Revision of Failed Total Hip Arthroplasty Acetabular Cups to Porous Tantalum Components

A 5-Year Follow-Up Study

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Abstract: We reviewed 263 consecutive patients with failed acetabular components after total hip arthroplasty that were revised using porous tantalum acetabular components and augments when necessary. The mean follow-up was 73.6 months (range, 60-84 months). The improvement of mean Harris hip score, Western Ontario and McMaster Osteoarthritis Index, and University of California Los Angeles activity scales were statistically significant ($P < .001$). Subjective assessments showed that 87.3% of patients reported "improvement" and 85.9% were "very or fairly pleased" with the results. At the most recent follow-up, all acetabular components were radiographically stable and none required rerevision for loosening. The acetabular revision was considered successful in 87% of cases. From this study, we conclude that the acetabular component used was reliable in creating a durable composite without failure for a minimum of 5 years. **Keywords:** total hip arthroplasty, acetabular revision, porous tantalum component.

Most acetabular revision procedures are performed using cementless porous-coated hemispherical acetabular components, with or without adjunctive screw fixation and bone grafting for defect repair when necessary [1-11]. The long-term fixation of the acetabular component depends on obtaining optimum initial mechanical stability (macrofixation) followed by bone ongrowth/ingrowth (microfixation). However, the presence of extensive acetabular bone defects frequently compromises the ability to achieve initial macrofixation and early component stability. Various surgical options have been described to treat these difficult revision arthroplasty cases [12-21]. In those cases involving significant acetabular defects, multiple concurrent issues exist for creating a durable acetabular composite. The uncertainty of achieving true biologic fixation in these revision composites involves simultaneously obtaining optimum component fit while maximizing contact with viable host bone and achieving bone graft incorporation [22].

To address the multivariable nature of revising a failed acetabular component, the use of a porous tantalum system of acetabular components and augments was proposed and used as a solution for such cases [22-27]. Tantalum has excellent mechanical and biologic compatibility with host bone and can be manufactured with a high-friction surface for optimizing the primary stability of the component [28]. The characteristics of the porous structure, in conjunction with the bioactivity of material surface, is shown to induce bone ingrowth with complete osseointegration of the scaffold at 4 to 6 months [29,30]. The short-term clinical results of tantalum components for the revision of failed acetabula in total hip arthroplasty are encouraging [22,24-27].

The primary purpose of this study was to analyze the minimum 5-year clinical and radiographic results obtained in a consecutive series of 263 cases of failed acetabular components in total hip arthroplasties revised

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by means of the Trabecular Metal (TM) acetabular system (Implex Corporation, Allendale, NJ; Zimmer, Warsaw, Ind). The secondary purpose was to consider these results in relation to the acetabular bone deficiency present at the time of revision.

Materials and Methods

Between July 2000 and December 2002, 263 consecutive patients across 5 surgical centers underwent revision of a failed acetabular component in which TM acetabular components were used. Patients presenting with infection, tumors, irradiated pelvis, and patients receiving antitumor drugs were excluded from this series. There were 150 women and 113 men with a mean age of 69.5 years (range, 39-84 years) at the time of revision (Table 1). The mean time from the previous procedure to revision was 8.9 years (range, 4 months to 12 years). The procedure was the first revision of the failed index acetabular component in 198 cases (75.2%). The other 65 patients had had a mean of 2.7 previous surgical procedures (range, 2-5). The indication for acetabular revision was aseptic loosening in 186 cases (70.7%), polyethylene wear with or without osteolysis in the presence of stable components in 62 cases (23.5%), and femoroacetabular instability and/or impingement in 15 cases (5.7%). Of those cases presenting with aseptic loosening, there were 148 in which periacetabular lesions were present. The femoral component was simultaneously revised in 170 cases (64.6%).

Clinical and radiographic assessments were performed for each patient before and immediately after the revision procedure and at the follow-up points at 3 months, 6 months, and annually thereafter. At the time of admission, the Charnley classification for the assessment of comorbidity was used [31]. Before the impending acetabular revision procedure, 33 patients were identified as Charnley class A (12.5%), 99 as Charnley class B1 (37.6%), 111 have both hips replaced (Charnley class B2, 42.2%), and 20 had multiple joint disease or other disabilities leading to difficulties in walking (Charnley class C, 7.6%).

Clinical evaluations were performed at all follow-up intervals using the Harris hip score (HHS) [32]. A score of 90 to 100 was considered as excellent, 80 to 90 as good, 70 to 80 as fair, and below 70 as poor. All patients completed the Western Ontario and McMaster Osteoarthritis Index (WOMAC) questionnaire (Spanish adaptation) as a disease-specific, self-administered health assessment [33]. The raw score was normalized to the 0 to 100 scale, with zero as the worst quality of life and 100 the best [34]. The outcome values for this score were divided into 3-part categorical responses, 0 to 63 poor, 64 to 85 good, and 86 to 100 excellent [35]. Patient activity was graded using the University of California Los Angeles (UCLA) activity scale [36]. Patients were also asked whether they were very pleased, fairly pleased, not very pleased, or very disappointed with the operation, and whether their hip was much improved, slightly improved, unchanged, slightly worse, or much worse than before surgery [37]. Questionnaires were administered by MF-F and AM Jr.

Standardized anteroposterior and lateral radiographs were obtained at all follow-up intervals and reviewed by the operating surgeon and 2 independent radiologists (AM and NL) having no knowledge of the clinical outcome and not having taken part in any other stage of this work. Implant and screw position, polyethylene wear, radiolucent lines, gaps, and osteolysis were assessed. Radiolucent lines adjacent to the acetabular component and/or augments were identified as described by DeLee and Charnley [38]. The width of radiolucencies was measured to the nearest millimeter using a transparent ruler. Acetabular index, hip center, and migration of acetabular component were considered after the method proposed by Callaghan et al [39]. The vertical distance from the center of femoral head to the interteardrop line and the horizontal distance to the perpendicular to this line at the teardrop figure were calculated. A normal hip center is reported to be 12 to 14 mm above the interteardrop line and 33 to 43 mm lateral to the acetabular teardrop [40]. A high hip center was arbitrarily defined as having the center of rotation on an anteroposterior radiograph greater than 35 mm proximal to the interteardrop line [41]. A component was described as radiographically unstable if a 1 mm or greater lucent line occurred across all 3 acetabular zones or if any measurable cup migration occurred [27]. Loosening was characterized by a change in the component abduction angle of greater than 10° or in the horizontal or vertical position of greater than 6 mm

Table 1. Demographic Data

Age (y)	69.5 (39-84)
Sex	
Male	113
Female	150
Time from previous surgical procedure (y)	8.9 (0.33-12)
Indication for revision	
Aseptic loosening	186 (70.7%)
Polyethylene wear	62 (23.5%)
Femoroacetabular instability/impingement	15 (5.7%)
Charnley classification	
A	33 (12.5%)
B1	99 (37.6%)
B2	111 (42.2%)
C	20 (7.6%)
Paprosky classification	
Type 1	20 (7.6%)
Type 2	194 (73.7%)
Type 2A	73 (27.7%)
Type 2B	82 (31.1%)
Type 2C	39 (14.8%)
Type 3	49 (18.7)
Type 3A	40 (15.2%)
Type 3B	9 (3.4%)