Acetabular Revision Using a Trabecular Metal Acetabular Component for Severe Acetabular Bone Loss Associated With a Pelvic Discontinuity

Scott M. Sporer, MD, MS, and Wayne G. Paprosky, MD, FACS

Abstract: Pelvic discontinuity can be encountered during acetabular revision in patients with severe bone loss. All patients who had an acetabular reconstruction for a type IIIB acetabular defect according to the classification of Paprosky et al [Paprosky WG, Perona PG, Lawrence JM. 1994. Acetabular defect classification and surgical reconstruction in revision arthroplasty. A 6-year follow-up evaluation. J Arthroplasty 9:33.] with an associated pelvic discontinuity between 2001 and 2003 were reviewed. A trabecular metal acetabular component with or that without an acetabular augment was used to obtain fixation proximal and distal to the discontinuity. Thirteen patients (13 hips) were treated for a type IIIB acetabular defect. At an average of 2.6 years of follow-up, 1 patient demonstrated possible radiographic loosening. The other 12 patients maintained radiographically stable hips. None of the patients required repeat surgical intervention. Clinically, the patients' modified Postel–Merle d'Aubigne score improved from 6.1 preoperatively to 10.3 postoperatively. The treatment of pelvic discontinuity during acetabular revision using a trabecular metal acetabular component with or that without an associated trabecular metal augment appears to provide reliable and reproducible short-term results. **Key words:** acetabular revision, type IIIB defect, pelvic discontinuity.

One of the most challenging aspects of acetabular revision surgery relates to the management of a pelvic discontinuity [1]. Pelvic discontinuity is described as "an uncommon condition occurring in association with total hip arthroplasty when the hemipelvis is separated superiorly and inferiorly by loss of host bone or a fracture through the acetabular columns" [2]. With the increasing life span of patients with total hip arthroplasties and a trend toward surgery at younger ages, the volume and complexity of revision surgery should increase. Cementless acetabular components have shown improved long-term survival over cemented components [3]. However, patients with cementless acetabular component fixation can present with extensive bone loss at the time of revision because of the effects of asymptomatic osteolysis and stress shielding. Poor long-term results using an acetabular cage for the reconstruction of severe acetabular defects with an associated pelvic discontinuity have prompted us to explore alternative methods

From the Department of Orthopedic Surgery, Rush University Medical Center, Chicago, Illinois; and Central Dupage Hospital, Winfield, Illinois.
Submitted September 16, 2005; accepted May 16, 2006.
No benefits or funds were received in support of this study. The authors certify that their institutions approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent was obtained.
Reprint requests: Scott M. Sporer MD, MS, 25 N. Winfield Road, Winfield, IL 60190.

0883-5403/06/1906-0004$32.00/0
doi:10.1016/j.arth.2006.05.015

of reconstruction [4-6]. This article presents the short-term results of acetabular reconstruction with the use of a trabecular metal acetabular shell with or that without an acetabular augment in patients with severe acetabular bone loss and an associated pelvic discontinuity.

Materials and Methods

We retrospectively reviewed the clinical results and radiographs of all patients who had an acetabular revision using a trabecular metal acetabular component with or that without augmentation for a pelvic discontinuity (Zimmer, Warsaw, Ind) at the Central Dupage Hospital (Winfield, Ill) between January 2001 and December 2003 (Figs. 1-3). Thirteen patients who had an acetabular revision with a pelvic discontinuity using a trabecular metal acetabular component with or that without a modular acetabular augment were identified. During this time, only 1 patient with a type IIIB acetabular defect with severe segmental bone loss and a discontinuity was treated with alternative reconstruction methods. The femur was revised in 5 patients and was able to be retained with an associated modular head exchange in 8. The mean age of the patients at the time of surgery was 63 years (range, 47-88 years). There were 3 men and 10 women. The average radiographic and clinical follow-up point for the cohort of revision patients was 2.6 years (range, 1-3 years).

A posterior approach was used in all patients. The acetabular defect was sized with acetabular

Fig. 1. Radiograph of a 68-year-old man with a type IIIB acetabular defect. Note the disruption of Köhler's line, severe ischial lysis, superior migration, and associated pelvic discontinuity.

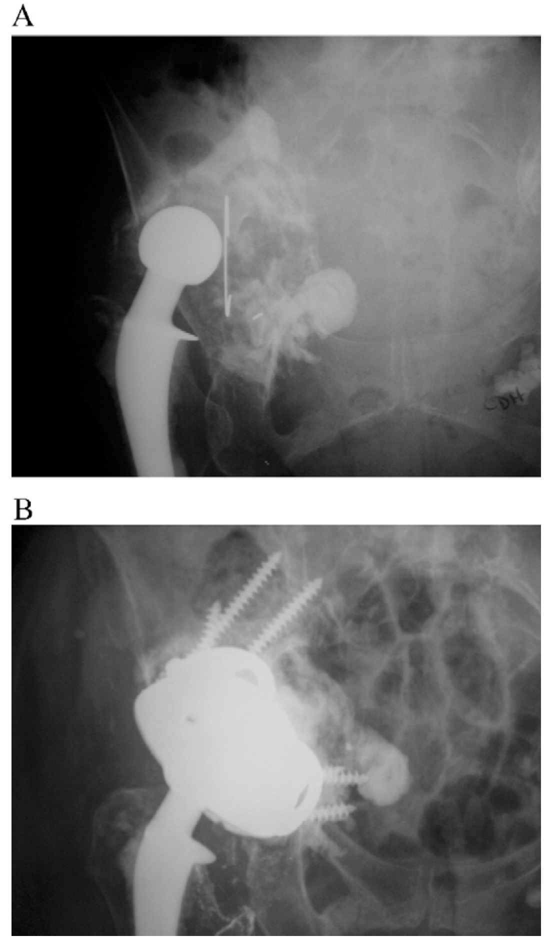

Fig. 2. A, Radiograph of a patient with a type IIIB acetabular defect with an associated pelvic discontinuity. B, The discontinuity was treated with a trabecular metal acetabular component along with a superiorly and inferiorly placed augment. Multiple screws were placed cephalad and caudal to the discontinuity to act as internal plates.

reamers in the desired location to find the dimension of the cavity until 2 points of fixation were achieved (anteroposterior [AP], anteroinferior to posteroinferior, posterosuperior to anteroinferior). The location of the pelvic discontinuity was assessed and the fibrotic pseudocapsule was removed within the region of the discontinuity between the superior and inferior hemipelvis. Depending on the degree of acetabular bone loss and the location of the discontinuity, a decision was made to use either an elliptical tantalum acetabular component alone or an elliptical tantalum acetabular component with a tantalum augment. Five patients were treated with an acetabular component alone, 4 were treated with an acetabular shell and 1 augment, and 4 were treated with an acetabular shell and 2 augments. Augments

Fig. 3. Pelvic discontinuity was most frequently encountered in type IIIB acetabular defects as described by Paprosky et al [7]. In a type IIIB defect, the most common location to place acetabular augments in was both medially and superiorly.

were used to decrease the acetabular volume and restore a rim to support a revision cup. The location and orientation of the augments were highly variable, depending on the bone loss pattern. Augments were often placed on the medial aspect of the ilium or were stacked. It was more common to use the augments with the wide base placed laterally and the apex medially. The revision cup had direct contact with the augments and allowed a press fit between the augments and host bone. The augments were initially secured to the host bone with the use of multiple screws. Portions of the augments in some cases needed to be removed with a burr or a reamer to optimize the surface area contact between the revision shell and the augments. Particulate bone graft was then placed into any remaining cavity before the hemispheric revision shell was impacted into place. The interface between the revision shell and the augments was cemented (these interfaces were placed in compression). Multiple-screw fixation was used through the revision shell. The acetabular liner was cemented into the tantalum acetabular component in 10 patients and press fit into the tantalum component with a locking mechanism in the remaining 3 patients. Most patients received a 36-mm or a 40-mm femoral head. Postoperatively, all patients were placed in an abduction brace and followed total hip arthroplasty precautions with touch weight bearing for 3 months before being advanced to weight bearing as tolerated.

The annual radiographic review consisted of standard AP radiographs of the pelvis, AP radiographs of the femur, and Lowenstein lateral radiographs. Radiographs taken preoperatively, immediately postoperatively, and at the most recent follow-up were reviewed. The preoperative AP radiographs were graded according to the acetabular defect classification of Paprosky et al [7]. The most recent radiographs were compared with the initial postoperative radiographs. Loosening was defined radiographically as a change in the component abduction angle of greater than 10° or a change in the horizontal or vertical position of greater than 6 mm after correcting for magnification.

Results

Postoperatively, 2 patients required the use of a walker, 2 required the use of a cane, and 9 walked without support for more than 6 blocks. Eleven patients had no pain or mild pain, whereas 2 had moderate pain. Clinically, the patients' modified Postel–Merle d'Aubigne score improved from 6.1 preoperatively to 10.3 postoperatively ($P<.05$).

Radiographically, one patient with a type IIIB defect reconstructed with trabecular metal demonstrated possible acetabular loosening secondary to screw breakage. This patient is currently asymptomatic and has had no further change in the position of his acetabular component. None of the remaining trabecular metal acetabular components was revised or demonstrated acetabular loosening.

Discussion

Reliable and durable fixation of cementless acetabular components requires an environment with adequate biologic potential (intimate contact of viable living bone with the implant) and mechanical stability (motion, <40-50 μm) to allow for bone ingrowth. Bone loss can compromise both of these prerequisites.

The Paprosky et al [7] classification is based on the severity of bone loss and the ability to obtain cementless fixation for a given bone loss pattern. Preoperative radiographic findings on AP radiographs of the pelvis can be used to predict the type of defect present, allowing surgeons to plan for the acetabular reconstruction accordingly.

Our approach to revision of the acetabulum with a suspected pelvic discontinuity relies on preoperative radiographic and intraoperative findings. The initial decision point relates to the superior migration of the hip center before revision. If the hip center has not migrated more than 3 cm above the superior obturator line, then the probability of a pelvic discontinuity is minimal. Once the acetabulum is fully exposed, the anterior and posterior columns are compressed with a Cobb elevator and then motion between the superior and inferior hemipelvis is assessed. Important intraoperative findings include the amount of host bone present, the location of structural defects, and the location of the discontinuity.

In the presence of a pelvic discontinuity, we make an intraoperative determination whether the discontinuity appears to be acute or chronic. An acute pelvic discontinuity, with potential for healing, will have minimal gapping between the superior and inferior hemipelvis such that bony apposition is possible with compression. A chronic discontinuity, with poor potential for healing, may have a large amount of fibrous tissue between the hemipelvis and sclerotic or nonvascularized bone or may have had prior irradiation. If healing is possible, then bone graft is placed into the discontinuity and the pelvis is compressed before the trabecular metal component is inserted. More commonly, there is no potential for healing and the discontinuity is distracted to improve initial component stability. The initial stability of the structural graft or the modular reconstruction is greatly enhanced with distraction, as opposed to compression in which there is little chance for the host bone to heal the discontinuity.

Type IIIB acetabular defects treated with acetabular transplants and cemented acetabular components (without a cage) have shown poor clinical results [8,9]. The senior author (WGP) followed 16 patients for a minimum of 8 years of follow-up (mean follow-up, 10 years). Six patients had well-functioning implants without loosening, 6 underwent revision for aseptic loosening at an average of 2.9 years, and 4 had radiographically loose hips. Because of the poor results noted with unsupported structural allograft, the senior author then began to use reconstruction cages. Despite the use of an acetabular cage, a high failure rate remained (66%) among this complex cohort of patients when a structural allograft and an acetabular cage were combined. Other surgeons have observed similarly high rates of failure among this difficult cohort of patients [4-6].

Other authors have reported poor clinical results when pelvic discontinuity is encountered during revision surgery [1,6]. Berry et al [1] reviewed 27 patients and found that patients who had good remaining pelvic bone stock had a higher likelihood of successful treatment as compared with those who had severe segmental bone loss or those who had had previous treatment with irradiation of the pelvis.

The poor clinical results noted in acetabular defects with associated pelvic discontinuity have prompted the senior author to explore the use of a trabecular metal acetabular component with 1 or 2 augments to span the discontinuity and provide internal fixation to the superior and inferior hemipelvis. Modular trabecular metal revision systems have not been used long enough to provide definitive recommendations. However, the results of trabecular metal remain encouraging both among our current series of patients and that from other institutions [10]. The prevalence, younger age, and greater life expectancy of the arthroplasty population ensure a continued need for solutions in patients requiring an acetabular revision in the face of severe bone loss.

References

1. Berry DJ, Lewallen DG, Hanssen AD, et al. Pelvic discontinuity in revision total hip arthroplasty. J Bone Joint Surg Am 1999;81:1692.
2. Berry DJ. Identification and management of pelvic discontinuity. Orthopedics 2001;24:881.
3. Della Valle CJ, Berger RA, Rosenberg AG, et al. Cementless acetabular reconstruction in revision total hip arthroplasty. Clin Orthop 2004;96.
4. Goodman S, Saastamoinen H, Shasha N, et al. Complications of ilioischial reconstruction rings in revision total hip arthroplasty. J Arthroplasty 2004; 19:436.
5. Peters CL, Curtain M, Samuelson KM. Acetabular revision with the Burch-Schneider antiprotrusio cage and cancellous allograft bone. J Arthroplasty 1995; 10:307.
6. Udomkiat P, Dorr LD, Won YY, et al. Technical factors for success with metal ring acetabular reconstruction. J Arthroplasty 2001;16:961.
7. Paprosky WG, Perona PG, Lawrence JM. Acetabular defect classification and surgical reconstruction in revision arthroplasty. A 6-year follow-up evaluation. J Arthroplasty 1994;9:33.
8. Sporer SM, Paprosky WG. Presented at the AAOS 2006 Annual Meeting, Chicago, Illinois.
9. Sporer SM, Paprosky WG, O'Rourke M. Presented at the American Academy of Orthopaedic Surgeons Annual Meeting, San Francision, California.
10. Nehme A, Lewallen DG, Hanssen AD. Modular porous metal augments for treatment of severe acetabular bone loss during revision hip arthroplasty. Clin Orthop Relat Res 2004;201.