

Tritanium acetabular wedge augments: short-term results

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Background: Reconstruction of acetabular defects in total hip arthroplasty (THA) presents a great challenge to orthopaedic surgeons. Previous studies have reported on the use and outcomes of trabecular metal acetabular augments for the reconstruction of acetabular defects. However, no study has been conducted evaluating the short-term results of tritanium acetabular wedge augments for the reconstruction of acetabular defects in THA.

Methods: A retrospective study was conducted using a prospective database at a single institution including primary and revision THA patients from January 2013 to December 2014. Patients were included if they received a tritanium acetabular wedge augment system and had a minimum of 2-year follow-up (average 2.2 years \pm 0.3, range, 2–2.6 years). Demographic data and outcomes data [Harris Hip Score—HHS and Short Form (SF)-36] was collected. Radiographic data was also collected on THA revision cases (Paprosky classification), developmental dysplasia of the hip (DDH) cases (Crowe classification), and radiographic follow-up using DeLee and Charnley's classification system.

Results: There were 4 revision THA patients, 3 DDH patients, and 1 patient with posttraumatic arthritis. At the latest radiographic follow-up, there were no lucent lines in DeLee and Charnley Zones I, II or III. During the follow-up period, there was no open revision surgery. The SF-36 physical score significantly improved from preoperative measurement (29.6 \pm 2.2) to postoperative measurement (52.2 \pm 8.7, $P=0.003$), and the SF-36 mental score also significantly improved from preoperative assessment (34.5 \pm 4.5) to postoperative assessment (52.2 \pm 7.5, $P=0.003$). Total HHS scores also significantly improved postoperatively ($P=0.02$), with significant improvements in both the pain score ($P=0.01$) and function score ($P=0.02$).

Conclusions: Tritanium acetabular wedge augments in this short follow-up case series exhibit high clinical outcome scores, no radiographic lucency, and no early failures.

Keywords: Total hip arthroplasty (THA); acetabular augments; tritanium; bone loss; developmental dysplasia of the hip (DDH); revision surgery

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Introduction

Reconstruction of acetabular defects presents a great challenge to orthopaedic surgeons. These acetabular defects may be due to congenital causes, such as developmental dysplasia of the hip (DDH), or may be post-traumatic in origin. Crowe *et al.* (1), developed one of the most widely use classifications for DDH, of which grade III may require the largest degree of acetabular defect reconstruction.

Acetabular defects may also occur as a result of bone loss following a failed primary total hip arthroplasty (THA), secondary to osteolysis, cup migration, or removal of implants.

Paprosky *et al.* (2) developed a classification of acetabular defects that recommend reconstruction options in revision THA. There are numerous publications on how to manage various acetabular defects (2-4). Due to lack of resources, the initial treatment for these types of defects was

Table 1 Demographics of the patient population

Demographics	Study population (n=8)
Age (mean \pm SD), years	59.9 \pm 13.3
Gender—Female, n (%)	8 (100.0)
Body mass index (mean \pm SD), kg/m ²	30.8 \pm 6.1
Laterality, n (%)	
Right	3 (37.5)
Left	5 (62.5)
American Society of Anesthesiologist classification	
I	5
II	0
III	3
Charlson comorbidity index—age adjusted (mean \pm SD)	3.6 \pm 2.4
Reason for acetabular augment use, n (%)	
Revision total hip arthroplasty	4 (50.0)
Developmental dysplasia of the Hip	3 (37.5)
Post-traumatic arthritis	1 (12.5)
Follow-up (mean \pm SD), years	2.2 \pm 0.3 (range, 2–2.6 years)

SD, standard deviation.

structural allografts (5,6). Later on, newer technology allowed the use of cages (7,8), jumbo cups (9-11), and most recently, acetabular augments have been added to our armamentarium (12,13). All these treatment options have been used for filling acetabular defects, but consensus for superiority of one method over others has not been reached. Lack of integration or reabsorption of allograft can happen (14), and despite precautions, transmission of infections can happen with the use of allografts (15). Following cage reconstruction, there can be increased bone loss and structural failure (16), and elevation of the center of rotation can occur after using jumbo cups (17,18). Previous studies have reported on the use and outcomes of trabecular metal acetabular augments for the reconstruction of acetabular defects (13). However, no study has been conducted evaluating augmentation of acetabular defects using tritanium acetabular wedge augments.

Thus, the purpose of this study is to present the short-

term results of tritanium acetabular wedge augments for the reconstruction of acetabular defects in DDH and for revision following a failed primary THA.

Methods

A retrospective study was conducted using a prospective database at a single institution including primary and revision THA patients from January 2013 to December 2014. Patients were included if they received a tritanium acetabular wedge augment system (Restoration[®], Stryker Orthopaedics, Mahwah, NJ, USA) and there was a minimum of 2-year follow-up. Patients were excluded if the tritanium acetabular wedge was not used as final implant. Tritanium is composed of a highly porous commercially pure titanium matrix.

Demographic data was collected on patients, including age, gender, body mass index (BMI), American Society of Anesthesiology classification, Charlson Comorbidity Index, and laterality. Outcomes data including Short-Form 12 (SF-36) and Harris Hip Scores (HHS) were collected and compared preoperatively and postoperatively. Preoperative classification was performed using Paprosky classification for revision THA cases (2) and Crowe classification for DDH cases (1), and radiographic analysis of the acetabulum at last follow-up was assessed using DeLee and Charnley's classification system (19). This study received Institutional Review Board approval prior to commencement. Written informed consent was obtained from all patients.

Statistical analysis

Demographic data was presented as descriptive data. Preoperative outcomes were compared to postoperative outcomes using paired *t*-tests. Statistical significance was determined by $P < 0.05$. SPSS (IBM, Armonk, New York, USA) version 23.0 was used to perform statistical analysis.

Results

There were a total of 8 patients that underwent surgery for primary or revision THA where tritanium acetabular wedge augments were used during the study period. These augments were used in 4 revision THA patients, 3 DDH patients, and 1 patient with posttraumatic arthritis. The demographics of the patient population are presented in *Table 1*.

Revision THA patients underwent revision for aseptic

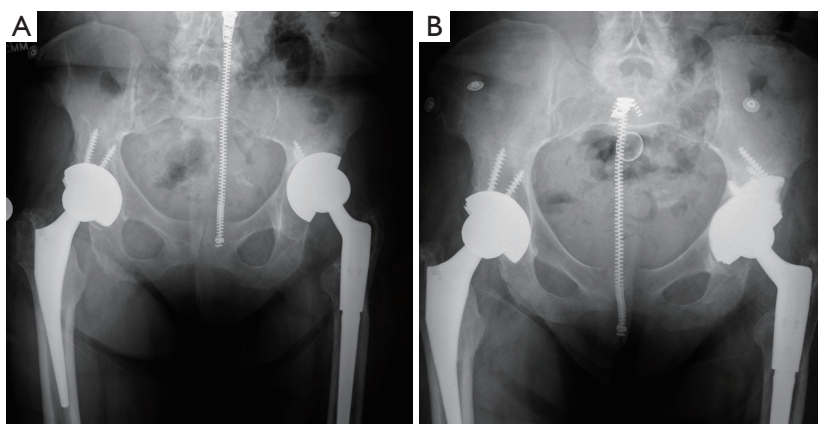


Figure 1 Revision left total hip arthroplasty performed for superior vertical acetabular cup migration. (A) Preoperative X-ray; (B) postoperative X-ray.

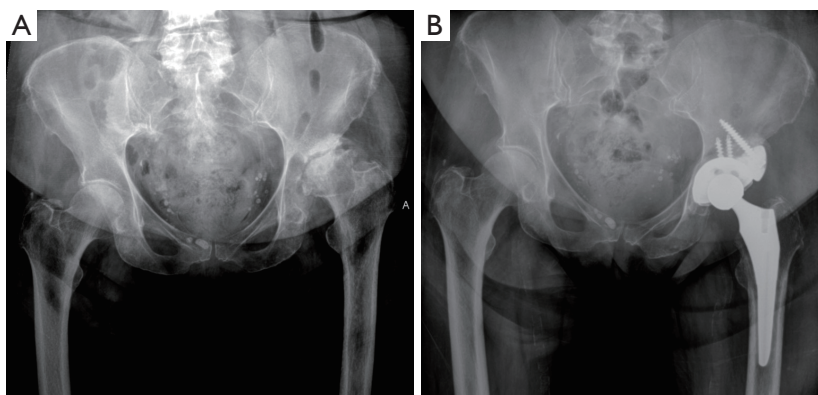


Figure 2 Developmental dysplasia of the hip with severe degenerative joint disease and superolateral subluxation of the femoral head. (A) Preoperative X-ray; (B) postoperative reconstruction with superolateral placement of an acetabular wedge.

loosening (3) and periprosthetic joint infection (1); all of which resulted in superior migration of the acetabular component with Paprosky IIB classification. *Figure 1A* demonstrates the preoperative imaging of a revision THA patient with superior and vertical migration of the acetabular cup, while *Figure 1B* demonstrates the postoperative radiograph of the acetabular wedge augment to reconstruct the superior defect. DDH patients, of which 2 were Crowe III and 1 was Crowe IV, often presented with severe degenerative joint disease and supero-lateral subluxation of the femoral head (*Figure 2A*), and acetabular wedges were placed supero-laterally (*Figure 2B*). The posttraumatic arthritis was a result of a right displaced femoral neck fracture, which was treated with three cannulated screws. The patient developed osteonecrosis with femoral head collapse (*Figure 3A*), which was treated with conversion THA using acetabular augments since the

protruding cannulated screws damaged some of the superior acetabular bone (*Figure 3B*).

The average follow-up was 2.2 years \pm 0.3 (range, 2–2.6 years). During the follow-up period, there was one closed reduction for early dislocation (six weeks after surgery) and no open revision surgery. At the latest radiographic follow-up, there were no lucent lines in DeLee and Charnley Zones I, II or III.

With regards to outcomes, the SF-36 physical significantly improved from preoperative assessment [mean \pm standard deviation (SD), 29.6 \pm 2.2] to postoperative assessment (52.2 \pm 8.7, $P=0.003$). The SF-36 mental score also significantly improved from preoperative values (34.5 \pm 4.5) to postoperative values (52.2 \pm 7.5, $P=0.003$). Total HHS scores also significantly improved comparing preoperative values (27.8 \pm 19.1) to postoperative values (85.0 \pm 13.7, $P=0.02$); the pain

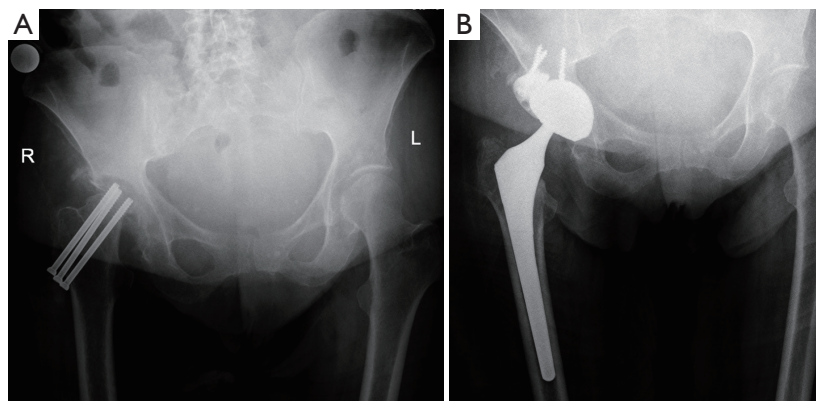


Figure 3 Posttraumatic arthritis secondary to a right displaced femoral neck fracture treated with three cannulated screws. (A) Preoperative X-ray with subsequent osteonecrosis and femoral head collapse; (B) postoperative X-ray after conversion THA using acetabular augments secondary to screw damage to the superior acetabular bone. THA, total hip arthroplasty.

score improved (preoperative 5.0 ± 10.0 , postoperative 38.0 ± 12.0 , $P=0.01$) and the function score improved (preoperative 18.8 ± 13.9 , postoperative 43.0 ± 5.2 , $P=0.02$).

Discussion

Acetabulum defects present a challenge to the adult reconstruction surgeon. Whether the cause of such defects is DDH or osteolysis present in a failed THA, reconstruction needs to be addressed accordingly (2-4). Technology has evolved from the use of structural allografts (5,6) to the use of cages (7,8), jumbo cups (9-11), and acetabular augments (12,13), depending on the size and location of the defect. Superiority of one over the others has not been reached (20). Allografts can reabsorb or fail to integrate (14), and continue to be a risk for transmission of infections (15). Structural failure is a concern seen following reconstructions with cages (16). Elevation of the center of rotation is known to be the result in some instance when jumbo cups are used (17,18). There is scant literature on the outcomes of acetabular wedge augments, and these publications are not exclusive for acetabular augments and only report on trabecular metal augments (13,16). Thus, the purpose of our study was to evaluate the ability of a tritanium acetabular wedge system to fill acetabular defects after primary and revision THA.

The overall experience with the tritanium acetabular wedge augment in this short follow-up case series report has been excellent, as no early failures have been detected in any of the patients in our study. This reflects findings in literature on other acetabular augments, as early follow-up with trabecular metal augments demonstrated improved

clinical outcomes and low revision rates (21-23), and mid-term follow-up with these same acetabular augments report 92% survivorship at ten years (12). Other trabecular titanium augments have shown less robust results, but have demonstrated improved functional scores at a minimum of 2-year follow-up (13). Porous tantalum metal has also been used in conjunction with impaction bone grafting (24,25) and for doing one-stage exchange arthroplasty for periprosthetic hip infections (26).

While this is the first study to report outcomes based results on the tritanium acetabular wedges, there are limitations to this study. This is a small series of patients with limited follow-up, as there are limited indications for using acetabular wedges. This is also a non-randomized study, and this study would have been strengthened with a comparison group, such as allograft or acetabular wedges composed of different materials.

Despite these limitations, this is the first study that reports the short-term results of tritanium acetabular wedges in a case series of patients that demonstrate good clinical radiographic outcomes. Further longitudinal studies with mid- to long-term follow-up are needed to further evaluate these promising findings.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: This study received Institutional Review Board approval prior to commencement and written informed consent was obtained from all patients.

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