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Trabecular Metal Use in Paprosky Type 2 and 3 Acetabular Defects: 5-Year Follow-Up

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ABSTRACT

Background: The reconstructive challenge of achieving a stable acetabulum in revision total hip arthroplasties in the presence of major osteolytic lesions has led to debate about the most appropriate surgical strategy to minimize implant-related failures. Trabecular metal (TM) implants have become popular but ongoing surveillance of their performance is required.
Methods: We reviewed the clinical and radiological outcome of a consecutive series of 52 patients (55 hips) who had undergone revision total hip arthroplasty for Paprosky type 2 or 3 acetabular defects with TM revision acetabular shells between 2002 and 2008.
Results: Four implant failures occurred (2 infections and 2 dislocations). Eleven patients from this cohort died (representing 12 hips) before the 5-year follow-up period giving us a follow-up of 78.2%. Implant survival at 5 years was 92% (95% confidence interval: 80.2%-96.9%). There were no cases of radiological loosening. The mean Oxford hip score was 34 (range, 5-48) at a mean follow-up of 63 months (range, 34-105 months).
Conclusions: We conclude that the use of TM revision shells for complex acetabular reconstruction yields satisfactory results.

The reconstructive challenge of achieving a stable acetabulum in the presence of major osteolytic lesions has led to debate about the most appropriate surgical strategy to minimize implant related failures [1,2]. More than 50% of revision total hip arthroplasties (THAs) involve the acetabular component [3], and the importance of identifying a satisfactory approach is pressing as the demand for revision THA in the United States is predicted to increase by 137% over the next 25 years [4]. This trend is likely to be mirrored globally because of a significant increase in the number of primary THAs performed over the past 20 years [5] coupled with an aging global population.

The choice of reconstructive technique is dependent on the location and extent of the acetabular bone loss with the Paprosky classification [6] being the most widely used method of stratifying the pattern and degree of host bone loss. The Paprosky classification [6] is widely used to stratify the pattern and degree of host bone loss. Type 1 defects involve an intact rim, and there is 90% bleeding host bone available for implant contact. These defects are not a major clinical concern as they can be adequately addressed using a conventional uncemented cup with or without screw fixation and bone grafting [7,8].

Type 2 defects involve distortion of the acetabular hemisphere with destruction of the dome and/or medial wall but the columns remain intact and will support a trial cup meaning initial stability is rarely a concern in these defects. Biological fixation is compromised as up to 30% of the cancellous bleeding host bone is replaced by nonbleeding sclerotic bone. Type 2 defects are subcategorized into types A-C according to the pattern of bone loss. Type 2A defects involve superior and medial bone loss, but the superior rim remains intact leading to migration of the cup superiorly and medially. Type 2B defects involve a superior rim defect of less than one-third of the rim circumference allowing the cup to migrate superiorly and

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laterally. Type 2C defects involve an intact rim but a focal medial wall defect is present with destruction of the teardrop and migration of the cup medial to Kohler's line.

Type 3 defects are categorized by extensive bone loss involving the acetabular rim and supporting structures usually causing component migration of more than 2 cm superiorly. Type 3 defects are the most difficult to treat because of difficulties obtaining initial stability and severe compromise to subsequent biological fixation because of a loss of bleeding cancellous bone. Type 3A defects involve a pattern of bone loss from 10-o'clock to 2-o'clock around the acetabular rim. The medial wall is intact causing the cup to migrate superiorly and laterally. There is moderate ischial and teardrop lysis, and between 40% and 60% of the bleeding cancellous bone stock is lost. Type 3B defects have less than 40% bleeding host bone available for ingrowth. There is an absent acetabular rim from the 9-o'clock to 5-o'clock position, complete obliteration of the teardrop, and severe ischial lysis usually resulting in superomedial cup migration. There is also the potential for a pelvic discontinuity in type 3B defects. Type 2 and 3 defects are more surgically challenging, and several techniques have been described depending on the need for additional structural support.

Component revision with various forms of impaction grafting [9-11] has proven to be an acceptable technique for type 2 defects, but the need for revision after aseptic loosening in grade 3 defects is more than 15% at 12 years [9]. The use of press fit "jumbo" uncemented components has had satisfactory 10-year fixation in Paprosky type 2 defects [12,13], but the complication rate, particularly dislocation, has been as high as 21% [12] and their use in type 3 defects remain controversial [13,14]. Bilobed acetabular implants are an alternative to jumbo cups and have the advantage of preserving bone loss from the anterior and/or posterior column. The number of published outcome studies is small with variable results [15-17]. A 24% rate of loosening at an average of 41 months prompted Chen et al [16] to recommend that these implants should not be used. Reconstruction with a high hip center achieves adequate initial stability for the cup [18] but comes at the cost of abductor muscle weakness [19] and increased rates of polyethylene wear [20,21]. The use of massive allografts is surgically challenging with high early failure rates associated with technical errors [22]. If adequate fixation is achieved, there is migration and instability of the cup in up to 44% of patients by 46 months [22]. An 80%-90% survivorship has been reported with the use of acetabular reconstruction cages [23-25]. However, cup-cage constructs show increased radiological migration with increase in the Paprosky defect stage [25]. Sporer et al [26] reported a 37.5% failure rate between 2- and 8-year follow-up for patients with major central acetabular defects treated with reconstruction cages. Custom-made triflanged acetabular components are associated with a revision rate of 15.9% and a complication rate of 24.5% [27-29].

Trabecular metal (TM) revision implants are a popular method to reconstruct all grades of defect and have shown promising early and midterm results with improvements in clinical outcome measures and improved survival over other techniques [30-38]. Skytta et al [32] reported survivorship of 92% after use of 827 revisions using TM components from the Finnish national registry, but no comment was made on the preoperative defect classification. There have been few studies reporting on the use of TM implants in the most complex acetabular defects falling into Paprosky grade 3A and 3B.

The primary purpose of this study was to analyze the minimum 5-year clinical and radiographic results obtained in a consecutive series of 55 cases of failed acetabular components in total hip arthroplasties revised using TM revision acetabular shells (Zimmer, Warsaw, IN) for Paprosky type 2 and 3 defects.

Patients and Methods

Using our local arthroplasty database, we identified all patients who had undergone primary or revision hip surgery using TM revision acetabular shells between May 2002 and December 2008 for the treatment of Paprosky type 2 or 3 acetabular defects. Our institutional review board has authorized all studies on patients included in our arthoplasty database relating to implant survival and functional outcome.

During the study period, a total of 689 patients underwent revision hip surgery in our unit and TM revision shells were used in 55 hips (52 patients) by 9 different surgeons. We did not exclude any patient from this series based on the reason for revision, grade of acetabular defect, or comorbidity. Demographic details are outlined in Table 1.

Patient Demographics

Table 1 outlines the demographics of this cohort. In 41 patients, TM was used in revision of a failed acetabular component after primary THA, and in the remaining 14 patients, at least 1 acetabular revision had been carried out before the use of TM. The indication for revision was aseptic loosening in 46 cases, but other indications included instability, fractures around the acetabular component, and infection. The femoral component was simultaneously revised in 53/55 cases—our unit uses the Exeter polished taper stem for the femoral implant, and as this prosthesis is easy to remove and revise, we routinely do so to improve access to the acetabulum in these complex revisions. Acetabular reconstruction involved debridement of the acetabular cavity and intraoperative assessment of the bone quality and bone loss. The use of an allograft femoral head bone graft reverse reamed into the acetabulum was used in 31 cases. The average TM revision shell measured 60 mm in diameter with a range of 44-70 mm. TM revision shells (Zimmer) were implanted in a position that allowed the highest contact with the host bone. The decision to use adjunctive screw fixation was made intraoperatively using trial components. If the fixation was questionable, the shell was reinforced with screw fixation into the

Table 1
Patient Demographics and Indication for Revision.

Demographic data	Number of patients
Age	Mean 72 (range, 38-95)
Male	22 (24 Hips)
Female	30 (31 Hips)
Paprosky classification	
2A	2
2B	7
2C	21
3A	15
3B	10
ASA grade	
1	4
2	16
3	26
4	6
Indication for revision	
Aseptic loosening	46
Instability	3
Infection	3
Acetabular fracture	3
Number of previous arthroplasty procedures	
1	41
2	7
3	5
4	1
5	1

ASA, American Society of Anesthesiologists.