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Original research

Is Retention of the Acetabular Component at Revision Surgery a Long-Term Solution?

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A B S T R A C T

Background: Acetabular retention in revision total hip arthroplasty (THA) may be advantageous, yet long-term survival data is limited. Thus, we investigated long-term survivorship of retained acetabular components in revision THA with analysis of rerevision rate, instability risk, and clinical outcomes.

Methods: We reviewed 98 hips with polyethylene wear and/or osteolysis that were revised with retained acetabular components. Acetabular inclination and anteversion were measured from prerevision radiographs. A retrospective chart review was performed, collecting outcomes of interest including Harris hip score, instability events, and rerevision surgery. Kaplan-Meier analysis was used to calculate the risk of revision over time. Predictors of survival including acetabular component position were analyzed by multiple logistic regression.

Results: Average follow-up was 13 years (range, 5-24). Survivorship rates at 5, 10, 15, and 20 years were 89.7%, 81.6%, 70.8%, and 63.8%, respectively. There was improvement in average Harris hip score (61 to 76, \( P < .0001 \)). There was a 9% rate of dislocation, and 6 hips (6%) were rerevised for recurrent instability. Overall, there were 23 (23%) rerevisions at an average of 6.1 years with the most common reasons being instability (6%) and aseptic loosening (6%). Use of conventional polyethylene was the only identified independent predictor of rerevision (\( P = .025 \)).

Conclusions: Retention of a well-fixed acetabular component in revision THA provides acceptable long-term outcomes with a 15-year survivorship of 71%. Instability and aseptic loosening were the most common reasons for rerevision. Surgeons may consider retaining the acetabular component at revision surgery if the implant is well-fixed and well-positioned.

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Introduction

Total hip arthroplasty (THA) is one of the most successful surgical procedures in all of medicine [1]. The volume of primary THAs performed annually is expected to rise substantially in the coming years [2]. With that rise in primary THA, the burden of revision THA is expected to increase as well [2]. A major cause of THA failure requiring revision is polyethylene wear and osteolysis, especially for prostheses placed prior to the popularization of highly cross-linked polyethylene [3,4]. Retention of a well-fixed acetabular component at revision surgery has been advocated as it preserves bone stock and results in less patient morbidity [5-7].

We previously reported on the midterm results of retaining a well-fixed acetabular component during revision surgery, demonstrating satisfactory implant survivorship and good clinical outcomes [8]. Other studies have similarly reported good clinical outcomes and implant survivorship with isolated head and polyethylene liner exchanges [9-13]. However, long-term survivorship is unknown, and some series have demonstrated an increased risk of instability and rerevision with retention of the acetabular component [14,15].

The purpose of this study was to evaluate long-term clinical outcomes, instability risk, risk of rerevision, and implant

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survivorship when retaining a well-fixed acetabular component during revision THA. Risk factors for failure were investigated, including acetabular component position, polyethylene type, liner insertion technique, femoral head size, concurrent femoral component revision, and use of bone grafting. We hypothesized the overall survivorship rate would be maintained from mid- to long-term follow-up with few revisions due to aseptic loosening or instability.

Material and methods

Our institutional joint replacement registry was reviewed for all cases of revision THA between 1996 and 2008 [8]. Included cases were performed for the following indications: isolated acetabular osteolysis (33%), isolated femoral osteolysis (11%), femoral and acetabular osteolysis (9%), or aseptic femoral loosening (33%). We did not include cases that were revisions for primary indication of recurrent instability or infection. Cases in which the acetabular component was revised or loose were excluded. Patients were followed for a minimum of 5 years or until rerevision or death. Patients who died within 2 years of revision surgery or those without complete 5-year clinical and radiographic follow-up were excluded. One hundred forty-three hips were revised during the study period for pelvic osteolysis, polyethylene wear, or femoral loosening. There were 16 hips (15 patients) that died prior to 2-year follow-up and were excluded to avoid confounding our long-term follow-up results. There were 29 hips that were excluded due to insufficient or missing 5-year follow-up, leaving 98 hips in the 94 patients included in the cohort.

Operative reports were reviewed for surgical approach, femoral head size, use of conventional or highly cross-linked polyethylene liner, liner insertion technique (use of existing locking mechanism vs cementation), simultaneous femoral revision, and use of bone graft around the acetabular and/or femoral component. This complete data has been previously published [8]. Clinical outcomes were measured using the Harris hip score. End points for the study included rerevision for any reason, death, or dislocation event.

The current study cohort included 44 men and 54 women. Average patient age at the time of revision was 60 years (range, 22-89). Index revisions were all performed through a posterior approach and included femoral head and liner exchanges. Additionally, 38% of patients underwent concurrent femoral revision. All included patients had a well-fixed acetabular component, which was retained. Bone grafting of either the acetabulum or femur was performed in 67% of cases.

Image measurements and intraclass correlation coefficients for this study cohort have been previously performed and reported [8]. Measurements were performed by 2 reviewers with an interclass correlation coefficient of 0.93 for anteversion assessment and 0.90 for inclination assessment [8]. Preoperative anteroposterior pelvic radiographs and cross-table radiographs of the affected hip were analyzed to determine acetabular component position as previously described [8,16,17]. These were recorded as to whether they were inside or outside the safe zones for inclination (safe zone 1 = 35° to 55°) and anteversion (safe zone = 5° to 25°) [18,19].

Patient outcomes were determined by comparing the prerevision and postrevision Harris hip scores. Mean scores were calculated and compared using a two-tailed t-test. Multiple logistic regression analysis was used to examine risk factors for revision surgery including acetabular component inclination and anteversion, femoral head size, use of conventional vs highly cross-linked polyethylene, liner insertion technique (locking mechanism vs cemented), concurrent femoral revision, and use of bone grafting. P values < .05 were considered significant. Kaplan-Meier analysis was used to calculate the risk of revision over time.

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grafting at the index revision ($P = .72$). The existing locking mechanism was used to insert the liner in 65% of index revisions. Sixty-one percent of failures utilized the existing locking mechanism ($P = .20$). The remainder of patients had a polyethylene liner cemented into the existing acetabulum. Femoral head size was not associated with increased risk of failure when grouped as heads <32 mm or ≥36 mm ($P = .17$). Of the 6 hips with instability events following revision, there was only one with femoral head size <28. 71% of acetabular components were inside the safe zone for inclination, and 56% were inside the safe zone for anteversion. Neither acetabular inclination nor anteversion outside of the safe zone were predictors of failure ($P = .07$ and $P = .39$, respectively).

For patients who had not undergone rerevision, average Harris hip scores and pain scores were significantly improved postoperatively. Harris hip scores improved from 60 preoperatively to 76 at the most recent follow-up ($P < .0001$). Pain scores improved from 22 preoperatively to 35 postoperatively ($P < .001$). (Table 3)

### Discussion

This study demonstrates acceptable long-term outcomes with retention of well-fixed acetabular components at revision surgery. With 13-year average follow-up, we found an overall implant survival rate of 77% with 15-year implant survivorship of 71%. The average follow-up of 13 years is the longest follow-up to our knowledge reported in the literature for retention of well-fixed acetabular components at revision surgery. Our long-term implant survivorship is similar to other studies, although the literature is heterogeneous as most studies evaluated isolated head and liner exchanges as opposed to including femoral revisions as reported in this study [14,15]. Some studies also included all-cause revisions in their cohorts, including instability, as opposed to evaluating only revisions for osteolysis or polyethylene wear. A recent study by Petis et al. evaluating the long-term outcomes of isolated head and liner exchange demonstrated remarkably similar implant survivorship. They reported a 91% 5-year, 81% 10-year, and 69% 15-year survival compared to 90%, 82%, and 71% in our series [9]. These numbers are also similar to a recent meta-analysis of retained acetabular components at revision THA with an average of 9-year follow-up [12].

Multiple prior studies have noted high postoperative instability rates as a drawback of retaining the acetabular component at revision. Dislocation rates have ranged from 3% to as high as 29% [10,11,14,20]. Our overall dislocation rate of 8% and 6% rerevision rate for recurrent instability are consistent with the available literature. Petis et al. reported similar revision rates for instability, but their overall dislocation rate was somewhat higher at 16% [9]. Some authors have advocated an anterolateral approach to decrease postoperative instability [21,22]. However, our relatively low dislocation rate and the low rates reported by others support the posterior approach as an appropriate strategy in this revision setting [10].

### Table 2

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Adjusted odds ratio (95% CI)</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetabular component inclination</td>
<td>0.39 (0.13-1.15)</td>
<td>.09</td>
</tr>
<tr>
<td>Acetabular component anteversion</td>
<td>0.65 (0.23-1.9)</td>
<td>.43</td>
</tr>
<tr>
<td>Conventional polyethylene</td>
<td>13.1 (1.4-123.2)</td>
<td>.025</td>
</tr>
<tr>
<td>Liner insertion technique (cement)</td>
<td>6.8 (0.73-62.3)</td>
<td>.09</td>
</tr>
<tr>
<td>Femoral head size</td>
<td>0.9 (0.77-1.06)</td>
<td>.21</td>
</tr>
<tr>
<td>Complete femoral component revision</td>
<td>0.72 (0.22-2.3)</td>
<td>.58</td>
</tr>
<tr>
<td>Bone grafting</td>
<td>0.78 (0.24-2.56)</td>
<td>.69</td>
</tr>
</tbody>
</table>

Bold value indicates statistical significance ($P < .05$)

### Table 3

<table>
<thead>
<tr>
<th>Outcome measures.</th>
<th>Preoperative</th>
<th>Postoperative</th>
<th>Observed difference</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harris hip score</td>
<td>60.6 ± 19.9</td>
<td>79.0 ± 19.1</td>
<td>14.4 ± 13.9</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Pain score</td>
<td>22.5 ± 11.6</td>
<td>34.9 ± 10.8</td>
<td>12.4 ± 21.3</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Other reasons for failure in our cohort included aseptic loosening of the acetabular component in 6% and recurrent polyethylene wear and osteolysis in 4%. All hips rerevised for recurrent wear and osteolysis utilized conventional polyethylene. These rates are also similar to prior studies [9,12,23].

The use of conventional polyethylene was the only implant or surgical variable that was identified as a significant independent risk factor for rerevision at long-term follow-up. While Petis et al. did not report a difference with the use of highly cross-linked polyethylene vs conventional, no hip treated with highly cross-linked polyethylene at the time of index revision went on to be rerevised for polyethylene wear or osteolysis in their series. The use of conventional polyethylene may indicate implant age if newer, highly cross-linked polyethylene is not manufactured to be compatible with the locking mechanism of older cups. This may influence our results.

At midterm follow-up, acetabular component inclination was a significant risk factor for failure in this patient cohort but did not reach statistical significance at longer-term follow-up in this investigation [8]. To our knowledge, no other study reports on implant survivorship in relation to acetabular component position in the revision setting; however, there have been some reports on component position and dislocation rate after revision THA. Sadhu et al. reported an increased risk for dislocation with components positioned outside the safe zone for both inclination and anteverision [24]. Conversely, 2 other studies have shown no effect of acetabular component position on dislocation rates after isolated head and liner exchanges [15,25]. Our findings suggest that acetabular position is a risk for early (within 2-years) failure but not as great of a risk longer term. In this study, as has been found in other publications, femoral head diameter was not a risk factor for failure [10].

Patient outcomes were significantly improved in our cohort. Harris hip scores improved from 61 to 76 postoperatively. Pain scores improved from 23 to 35 postoperatively. Two other studies reported improvements in Harris hip scores with isolated head and liner exchanges [9,26]. Both studies reported postoperative scores >90. However, most other studies have reported similar, more modest improvements in hip scores in revision THA [27-35]. The lower postoperative scores in this study could be related to the inclusion of concurrent femoral revisions in our cohort. This study has limitations. It was retrospective and could be limited by selection bias in that the well-fixed acetabular components treated during this time period were revised for a variety of reasons. Included cases were performed at a single, academic institution by fellowship-trained arthroplasty surgeons so results may not be generalizable to other practice settings. We excluded patients who died in the first 2 years after surgery in order to ensure our survival rate was not falsely elevated given that we considered death without revision as a success. However, there were a significant number of patients who died during the follow-up window, which makes it difficult to evaluate long-term outcomes for all revisions. There was also no control over implant selection or age of implants. All revision surgeries were performed through a posterior approach, however we do not have data to report the approach utilized for the primary hip arthroplasty, which may influence dislocation risk. Given there was an increased
risk of rerevision with conventional polyethylene, there may be an association between older implants that do not have a high molecular weight polyethylene option and failure, but we did not have the information for this analysis. Additionally, acetabular components that were positioned outside traditional “safe zones” were retained based on surgeon decision-making if the risk of bone loss from acetabular revision outweighed the risk of later instability or wear. Although acetabular component position did not have significant association with failure in this study, we do not advocate for retaining a malpositioned cup, and this should be considered on an individual case basis. We do study the use of lipped liners or face-changing polyethylene liners, which may be an area for future investigation. While including concurrent femoral revisions adds another piece of data to the literature on retaining well-fixed acetabular components, this could be a confounding factor in our data when compared to the other series that are largely isolated head and liner exchanges. It should be noted that this study is largely observational and may be underpowered to detect differences in dislocation or revision rates based on factors such as head size and bone grafting.

Conclusions

This study demonstrates that retention of a well-fixed acetabular component during revision THA provides acceptable long-term implant survivorship and moderate improvements in clinical outcomes. This study also highlights improved outcomes with the contemporary practice of using highly cross-linked polyethylene. Surgeons should still make calculated decisions when faced with a well-fixed component that is malpositioned in relation to the bone loss and morbidity of acetabular revision vs the risk of instability and possible need for rerevision for polyethylene wear. However, this study does show that retention of a well-fixed component that is properly positioned is a durable solution for most patients when undergoing revision THA.

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Conflicts of interest

E. Lieberman is a paid consultant for DePuy and A Johnson & Johnson Company; a board member/committee member of the American Association of Hip and Knee Surgeons, the Oregon Association of Orthopaedic Surgeons, and the Ruth Jackson Orthopaedic Society. R. Barrack receives royalties and a paid consultant of Stryker; receives research support from Stryker, Zimmer, and Smith & Nephew; and is an editorial/governing board member of Journal of Bone and Joint Surgery-American and Journal of Bone and Joint Surgery-British. R. Nunley receives royalties from DePuy, Microport, and Smith & Nephew; is a paid consultant of DePuy, A Johnson & Johnson Company, Ethicon, Medtronic, Mizaros, Rom Tech, and Smith & Nephew; receives stock options from Hyalex and Rom Tech; receives research support from Stryker, A Johnson & Johnson Company, Smith & Nephew, Stryker, and Zimmer; is a board/committee member of the American Association of Hip and Knee Surgeons, Board of Directors and Treasurer, and Southern Orthopaedic Association 2018 President. J. Clohisy receives royalties from Microport; is a paid consultant of Microport Orthopedics, Inc. and Zimmer; receives research support from the Department of Defense and Zimmer; receives other financial and material support from Wolters Kluwer Health, Lippincott Williams & Wilkins; and is a board/committee member of the Hip Society, the International Hip Society, and the International Society for Hip Arthroscopy. All other authors declare no potential conflicts of interest.

For full disclosure statements refer to https://doi.org/10.1016/j.arth.2023.101197.

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