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Metal-on-Metal Total Hip Arthroplasty at Five to Twelve Years Follow-Up: A Concise Follow-Up of a Previous Report

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ABSTRACT

Background: Concern has arisen regarding potential complications with modular metal-on-metal (MoM) acetabular components in total hip arthroplasty. The purpose of this study was to analyze longitudinally the longer term results of a previously reported cohort of patients utilizing a cementless modular acetabular component with a MoM bearing.
Methods: One hundred sixty-nine consecutive but selected total hip arthroplasties were performed in 148 patients at 2 institutions using a modular acetabular MoM component. One hundred thirty-nine patients (158 hips) were living at minimum 5 years, 1 patient (1 hip) was lost to follow-up and 8 patients (10 hips) were deceased. Patients were evaluated clinically in terms of revision as well as radiographically. Additional testing (metal ion levels, advanced imaging) was performed when concerns for adverse local tissue reaction (ALTR) arose.
Results: There were 6 (3.8%) additional hips revised since the prior report for a total of 7 hips (4.4%) revised at 5-12 year follow-up. All newly revised hips (3.8%) demonstrated ALTR. There were 7 (4.7%) additional cases of radiographically detected acetabular osteolysis and 7 (4.7%) cases of femoral osteolysis.
Conclusion: Longitudinal evaluation of a modular MoM bearing surface acetabular component demonstrated increased rates of ALTR and osteolysis at longer duration follow-up. Although greater than 95% of hips in this study performed well at 5-12 years, when comparing the results to metal-on-polyethylene bearings using the same acetabular component, the results were inferior. Longitudinal surveillance is warranted with this design and this bearing surface couple as cases of ALTR and osteolysis increased with longer follow-up.

Concern over metal-on-metal (MoM) bearing surfaces in total hip arthroplasty initially arose with one-piece acetabular constructs as high revision rates were reported in joint registries [1,2]. However, there are few intermediate term follow-up studies of contemporary modular acetabular components with a MoM bearing surface. To our knowledge, there are no follow-up studies evaluating such a group longitudinally at multiple follow-up intervals. Additionally, there is current interest regarding potential sites of the total hip construct that could produce metal ions, corrosion, or adverse local tissue reaction (ALTR). Possible sites include the MoM bearing surface, head-neck taper, and the interface of the liner and acetabular shell.

We previously reported the 3- to 8-year follow-up results for a MoM bearing using a modular acetabular component with screw augmentation in a consecutive series of 169 total hip arthroplasties in 148 patients [3]. At that early follow-up, there was one revision for aseptic loosening, 3 cases of acetabular osteolysis, and three cases of femoral osteolysis. No cases of ALTR were reported at that time.

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The purpose of this study was to evaluate this cohort of a MoM bearing surface modular acetabular component longitudinally and compare the results obtained at 3-8 years to that of 5- to 12-year follow-up. Continued evaluation of this cohort is warranted as concern has arisen regarding the complications associated with ALTR in similar cohorts of modular MoM acetabular constructs [4-6].

Materials and Methods

The present study, which was performed with institutional review board approval, involved patients who were evaluated prospectively and included data reviewed retrospectively at a follow-up period of 5-12 years. The series consists of a consecutive series of 169 total hip arthroplasties in 148 patients performed by 2 surgeons (D.D.G. and C.R.M.). A modular acetabular component was used in all cases, which consisted of metal on metal bearings (Ultamet, DePuy, Warsaw, IN) and acetabular shells with screw augmentation (Pinnacle Sector; DePuy). In all cases, a Summit femoral stem (DePuy) was used. Thirty-six millimeter diameter modular femoral heads were used in most cases (164 hips). These hip replacements represent 33.4% of the 506 primary total hip arthroplasties performed by the 2 surgeons during the time interval between September 2002 and August 2006.

The original study cohort consisted of 169 total hip arthroplasties in 148 patients. At the time of 3- to 8-year follow-up, one hip was lost to follow-up and 5 patients (5 hips) died without hip revision. Since that time, 3 additional patients (5 hips) died and no additional hips were lost to follow-up. Thus, at a minimum of 5 years after total hip arthroplasty, 8 patients (10 hips) were deceased and one patient (1 hip) was lost to follow-up. The remaining 139 patients (158 hips) were the focus of the present study with an average of 8.7 years follow-up.

Clinical evaluation included post-operative Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) [7], Short Form 36 (SF-36) health survey [8], and University of California Los Angeles (UCLA) activity scale [9] and need for revision. The Harris hip score (HHS) was obtained both preoperatively and postoperatively [10].

Anteroposterior and lateral radiographs were evaluated by 2 observers not involved with the surgery (J.J.G. and J.J.C.) with findings determined by consensus. The femoral component was evaluated for bone ingrowth, stable fibrous fixation, or unstable fibrous fixation according to the criteria of Engh et al [11]. Femoral component subsidence was determined using the relationship of the top of the lesser trochanter to the medial aspect of the stem, defined as a decrease of at least 5 mm between the initial post-operative radiograph and those from radiographs at the most recent follow-up [12]. Femoral component stress shielding, using a modification of the criteria defined by Engh and Bobyn [13], was also recorded. Mild stress shielding was defined as limited to the upper 1/3, moderate stress shielding defined as extending to the middle 1/3, and severe stress shielding defined as extending below the middle 1/3 of the femoral component. Femoral component osteolysis was defined as any nonlinear radiolucency at the bone prosthesis interface that was at least 5 mm^2 and was recorded according to the 7 femoral zones defined by Gruen et al [14]. Femoral radiolucencies were also recorded according to the same 7 femoral zones defined by Gruen et al [14]. Acetabular components were evaluated for bone-prosthesis radiolucencies and acetabular component migration according to the criteria of Massin et al [15]. The definition of acetabular osteolysis was the same as that for femoral osteolysis. Radiographs were compared to evaluate for progression or regression of radiolucencies and osteolysis around the acetabular and femoral components since the previous interval of follow-up (ie, minimum 3 years). Lateral cup opening angle was determined in the initial report by measurement on immediate postoperative anteroposterior radiographs.

Patients underwent further testing when indicated based on clinical symptoms, including hip pain and concern for ALTR. The additional work-up was determined at the discretion of the treating physician (D.D.G. and C.R.M.) and potentially included laboratory data (metal ion levels, erythrocyte sedimentation rate, and C-reactive protein) as well as advanced imaging (bone scan, magnetic resonance imaging [MRI], or computed tomography [CT]). Those with either serum cobalt or chromium >7.0 ppb were noted as significantly elevated and in need for consideration of revision based on published guidelines [16]. Intraoperative samples during revision surgery were collected in select cases; the histopathological reports of these samples were obtained for further analysis.

ALTR was defined as the presence of metallosis; or corrosion at the MoM bearing surfaces; or pseudotumor found at revision or by imaging; or perivascular lymphocytes seen in a histopathological specimen with tissue necrosis or fibrin deposition; or metal ions significantly elevated; or significant clinical improvement after exchange of the MoM articulating surface.

Kaplan-Meier survivorship analysis was performed with the following end points: (1) revision for any reason and (2) revision for ALTR [17].

Results

Reoperations

As reported in the previous study only one hip required revision for aseptic loosening of the femoral component at 1.1 years. At further follow-up of 5-12 years, the same hip was revised for iliopsoas tendonitis (with liner exchange and psoas release). There were 6 additional hips that underwent revision, with one of these hips receiving a second revision one week later due to dislocation. Thus, at minimum 5-year follow-up, there were a total of 7 hips (4.4%) revised (Table 1). Average time to revision was 7.4 years (range 1.1-10.8). Revisions occurred in 5 females and 2 males. Excluding the revision for loosening in the previous report and the revision due to dislocation, all hips were revised due to concern of ALTR. In all ALTR cases, the modular metal liner was exchanged for a polyethylene liner and the cobalt femoral head was exchanged for a ceramic head. The acetabular shell and femoral components appeared bone ingrown at the time of surgery. In one hip a solid mass pseudotumor was encountered during the revision. No components of the newly deceased patients were revised before death.

Clinical Results

Five- to 12-year clinical outcome scores were completed at an average of 7.4 years (range 5.0-12.4) after index surgery. Mean values for all clinical outcome scores decreased at 5- to 12-year follow-up from the earlier follow-up period (Table 2). There were 29 patients (33 hips) that had at least a 10 point decrease in HHS from the minimum 3-year follow-up to the current follow-up. Of these, there were 2 patients (2 hips) that received additional testing due to clinical concerns and there were 2 patients (3 hips) that went on to revision for ALTR.

Radiographic Results

At the time of final follow-up, minimum 5-year radiographs were available for 150 of the 158 (95%) hips in the group of 138 patients who were still living. The average duration of radiographic