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Outcome of 4 Surgical Treatments for Wear and Osteolysis of Cementless Acetabular Components

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ABSTRACT

Background: Loosening and periprosthetic osteolysis are some of the most common long-term complications after hip arthroplasty. The decision-making process and surgical treatment options are controversial.

Methods: We retrospectively reviewed 96 acetabular revisions (91 patients) performed between 2002 and 2012, with a minimum of 2 years of follow-up and a mean of 5.7 years of follow-up. Clinical outcome was assessed using the Harris Hip Score. The size and location of osteolytic lesions were evaluated using the preoperative radiographs; healing of the defects was categorized using a standardized protocol.

Results: Thirty-three (34.4%) hips had isolated liner exchanges (ILEs), 10 (10.4%) hips had cemented liners into well-fixed shells (CLS), 45 (46.9%) hips had full acetabular revisions (FARs), and 8 (8.3%) hips had revision with a roof ring/antiprotrusio cage (RWC). All procedures showed significant improvement in Harris Hip Score after revision ($P \leq .001$). Fifteen patients had moderate residual pain (pain score ≤20): 8 (24%) ILE, 3 (30%) CLS, and 4 (9%) FAR. Complete bone defect healing after grafting was lower with acetabular component retention procedures (ILE and CLS; 27%) compared with full acetabular component revision procedures (FAR and RWC; 57%). Fifteen patients underwent reoperation: 3 ILE, 1 CLS, 8 FAR, and 3 RWC.

Conclusion: Acetabular component retention demonstrates a low risk of reoperation; however, residual pain and limited potential for bone graft incorporation are a concern. FAR is technically challenging and may have an elevated risk of reoperation; however, higher degrees of bone graft incorporation and satisfactory clinical outcome can be expected.

Aseptic loosening secondary to periprosthetic osteolysis is one of the most common long-term complications after total hip arthroplasty (THA). Wear and osteolysis constitute 5%-11% of overall causes of failure in THA [1–3]. The diagnosis, grading of severity, and prognostic evaluation of osteolytic lesions remain challenging and controversial [4]. Moreover, the options for surgical treatment are often confusing and few guidelines exist to suggest optimal treatment.

With a well-fixed and well-positioned modular cup, simple isolated polyethylene liner exchange (ILE) or cementing new liners into the well-fixed shell (CLS) are viable options for acetabular component retention. Previous studies have reported promising results with these surgical procedures [5–10]. The advantages of these procedures are rapid patient recovery, early postoperative mobilization, and prevention of iatrogenic bone loss during removal of a well-fixed cup. However, there are concerns regarding inadequate exposure of the osteolytic lesions leading to insufficient bone graft application or incorporation [11]. Higher risk of dislocation after ILE has also been reported [12,13].

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Revision of the entire acetabular component must be considered if the cup is loose or poorly positioned or if the cup is stable but does not fulfill the criteria for cup retention including a very small shell with a poor locking mechanism or liners that are unavailable or cannot be cemented optimally [5,6]. In this group of patients, difficulties of reconstruction depend on the degree of bone loss and the ability to restore host bone stock, and the ability to obtain rigid implant fixation. Clinical outcomes are more predictable in cavitary or minor segmental defects when sufficient host bone is remaining to allow adequate fixation of a new porous-coated acetabular component [14,15]. In cases of severe acetabular deficiencies requiring reconstruction cages, structural allografts, or metal augments to restore massive bone defects, higher complications and reoperation risk have been reported [16,17].

The majority of clinical studies have focused on a specific surgical treatment procedure. Limited literature is currently available regarding the results of different surgical techniques in the same study cohort [18,19]. A high variability of patient selection criteria, surgical techniques, implant options, and outcome measurement are the major limitations in the interpretation of outcomes of different surgical procedures. The purpose of this study was to evaluate the clinical and radiographic outcomes of a consecutive series using 4 surgical procedures used for the treatment of periprosthetic acetabular osteolysis in a single institution over a 10-year period.

Materials and Methods

The medical records and radiographs of all patients undergoing revision THA because of polyethylene wear and osteolysis between July 2002 and December 2012 were reviewed. All surgeries were performed by 3 experienced fellowship-trained surgeons at a single institution. The inclusion criteria for this study were (1) a minimum follow-up period of 2 years postoperatively; (2) use of a cementless hemispherical cup in the primary THA; (3) revision surgery performed with one of the following: ILE, CLS, revision of entire acetabular component, or utilization of a reconstruction ring or cage; and (4) preoperative radiographs showing eccentric wear of the polyethylene liner with or without osteolysis around the acetabular cup. Patients with incomplete or unavailable medical record data, preoperative and postoperative radiographic studies, and functional scores were excluded from this study.

Data collection from the medical records included demographic information, underlying disease, diagnosis, indication for surgery, date of surgery, age at time of surgery, type of surgical procedures, surgical approach, implant information, method of bone defect restoration, intraoperative stability of acetabular component, and details of complications or reoperation.

Patients were evaluated for clinical outcome using the Harris hip score (HHS) [20]. For accuracy of the postoperative functional score, all patients who returned for last clinical visit before Jan 2014 were contacted using the information listed in their medical records. Pain and functional subscale of the HSS were used for evaluation (pain: maximum score = 44; function: maximum score = 47; and total: maximum score = 91). All telephone calls were made by a single research coordinator. At least 3 attempts on 2 separate days were made to contact patients by phone or email before considering them as “lost to follow-up.”

Clinical and functional scores may be affected by many factors such as medical comorbidities, other bone and joint dysfunction, spine problems, and so forth. Relieving pain is the primary goal of treatment and HHS questionnaire is specific to the affected hip joint. In this study, we defined patients who had pain subscale $\leq$20 at the last follow-up visit as “significant residual pain” group. This outcome measurement reflects the number of patients who were disturbed by pain during their activities of daily living. Patients who underwent reoperation or rerevision surgery were excluded from the clinical score calculation.

All preoperative anteroposterior (AP) pelvic radiographs, lateral radiographs, and oblique (Judet) views of the hip were reviewed. Location of the osteolytic lesion was determined as per the DeLee and Charnley [21] zones of demarcation that divide the location of osteolytic lesions of the acetabulum into zones 1, 2, and 3 on the AP view. The approximate size of the lesion was measured on AP pelvic radiographs by measuring the longest width and then measuring a second length perpendicular to the first line, similar to the method proposed by Maloney el al [5]. Radiographs taken at the last clinical visit were used for evaluation of regression or progression of the osteolytic lesion as compared with preoperative radiographs. The healing response of the osteolytic lesion(s) if present after treatment was (were) categorized into 4 groups as follows: (1) complete healing: increasing bone density and continuity of trabecular lines across the entire area of the lesion; (2) partial healing: lesion size is smaller than preoperative radiographs but radiolucent areas in the lesion and discontinuity of trabecular lines remain; (3) no change: lesion size and radiolucent area is similar to preoperative radiographs; (4) progression of the lesion: lesion size larger than preoperative radiographs or evidence of cup migration is present (Fig. 1). The acetabular component was evaluated for cup migration using the criteria proposed by Massin et al [22].

Statistical Analysis

Patient characteristics, follow-up operative data, radiographic results, and reoperation were analyzed by descriptive statistics. All categorical variables are reported as the amount and percentage. Statistical comparisons of clinical outcome scores among different surgical treatment options were made using 1-way analysis of variance. Statistical differences of the rates of healing between groups were compared using the independent-paired *t* test.

Results

Patient Characteristics and Follow-Up Data

Of 112 revision THA patients who met our inclusion criteria, preoperative radiographs were unavailable in 6 patients, 6 patients died, 2 patients had a follow-up period of <2 years, and 7 cases were lost to follow-up. The remaining 96 hips in 91 patients were included in this study. The average age at the time of index revision surgery was 60.2 years (range, 28-85 years). Study participants included 55 women and 41 men. There were 48 left hips (50%) and 48 right hips (50%). Medical comorbidities included rheumatoid arthritis (11 cases), ankylosing spondylitis (2 cases), end-stage renal disease/renal transplantation (3 cases), chronic obstructive pulmonary disease (3 cases), coronary artery disease (9 cases), hypertension (47 cases), diabetic mellitus (14 cases), and depression requiring medication (13 cases). The average length of time from primary THA or previous revision surgery to present revision surgery was 13.3 years (range, 6-29 years). The follow-up among living patients averaged 5.7 years (range, 2-11 years). The patient demographic data including age, follow-up period, time from primary THA to revision surgery, preoperative HHS score, location of the osteolytic lesions, lesion size, intraoperative finding of fixed and loose cup, and numbers of femoral stem revision are showed in Table 1.

Operative Data

Type of surgical procedures which were performed during revision THA consisted of polyethylene ILE in 33 cases (34%), acetabular CLS in 10 cases (10%), revision with a hemispherical cup