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Isolated Polyethylene Exchange versus Acetabular Revision for Polyethylene Wear

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Running title: Polyethylene alone versus Cup Revision

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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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ABSTRACT

Polyethylene wear and osteolysis are not uncommon features seen when assessing advanced survivorship in THA. The dilemma faced by the orthopedic 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 possibly encounter a high rate of postoperative recurrent instability and dislocation that will necessitate further surgery. Of 67 hips that underwent revision arthroplasty for polywear and osteolysis, 36 had isolated polyethylene exchange, while 31 had full acetabular revision performed. The minimum follow-up was 2 years (mean, 2.8 years; range, 2 to 5 years). Three of the 36 hips with a retained cup that were grafted through the cup holes failed due to acetabular loosening within 5 years postoperatively. One of the 31 hips with full revision required re-revision for aseptic cup loosening at 5 months postoperatively. Although we cannot recommend prophylactic revision of all cups for polywear and osteolysis, the patient may be warned of the possibility of a slightly higher 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.

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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.[6,9,23,24] The result is a greater demand for THA with the number of operations expected to double in the next decade.[10-12] 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.[8,16]

Polyethylene wear and osteolysis can be found frequently and pose the following dilemma to the surgeon; Exchange the Polyethylene alone or revise the acetabular cup instead, especially in the presence of a well-fixed acetabular component[18,21]. Some studies have advocated revising the acetabular component due to the high rate of postoperative instability and dislocation appreciated with isolated polyethylene exchange that can reach up to 30%.[1,2] Other investigators support retaining the acetabular shell due to the lower dislocation rates perceived in their series which they attributed to the use of the anterolateral and direct lateral approaches.[19,22]

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We hypothesized that polyethylene exchange with or without 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 of which 36 (54%) had polyethylene exchange and 31 (46%) had complete acetabular revision from 2002 to 2004. Patients were identified through a search of our joint registry database to identify patients who underwent revision THA at our institution during the period spanning. 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 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. Demographic data and time to revision were recorded from the medical records (Table1). We obtained the type of implant, liner elevation, and size of femoral head from the operative records. The type of cups used in the polyexchange group where 25 Universal cups (Biomet, Warsaw, IN), 3 Howmedica Osteonics cups (Stryker, Mahwah, NJ), 3 Duraloc (Depuy, Warsaw, IN) cups, 3 Reflection cups (Smith & Nephew, Memphis, TN), and 2 Converge cups (Zimmer, Warsaw, IN) . Patients were followed for a minimum of 2 years (mean, 2.8 years; range, 2-5 years). There where no patients lost to follow-up during these period.

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We had prior Institutional Review Board approval. The criteria for liner exchange versus revision of the acetabular component was based on a number of factors including fixation status of the component, presence of osteolysis, size and track record of the acetabular component in situ, and age or activity level of the patient. Acetabular component was revised when loose, or too small to allow adequate thickness of polyethylene, or if it had a bad track record, and presence of symptoms (pain). - - We included only patients with primary THA and both detectable polywear and any degree of osteolysis at time of presentation for revision and only patients with cementless components. We excluded patients who underwent revision THA for instability (n = 68), component loosening (n = 230), and malpositioning in which polywear and osteolysis were not the only cause (n = 18).

All patients underwent revision arthroplasty using direct lateral approach and under regional anesthesia. Bone graft was used in 15 out of 31 (48%) of patients undergoing revision of the acetabular component. In most of these patients the acetabulum could be reamed to accept a larger diameter acetabular component and obliterating ostelytic lesion. Of the 36 hips that underwent isolated polyethylene exchange, allogeneic bone graft was impacted through the cup holes in 32 hips. In the remaining four hips, either the size of osteolysis was not deemed to be large 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 the following reasons in addition to wear and osteolysis, the

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78 locking mechanism was damaged in two cases, and the size of the cup precluded the
79 alternative of cementing a polyethylene liner into these well fixed cups; the femoral head
80 had eroded into the metal shell in eight cases; the orientation and position of the
81 acetabular component was less than optimal for a stable construct in six cases, in which
82 pre-operative evaluation showed no apparent malpositioning of the acetabulum, but intra-
83 operatively the cup was in neutral position in 4 patients and retroverted in the other 2
84 patients, although these patients did not complain of any preoperative instability;
85 incompatibility of the old shell with newer generation polyethylene liners in five cases;
86 the acetabular component was poorly attached after removing the screws in 10 cases.
87 Allograft was inserted into the acetabulum in 12 of the 31 hips. Prophylactic antibiotics
88 were administered to all patients within 1 hour of surgery. Femoral head sizes 28 mm, 32
89 mm, were frequently used and on one hip 36 mm was used,, while only four patients
90 received a 22-mm head. A high wall, 10°, and 20° elevated liners were inserted in the
91 majority of cases with the exception of 10 patients who received a nonelevated liner.
92 Autogenic blood was routinely transfused intraoperatively in all patients who had
93 donated their own blood preoperatively, while allogeneic transfusion was deemed
94 necessary in only two cases. Drains were not used in any patient.

95

96 Radiographic review of all the preoperative and follow-up radiographs was performed by
97 two of the authors (CR, WJH), for any signs of loosening, osteolysis, and implant

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98 malposition. There were no differences among the two reviewers.. The survival time of
99 the implant construct was taken from the time of revision. Postoperative complications
100 including infection, wound drainage, and mechanical failure were documented.

101 The means of the patient's age, BMI, and survivorship of the index joint were calculated
102 and compared using t-test, while Chi-square test was used to compare the gender and
103 ASA distribution of both patients. The probability value for each test demonstrated the
104 strength of evidence.

105 All analyses were performed using SPSS, version 13, software (SPSS, Inc., Chicago, IL)..

106 **RESULTS**

107 Three of the 36 acetabular components retained were bone grafted through the cup holes
108 and loosened at 20, 31, and 53 months after the index revision. These 3 patients had
109 extensive superior and medial osteolysis, and their cup was a Universal cup (Biomet.,
110 Warsaw, IN) with ongrowth surface. The implantation times of the three cups were
111 25.5, 16.8, and 17.5 years respectively. Two hips were reconstructed using allograft and
112 an upsized Trident porous-coated cup (Stryker, Mahwah, NJ), while the third required a
113 tantalum trabecular metal-coated cup (Zimmer, Warsaw, IN) with trabecular mesh
114 augments for proper fixation and support.

115 Among the 31 hips with complete acetabular revision one cup loosened and the patient
116 underwent another revision at 5 months after index revision surgery. The patient had

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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.[5,17,22] The dilemma faced by surgeons treating patients with ostelysis and well fixed acetabular components therefore is when to choose polyethylene exchange alone versus revising the acetabular component.. The high incidence of dislocation, reaching up to 30%, reported after isolated polyethylene exchange has prompted some surgeons to choose revision of acetabular component in most cases[1-3] Other investigators have advocated the opposite and recommended more conservative measures such as bone grafting through the cup holes to preserve bone stock and halt the progression of osteolysis.[7,14,22] 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.

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Some caveats must be kept in mind when scrutinizing our results. The data collection was retrospective in nature and therefore its validity may have been marred by the available information. Another point that arises is the stringency of our inclusion criteria in which patients with instability or dislocation or gross loosening of their components with concomitant polywear and lysis were excluded from our cohort. This was done to eradicate possible biases that may have influenced the surgeon's decision making in favor of any particular intervention. One shortfall of our study is that 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. Unfortunately because of the relatively small sample size we were not able to perform meaningful statistical 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[13].

We have reported 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,[7] acetabular cup loosening may have resulted possibly due to inadequate retroacetabular bone stock. On

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157 the other hand, the acetabular failure rates of early-generation porous-coated implants
158 have been reported to range between 5 to 24% at 10 to 15 years follow-up.[4] Therefore,
159 the acetabular components in the polyethylene exchange group may have failed due to
160 their advanced implantation age, which approached 20 years after index surgery.

161 A recent investigation by Lie et al[15] found a higher cup revision rate in patients who
162 underwent isolated polyethylene exchange compared to previous studies. However, the
163 incidence of postoperative dislocation and cup loosening was similar to the group that
164 had acetabular revision in their series. Furthermore, some of their patients may have
165 undergone polyethylene exchange or cup revision for instability, malpositioning, and
166 loosening without the associated polywear and osteolysis factor.[15] The question still
167 remains to be answered by further studies.

168 To extract the acetabular components in every case of polywear and osteolysis implies
169 relying on the retroacetabular bone stock quality. Maloney et al[17] first started by treating
170 retroacetabular osteolysis with revision of the well-fixed cup and bone grafting. They
171 observed large medial wall defects, extensive damage to the anterior and posterior
172 columns, and in some cases pelvic discontinuity. To fill this void, cages and allograft
173 which have lower survivorship and poor outcome become a necessity.[20] If there is any
174 osteolysis present at the time of surgery, the addition of bone graft through the acetabular
175 holes may increase the overall quality of the defect. Therefore, when the eventual need

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for revision surgery arises due to acetabular loosening, the patient may be revised with less aggressive implants.

Although we cannot recommend prophylactic revision of all cups for polywear and osteolysis, the patient may be warned of the possibility of a slightly higher 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.

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