore, when the eventual need for revision surgery arises due to acetabular loosening, the patient may be revised with less aggressive implants.

Although we do not recommend prophylactic revision of all cups for polywear and osteolysis, we believe retaining acetabular components with poor track records, such as the Universal cup in this series, is likely to lead to higher failure. Nearly 10% of the acetabular components that had been retained failed at an early time point. However, all of these components were the ongrowth type with poor in vivo performance. As a rule we advocate revision of the acetabular component in the following situations: damage to the locking mechanism, erosion of the femoral head through the liner and into the cup damaging the metal, and a malpositioned component that may jeopardize the stability of the revision.

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