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Camilo Restrepo

Department of Orthopaedic Surgery, Thomas Jefferson University Hospital, Rothman Institute

Elie Ghanem

Department of Orthopaedic Surgery, Thomas Jefferson University Hospital, Rothman Institute

Carrie Houssock

Department of Orthopaedic Surgery, Thomas Jefferson University Hospital, Rothman Institute

Mathew Austin

Department of Orthopaedic Surgery, Thomas Jefferson University Hospital, Rothman Institute

Javad Parvizi

Department of Orthopaedic Surgery, Thomas Jefferson University Hospital, Rothman Institute

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Authors

Camilo Restrepo, Elie Ghanem, Carrie Houssock, Mathew Austin, Javad Parvizi, and William J. Hozack

Isolated Polyethylene Exchange versus Acetabular Revision for Polyethylene Wear

Running title: Polyethylene alone versus Cup Revision

Camilo Restrepo, MD; Elie Ghanem, MD; Carrie Houssock MD; Mathew Austin MD;
Javad Parvizi MD, FRCS; and William J. Hozack MD

From the Department of Orthopaedic Surgery, Thomas Jefferson University Hospital,
Rothman Institute, Philadelphia, PA

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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.

Correspondence to: William J. Hozack, MD, Department of Orthopaedic Surgery,
Thomas Jefferson University Hospital, Rothman Institute, 925 Chestnut St., 5th Floor,
Philadelphia, PA 19107. Phone: 267-339-3608; Fax: 215-503-5651; E-mail:
research@rothmaninstitute.com.

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1 ABSTRACT

2 Polyethylene wear and osteolysis are not uncommon features seen when assessing
3 advanced survivorship in THA. The dilemma faced by the orthopedic surgeon is whether
4 to revise the cup and risk damage to the supporting columns and even pelvic
5 discontinuity or to perform isolated polyethylene exchange and possibly encounter a high
6 rate of postoperative recurrent instability and dislocation that will necessitate further
7 surgery. Of 67 hips that underwent revision arthroplasty for polywear and osteolysis, 36
8 had isolated polyethylene exchange, while 31 had full acetabular revision performed. The
9 minimum follow-up was 2 years (mean, 2.8 years; range, 2 to 5 years). Three of the 36
10 hips with a retained cup that were grafted through the cup holes failed due to acetabular
11 loosening within 5 years postoperatively. One of the 31 hips with full revision required
12 re-revision for aseptic cup loosening at 5 months postoperatively. Although we cannot
13 recommend prophylactic revision of all cups for polywear and osteolysis, the patient may
14 be warned of the possibility of a slightly higher failure rate when retaining the acetabular
15 component. We do however advocate cup extraction in the following situations: damage
16 to the locking mechanism, erosion of the femoral head through the liner and into the cup
17 damaging the metal, and a malpositioned component that may jeopardize the stability of
18 the revision.

19 Level of Evidence: Level II, Prognostic study See the Guidelines for Authors for a
20 complete description of levels of evidence.

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21 **Introduction**

22 Total hip arthroplasty (THA) is one of the most successful procedures performed for
23 various hip disorders, including degenerative joint disease, rheumatoid arthritis,
24 osteonecrosis, and degenerative changes secondary to developmental dysplasia.^{6,9,23,24}
25 The result is a greater demand for THA with the number of operations expected to double
26 in the next decade.¹⁰⁻¹² Although contemporary materials and enhanced bearing surfaces
27 have improved the durability of THA, failure secondary to instability, malpositioning,
28 infection, aseptic loosening, and polyethylene wear is inevitable.^{8,16}

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

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

41 **MATERIALS AND METHODS**

42 We retrospectively reviewed 62 patients (67) hips of which 36 (54%) had polyethylene
43 exchange and 31 (46%) had complete acetabular revision from 2002 to 2004. Patients
44 were identified through a search of our joint registry database to identify patients who
45 underwent revision THA at our institution during the period spanning. The study
46 population included 35 women (56.5%) and 27 men (43.5%) with an average age of 62.4
47 years (range, 31-88 years) and body mass index (BMI) of 28.7 (range, 19-53). Primary
48 THA was performed for degenerative osteoarthritis, dysplasia, avascular necrosis,
49 rheumatoid arthritis, and posttraumatic arthritis. Revision surgery was performed at an
50 average of 12.4 years (range, 2-23.8 years) after the index THA. Demographic data and
51 time to revision were recorded from the medical records (Table1). We obtained the type
52 of implant, liner elevation, and size of femoral head from the operative records. The type
53 of cups used in the polyexchange group where 25 Universal cups (Biomet, Warsaw, IN),
54 3 Howmedica Osteonics cups (Stryker, Mahwah, NJ), 3 Duraloc (Depuy, Warsaw, IN)
55 cups, 3 Reflection cups (Smith & Nephew, Memphis, TN), and 2 Converge cups
56 (Zimmer, Warsaw, IN) . Patients were followed for a minimum of 2 years (mean, 2.8
57 years; range, 2-5 years). There where no patients lost to follow-up during these period.

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

69 All patients underwent revision arthroplasty using direct lateral approach and under
70 regional anesthesia. Bone graft was used in 15 out of 31 (48%) of patients undergoing
71 revision of the acetabular component. In most of these patients the acetabulum could be
72 reamed to accept a larger diameter acetabular component and obliterating osteolytic lesion.
73 Of the 36 hips that underwent isolated polyethylene exchange, allogeneic bone graft was
74 impacted through the cup holes in 32 hips. In the remaining four hips, either the size of
75 osteolysis was not deemed to be large require bone grafting or an access point to
76 introduce the graft could not be found.. Complete acetabular revision was performed in
77 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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117 received allograft during the index revision but was reconstructed during the second
118 operation using only an upsized tantalum trabecular metal-coated cup (Zimmer, Warsaw,
119 IN).

120 **DISCUSSION**

121 Polyethylene exchange with bone grafting for polywear and osteolysis renders itself as a
122 relatively simple and benign operation compared to revising a well-fixed acetabular
123 component.^{5,17,22} The dilemma faced by surgeons treating patients with osteolysis and
124 well fixed acetabular components therefore is when to choose polyethylene exchange
125 alone versus revising the acetabular component.. The high incidence of dislocation,
126 reaching up to 30%, reported after isolated polyethylene exchange has prompted some
127 surgeons to choose revision of acetabular component in most cases¹⁻³ Other investigators
128 have advocated the opposite and recommended more conservative measures such as bone
129 grafting through the cup holes to preserve bone stock and halt the progression of
130 osteolysis.^{7,14,22} These studies consisted of a relatively heterogeneous population that
131 included patients who presented with instability and recurrent dislocation that biases the
132 surgical intervention and postoperative results. Given that there is still no general
133 consensus or specific guideline indicating whether a well-fixed acetabular shell should be
134 revised or retained, we set out to answer this question with a more homogenous
135 population of patients who presented with only polywear and osteolysis as their primary
136 indication for surgery.

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137 Some caveats must be kept in mind when scrutinizing our results. The data collection was
138 retrospective in nature and therefore its validity may have been marred by the available
139 information. Another point that arises is the stringency of our inclusion criteria in which
140 patients with instability or dislocation or gross loosening of their components with
141 concomitant polywear and lysis were excluded from our cohort. This was done to
142 eradicate possible biases that may have influenced the surgeon's decision making in favor
143 of any particular intervention. One shortfall of our study is that the two cohorts were not
144 matched and it is plausible that factors such as BMI, activity level, age, and degree of
145 osteolysis may have influenced the outcome. Unfortunately because of the relatively
146 small sample size we were not able to perform meaningful statistical analyses to evaluate
147 the influence of each factor. In addition the reason for low incidence of dislocation (none
148 in this cohort) after isolated polyethylene exchange in our patients may relate to the type
149 of surgical approach, direct lateral in this case. Thus the findings of this study may not be
150 directly applicable to patients undergoing similar procedures using posterior approach
151 which is associated with a higher incidence of instability¹³.

152 We have reported a similar acetabular failure rate after revision THA for isolated
153 polyethylene exchange compared to complete acetabular revision for polyethylene wear
154 and osteolysis in uncemented cups. Although bone grafting was implemented in
155 accordance with the recommendations in the literature to halt osteolysis,⁷ acetabular cup
156 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 al¹⁵ 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 al¹⁷ 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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176 for revision surgery arises due to acetabular loosening, the patient may be revised with
177 less aggressive implants.

178 Although we cannot recommend prophylactic revision of all cups for polywear and
179 osteolysis, the patient may be warned of the possibility of a slightly higher failure rate
180 when retaining the acetabular component. We do however advocate cup extraction in the
181 following situations: damage to the locking mechanism, erosion of the femoral head
182 through the liner and into the cup damaging the metal, and a malpositioned component
183 that may jeopardize the stability of the revision.

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