The Journal of Arthroplasty xxx (2017) 1–6

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Acetabular Revision Using Trabecular Metal Augments for Paprosky Type 3 Defects

Cathleen J. O'Neill, IMRCS, MSC, MCH [a], Stephen B. Creedon, MB BAO, MCh [a], Stephen A. Brennan, MSc, MCh, FRCS [b,*], Fiona J. O'Mahony, BMBS, BA [a], Rosanne S. Lynham, MB BCh BAO [a], Shane Guerin, MENG, MCh, FRCS [a], Rehan Gul, FRCS [a], James A. Harty, MSc, FRCS [a]

[a] Department of Orthopaedic Surgery, South Infirmary Victoria University Hospital, Cork, Ireland
[b] Department of Orthopaedic Surgery, Bon Secours Hospital, Cork, Ireland

ARTICLE INFO

Article history:
Received 24 April 2017
Received in revised form
7 October 2017
Accepted 15 October 2017
Available online xxx

Keywords:
trabecular
metal
augments
revision
hip
arthroplasty

ABSTRACT

Background: Trabecular Metal (TM) augments are one option when reconstructing bone loss during acetabular side revision surgery.
Methods: We studied 38 consecutive patients with Paprosky type 3 defects that were revised using a TM shell and one or more augments over a 6-year period. There were 29 Paprosky type 3A defects and 9 Paprosky type 3B defects. The mean age of the patients at the time of surgery was 68.2 years (range 48-84). The mean length of follow-up was 36 months (range 18-74).
Results: The mean preoperative short form 12 health survey improved from 27.7 before operation to 30.1 at the time of final follow-up ($P = .001$). The mean Western Ontario and McMaster Universities Osteoarthritis Index score improved from 53 preoperatively to a mean of 78.8 at final follow-up ($P < .0001$). There was evidence of radiographic loosening in 7 of the cup-augment constructs. One patient developed a deep infection requiring re-revision. Two patients required revision for aseptic loosening.
Conclusion: The use of TM in complex acetabular reconstruction is associated with good outcome in the short to medium term.

The management of severe acetabular defects in revision hip surgery is a substantial challenge. Paprosky et al [1] classified these defects into 3 categories (Table 1). Type 3A defects display superior migration of the femoral component greater than 3 cm above the superior obturator line, moderate teardrop lysis, minimal ischial lysis, and Kohler's line remains intact. Type 3B defects typically migrate medially causing disruption of Kohler's line with associated severe teardrop and ischial osteolysis.

The current construct options to overcome these defects include jumbo cups, structural allografts, impaction bone grafting (IBG), antiprotrusio cages, Trabecular Metal (TM) augments and shells, cup-cage constructs, oblong cups, and custom triflange components [2–7]. The use of TM augments and shells has become increasingly popular. The variation in size and shape of the augments allows for a customized reconstruction of the bony defect. The high coefficient of friction of tantalum assists with initial primary stability, while the high three-dimensional porosity allows deep bony ingrowth and secondary biologic fixation [8,9].

Studies reporting the early outcome of these constructs have shown encouraging results [10,11]. The purpose of this study is to evaluate the survivorship, patient-reported outcomes, hip center restoration, and osseointegration of reconstructions using these components in our unit.

Patients and Methods

This study reviewed 38 consecutive patients who were revised using the Trabecular Metal Acetabular Revision System (Zimmer Inc, Warsaw, IN). Patients were included if they received one or more augments. The mean age of the patients at the time of surgery was 68.2 years (range 48-84). The mean length of follow-up was 36 months (range 18-74). The indication for revision was aseptic

No author associated with this paper has disclosed any potential or pertinent conflicts which may be perceived to have impending conflict with this work. For full disclosure statements refer to https://doi.org/10.1016/j.arth.2017.10.031.

* Reprint requests: Stephen A. Brennan, MSc, MCh, FRCS, Department of Orthopaedic Surgery, Bon Secours Hospital, Cork, Ireland.

https://doi.org/10.1016/j.arth.2017.10.031
0883-5403/

Table 1
Paprosky Classification of Acetabular Bone Loss.

Type	Femoral Head Center Migration	Kohler's Line	Teardrop	Ischial Osteolysis
1	None	Intact	Intact	None
2A	Mild (<3 cm)	Intact	Intact	None
2B	Moderate (<3 cm)	Intact	Intact	Mild
2C	Mild (<3 cm)	Disrupted	Moderate lysis	Mild
3A	Severe (>3 cm)	Intact	Moderate lysis	Moderate
3B	Severe (>3 cm)	Disrupted	Severe lysis	Severe

loosening in 34 patients and 2-stage revision for infection in 4 patients. A posterolateral approach was used in all cases. Patients were instructed to partially weight bear for 6 weeks postoperatively. Patients were followed up at intervals of 6 weeks, 6 months, and yearly thereafter.

Preoperative radiographs and intraoperative finding were used to classify acetabular defects according to the Paprosky classification [1]. Postoperative anteroposterior pelvic and lateral hip radiographs obtained at the last follow-up visit were evaluated. The Moore classification describes radiographic signs suggestive of osseointegration in uncemented shells [12]. This system was modified by Gross et al to assess the probability of osseointegration of the shell and augment construct [13]. This modified classification considers augments to be unstable if (1) >3 mm migration compared with the early postoperative radiograph; (2) a radiolucent line at the augment-bone interface; (3) radiolucent lines around all screws; or (4) screw fracture. The hip center of rotation (HCOR) after the operation was compared to that preoperatively. This was measured relative to the interteardrop line and also, when available, the contralateral native HCOR. Radiological magnification was corrected based on the known femoral head diameter.

Patients were assessed clinically using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and short form 12 health survey scoring systems. Failure was defined as revision for septic or aseptic loosening of the acetabular component or a WOMAC score of less than 60 [14].

A paired t-test was used to compare preoperative and postoperative hip function. A *P*-value of less than .05 was considered statistically significant. Kaplan-Meier survival analysis with 95% confidence intervals (CIs) was used to assess implant survival, with failure due to any cause or failure secondary to aseptic loosening as the endpoints.

Results

Twenty-nine patients had Paprosky type 3A defects and 9 patients had Paprosky type 3B defects. Four of the patients with type 3B defects had pelvic discontinuity. The mean preoperative short form 12 health survey improved from 27.7 to 30.1 at the time of final follow-up ($P = .001$). The mean WOMAC score improved from 53 preoperatively to a mean of 78.8 at final follow-up ($P < .0001$).

The mean size of the TM shell was 63 mm (56-80). All 38 patients received at least 1 conventional augment. In addition to this, 6 patients received a medial augment and 1 patient received an additional shim and column buttress (Figs. 1 and 2). Four patients required a cup-cage construct. Fourteen patients had morselized femoral head allograft implanted in addition to TM augments.

The shell-augment construct was fixed using a mean of 4.6 screws (2-10). In 31 of 38 patients the shell-augment construct satisfied the criteria for osteointegration (3 or greater signs present according to Moore's criteria) (Table 2). Two patients displayed radiographic evidence of metal debris at the shell-augment interface. Neither of these patients had visible third body polyethylene wear. Eight patients developed Brooker grade 1 heterotopic ossification, 3 patients grade 2, and 3 patient grade 3 [15]. There were 2 deep infections. One occurred in the early postoperative period and was successfully managed with lavage and intravenous antibiotics. The other was a recurrence of deep sepsis and required a 2-stage revision. There was 1 trochanteric nonunion resulting in recurrent dislocations and 1 transient sciatic nerve palsy. In 4 patients there was bone graft resorption and medial migration of the shell. Of these 4 patients, only 1 had a poor clinical outcome requiring re-revision (Table 3).

Fig. 1. Preoperative radiograph showing loosening with acetabular bone loss.

With revision due to any cause as the endpoint, the 3-year Kaplan-Meier survival rate was 92.1% (95% CI 83-101) with 35 patients at risk (Fig. 3). At the same interval, the Kaplan-Meier survival rate with revision due to aseptic loosening as the endpoint was 94.7% (95% CI 87-102) (Fig. 4).

The preoperative HCOR was a mean value of 40 mm (22-64) above the interteardrop line. Postoperatively, the HCOR was a mean value of 24 mm (10-41) above the interteardrop line. The normal anatomic HCOR could be determined in 15 patients. The preoperative level of the prosthetic center of rotation was located at a point superior to the position of the anatomical HCOR by a mean of 25 mm (1-48) and lateral to it by a mean of 10 mm (−17 to 25). The position improved in both axes after revision, so that the mean location of the HCOR moved to a point 4.6 mm (−8 to 12) superior and 1.2 mm (−15 to 7) medial to the anatomical center.

Discussion

Paprosky type 1 and type 2 defects have minimal loss of bone and structural support. These defects can be reconstructed with the use of a hemispherical acetabular component with or without the use of nonstructural cancellous bone graft. Acetabular revisions

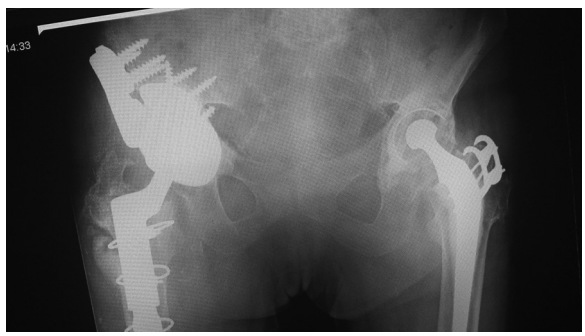

Fig. 2. Postoperative radiograph showing reconstruction of defect with trabecular metal augments.