Revision of Failed Acetabular Components with Use of So-Called Jumbo Noncemented Components

A Concise Follow-up of a Previous Report*

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Abstract: Acetabular revision in the presence of major bone-stock deficiency is a difficult clinical and surgical problem. Of an original pool of twenty-four consecutive patients treated with an acetabular revision with a so-called jumbo (>65-mm) cementless hemispherical acetabular component, fifteen were followed for an average of seven years in our previous study. The current report presents the results for the twelve patients in this group who were alive at a minimum of twelve years (mean, 13.9 years) postoperatively and agreed to return for follow-up. The average final Harris hip score was 79 points. No acetabular shell had been revised because of aseptic loosening, and none was loose as seen radiographically. The complication rate was high but was largely related to infection. In the patients without infection, the fixation of these large sockets remained excellent at the time of long-term follow-up.

Level of Evidence: Therapeutic Level IV. See Instructions to Authors for a complete description of levels of evidence.

Background

The use of a hemispherical, porous-coated, cementless component for acetabular revision following total hip arthroplasty has yielded, in general, a high percentage of good-to-excellent long-term results, despite the fact that acetabular revision is often associated with major loss of pelvic bone stock[1,2]. In the presence of severe bone loss, cementless fixation remains our preferred solution, but it often requires the use of special surgical techniques, such as the insertion of a large (so-called jumbo) acetabular component.

While we[3] and other authors[4-7] have demonstrated favorable results following revision with these large acetabular cups, with or without additional bone-grafting to reconstruct major acetabular deficits, the follow-up intervals have been of intermediate duration. In our previous study, we reported no aseptic loosening at an average of seven years in a group of fifteen patients (fifteen hips)[3]. We now report our results in these same patients at an average of 13.9 years.

Methods

Between August 1986 and December 1991, twenty-four patients underwent a total of twenty-four consecutive acetabular revisions with an acetabular cup of >65 mm in diameter, performed by the senior author (W.H.H.). Twelve Harris-Galante-I and twelve Harris-Galante-II acetabular shells (Zimmer, Warsaw, Indiana) were inserted, all with supplemental screw fixation. At the time of the index procedure, the average age of the patients was fifty-eight years (range, twenty-one to eighty-one years). An average of 2.1 operations (range, one to four) had been performed prior to the index procedure.

We previously reported the demographic features and clinical and radiographic results for fifteen of these hips at an average of seven years[3]. In the current study, we report the results for these patients at a minimum of twelve years. After we obtained institutional review board approval, each patient was contacted and each consented to participate in the study.

None of the original cohort of twenty-four patients was lost to follow-up. Three patients underwent revision of the acetabular shell because of deep infection, and six patients died less than five years postoperatively, which left fifteen patients in the previous study[3]. Subsequently, two additional patients died and one patient, who was involved in a lawsuit unrelated to the acetabular implant, refused to return for follow-up. Thus, twelve patients (twelve hips) were included in the current follow-up study. Eleven patients were evaluated with a clinical examination, determination of the Harris hip score[8] and the University of California at Los Angeles (UCLA) activity level[9], and current radiographs,

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TABLE I Description of Prosthetic Components

Acetabular Shell				Femoral Component	
Type	Outer Diameter *(mm)*	Inner Diameter/ Head Size	No. of Screws	Type	Status at 12 Yr
Harris-Galante II	66	32	2	Harris Calcar	Stable
Harris-Galante II	68	26	4	Harris Calcar	Stable
Harris-Galante I	66	28	3	Harris Precoat	Stable
Harris-Galante II	66	22	2	Harris Precoat	Stable
Harris-Galante I	72	32	6	Harris Precoat	Stable
Harris-Galante I	70	28	3	Harris Calcar	Stable
Harris-Galante I	72	26	2	Harris Precoat	Stable
Harris-Galante II	70	32	2	AML	Stable
Harris-Galante II	66	26	2	Charnley	Stable
Harris-Galante II	66	26	4	Harris Precoat	Stable
Harris-Galante II	72	26	3	Harris Calcar	Stable
Harris-Galante II	72	26	2	Centralign	Loose

whereas the remaining patient was evaluated only on the basis of a Harris hip score, which was determined with a telephone interview, and without current radiographs. The duration of follow-up averaged 13.9 years (range, 12.3 to 16.2 years) for the twelve patients. Table I lists the components that were used in each of the patients.

An orthopaedic surgeon who was not involved with the index acetabular revision examined the radiographs for signs of loosening of the acetabular shell. Gaps and radiolucent zones were defined with use of previously published criteria[10]. All radiolucent zones of >3 mm in width were arbitrarily considered to represent osteolysis. The locations of periacetabular radiolucencies were described according to the classification system of DeLee and Charnley[11]. The interteardrop line and the vertical line drawn at a right angle to the interteardrop line, arising from the teardrop, were used as a reference to determine the vertical and horizontal position of the hip center. Migration of the acetabular component of ≥4 mm or an angular change of the component of ≥5° was deemed to be evidence of migration. A high hip center was defined as a hip center ≥35 mm proximal to the interteardrop line. Linear femoral head penetration was measured with the computer-assisted Livermore method[12].

Results

The two patients who died since the previous report but less than twelve years postoperatively both had been asymptomatic and functioning well, without osteolysis, at the time of their last follow-up, eleven and eight years after the index acetabular revision.

At the time of the latest follow-up, the Harris hip scores for the twelve hips in the current study averaged 79 points (range, 46 to 98 points) (Figs. 1-A, 1-B, and 1-C). The Harris hip pain scores averaged 38 points (range, 20 to 44 points). Only one patient had more than slight pain, and that patient had symptomatic femoral loosening due to osteolysis. The Harris hip function scores averaged 33 points (range, 17 to 45 points). The UCLA activity scores averaged 5 points (range, 1 to 6 points). Eight of the twelve hips were rated good or excellent, and four were rated poor. One of the four patients with a poor result had poor function because of a recent stroke but had no symptoms related to the hip. Another of the four patients was very debilitated because of medical conditions. One patient was awaiting revision of the femoral component because of symptomatic loosening secondary to osteolysis (as mentioned above), and the fourth patient had been involved in a motor-vehicle accident and was being treated for severe, chronic back pain. No patient had undergone a repeat revision of the acetabular shell for any reason since our previous report.

None of the original twenty-four hips had the shell revised because of aseptic loosening. No acetabular liner exchange had been performed, but one was planned as an incidental component of the procedure for the patient who was awaiting a femoral revision because of osteolysis. Of the eleven hips for which current radiographs were available, five demonstrated radiolucency in all three zones of the component-bone interface. However, none of these radiolucencies was seen to be continuous on any view, and none was wider than 2 mm. One patient had radiolucencies of <4 mm in length in zones 1 and 2, but these were unchanged compared with their appearance on the initial postoperative radiograph (when they were designated as gaps) and they were not deemed to represent osteolysis. No component migrated. Femoral head penetration into the polyethylene averaged 0.213 mm/yr (range, 0.102 to 0.338 mm/yr).

Discussion

When performing an acetabular revision in the presence of major periacetabular bone loss, the surgeon has several limited options for achieving a stable reconstruction.

Fig. 1-A

Figs. 1-A, 1-B, and 1-C Radiographs of a male patient who initially underwent a left total hip arthroplasty with cement because of acetabular dysplasia. **Fig. 1-A** Anteroposterior radiograph made when the patient was fifty years old, sixteen years after the arthroplasty, showing a loose acetabular component with major proximal acetabular bone loss. A medial Tanzer[10] grade-IIIB defect was also noted at the time of the surgery.

These include placing a large hemispheric cementless acetabular component supported by host bone, with or without augments; placing a standard or smaller cementless component at a high hip center; using structural allograft to augment bone stock for the acetabular component; impaction allografting with use of bone cement; or using a cage or bilobed type of acetabular component. Results assessed at sixteen years following use of bulk structural graft (either allograft or autograft) have been disappointing[13], as have the results of use of acetabular cages in the presence of major bone loss[14]. Impaction allografting of the acetabulum, as reported by the originator of the technique, has provided good results in the medium term[15]. However, in the presence of major bone loss and when the bone graft is not contained, it is a technically demanding procedure. In one study[16], the overall acetabular revision rate was eleven of sixty-one, with seven of the sixty-one sockets revised because of aseptic loosening, and the survival rate with revision due to aseptic loosening as the end point was 84% (95% confidence interval, 73% to 95%) at fifteen years. Other authors have shown less encouraging results with impaction allografting[17]. The use of a standard-sized acetabular component supported primarily by host bone at a high hip center has consistently yielded good-to-excellent results in the short to medium term[18], but this method is not feasible with major bone loss. Placement of a smaller acetabular component at a high hip center has also yielded good short to medium-term results[18], but the procedure is technically demanding with respect to avoiding limb-length discrepancy, restoring abductor muscle strength, and preventing osseous impingement. Because of all of these concerns, we prefer, when feasible, to use a jumbo acetabular component against host bone when we are faced with major bone loss in the revision setting.

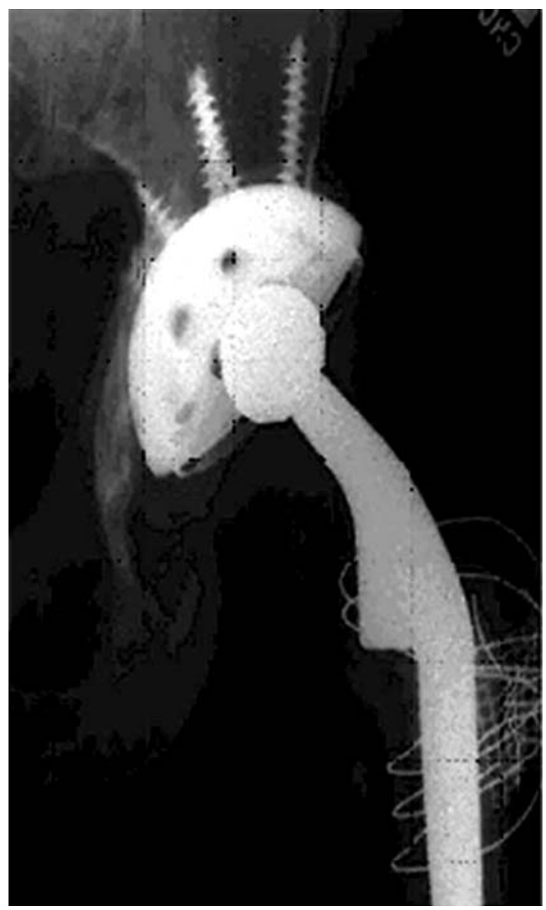

Fig. 1-B

Anteroposterior radiograph of the left hip, made five and one-half years after the index revision. There was excellent contact of the component with the host bone and no evidence of osteolysis. The Harris hip score was 96 points.

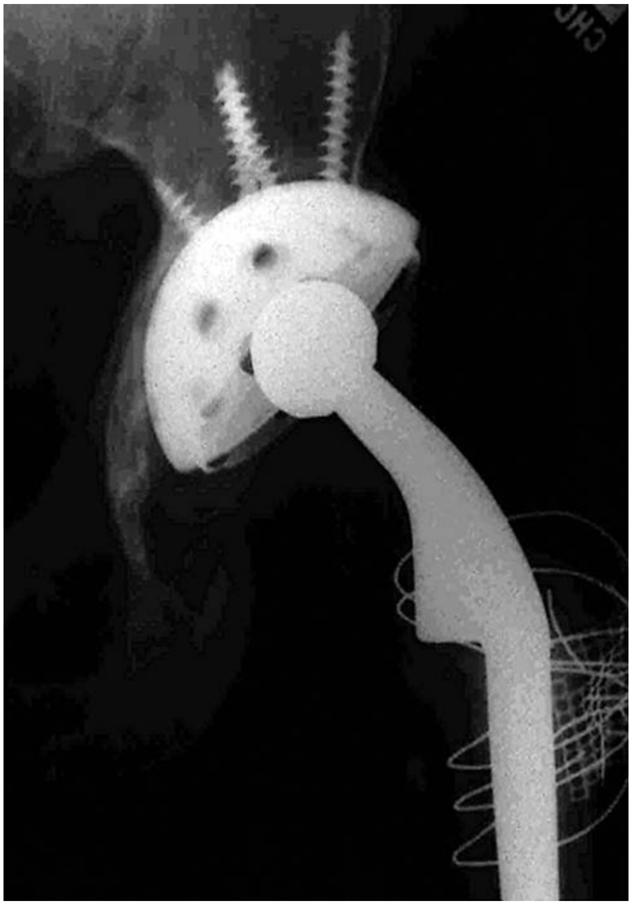

Fig. 1-C
Anteroposterior radiograph of the left hip, made 13.5 years after the index revision. Contact of the component with the host bone remained excellent, and there was no evidence of osteolysis. The Harris hip score was 91 points.

The use of a jumbo acetabular component allows a large surface area for bone ingrowth. In addition, the center of the hip joint is maintained in a more anatomical position, less bone graft is required, and multiple screws can be used for rigid fixation. Finally, use of a jumbo cup allows the option of using a thicker acetabular liner and a larger femoral head. One relative disadvantage of using a jumbo acetabular component is that augmentation of the host bone is decreased because the larger component occupies space that could otherwise have been filled with some type of graft material.

Other authors' definitions of a "jumbo cup" have slightly differed from the one used here. We originated the design of "jumbo" cups and previously defined them as cups with a diameter of >65 mm. Whaley et al.[7] and Patel et al.[4] both suggested a gender-related definition of an extra-large cup as one that was >65 mm in men and >61 mm in women, a definition that was based on a shell that was >10 mm larger than the average cups implanted in men and women. Ito et al.[5] defined large cups as being "relative to the ratio of the component size to the pelvis and hip joint." In our report, we used our original designation of >65 mm in order to achieve lasting stability against host bone and, in so doing, to restore hip biomechanics more closely to normal.

Remaining small contained defects can be filled with particulate graft, which can be impacted with reverse reaming. This provides additional initial stability and restores some host bone stock in the event that a subsequent repeat revision is required. Additional stability can also be achieved with acetabular screws. Obenaus et al.[6] reported osseous integration in fifty-nine of sixty patients who had undergone revision with a jumbo acetabular cup with press-fit fixation only. However, the small risk associated with screw placement must be weighed against the necessity of achieving adequate initial stability of the acetabular component. We generally recommend placing screws for supplemental fixation in most revision procedures.

The rate of femoral head penetration in this series was higher than what has been reported previously for polyethylene that had been gamma-irradiated in air. Despite these high penetration rates, the rate of osteolysis was low, and none of our patients demonstrated progression of osteolytic lesions on plain radiographs during the interval between the seven-year and latest follow-up examinations. No new cases of aseptic loosening developed during this time. We are unsure about the specific cause of these higher penetration rates. However, regardless of the cause, the high penetration rate supports the idea of exchanging an older polyethylene liner to an alternative bearing surface at the time of a femoral revision. This would allow placement of a more wear-resistant bearing surface and preferably, if possible, one that would accommodate a larger femoral head as well.

The acetabular shells that were utilized in this report have an excellent track record with regard to osseous integration with host bone over the long-term[1]; however, the locking mechanism of the polyethylene liner has failed in some studies[19,20]. We did not encounter any failures of the locking mechanism or tine fractures in this small cohort of patients. ■

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