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Original Article

Patient-Reported Outcomes After Revision of Metal-on-Metal Total Bearings in Total Hip Arthroplasty

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ABSTRACT

Background: Failure of metal-on-metal (MOM) total hip arthroplasty (THA) bearings is often accompanied by an aggressive local reaction associated with destruction of bone, muscle, and other soft tissues around the hip. Little is known about whether patient-reported physical and mental function following revision THA in MOM patients is compromised by this soft tissue damage, and whether revision of MOM THA is comparable with revision of hard-on-soft bearings such as metal-on-polyethylene (MOP).
Methods: We identified 75 first-time MOM THA revisions and compared them with 104 first-time MOP revisions. Using prospective patient-reported measures via the Veterans RAND-12, we compared Physical Component Score and Mental Component Score function at preoperative baseline and postoperative follow-up between revision MOM THA and revision MOP THA.
Results: Physical Component Score did not vary between the groups preoperatively and at 1 month, 3 months, and 1 year postoperatively. Mental Component Score preoperatively and 1 and 3 months postoperatively were lower in patients in the MOM cohort compared with patients with MOP revisions (baseline: 43.7 vs 51.3, $P < .001$; 1 month: 44.9 vs 53.3, $P < .001$; 3 months: 46.0 vs 52.3, $P = .016$). However, by 1 year, MCS scores were not significantly different between the revision cohorts.
Conclusion: Postrevision physical function in revised MOM THA patients does not differ significantly from the outcomes of revised MOP THA. Mental function is markedly lower in MOM patients at baseline and early in the postoperative period, but does not differ from MOP patients at 1 year after revision. This information should be useful to surgeons and physicians facing MOM THA revision.

Modern large-head metal-on-metal (MOM) bearing surfaces, which were purported to have better wear properties than traditional metal-on-polyethylene (MOP) bearing surfaces, were introduced in Europe in 2003 and in the United States in 2005. However, registry studies from the United Kingdom and Australia soon demonstrated high early failure rates of MOM total hip arthroplasty (THA) implants, with revision rates of 5%-10% at 5 years [1,2].

Traditional MOP THA often fails due to aseptic loosening with polyethylene particle-mediated osteolysis [3]. Failure of MOM THA has been associated with local macrophage and lymphocyte

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reaction to cobalt and chromium ions released due to wear [4-6]. The combination of increased early failure rates and local adverse reactions to metal ions, such as aseptic lymphocyte-dominated vasculitis associated lesions (ALVAL), has led to many early revisions [7-9]. ALVAL has been linked to MOM hip implants and is thought to contribute to soft tissue destruction [10-14]. Well-fixed implants with poor surrounding tissue can make revision surgery more complex and result in potentially worse outcomes [12,14,15].

To date, patient-reported outcomes (PROs) of revised MOM THA have not been thoroughly studied, making it difficult to counsel patients on expected functional recovery and most studies of clinical outcomes of revised MOM THA do not examine PROs after revision [16]. Generally, patients report good health status after successful primary THA and return to a relatively good health status after successful revision THA [17]. Given that approximately 40% of all hip arthroplasties performed in the United States over the last decade involved MOM hip implants [18], it is important to understand whether patients undergoing revision of MOM THA will enjoy a similar function improvement after their revision.

We assessed PROs after revision of MOM THA compared with outcomes after revision of MOP THA, using prospectively collected Veterans RAND-12 (VR-12) surveys, a validated measure of general health-related quality of life [19]. We hypothesized that there would be no difference between PROs after revision of MOM and revision of MOP THA.

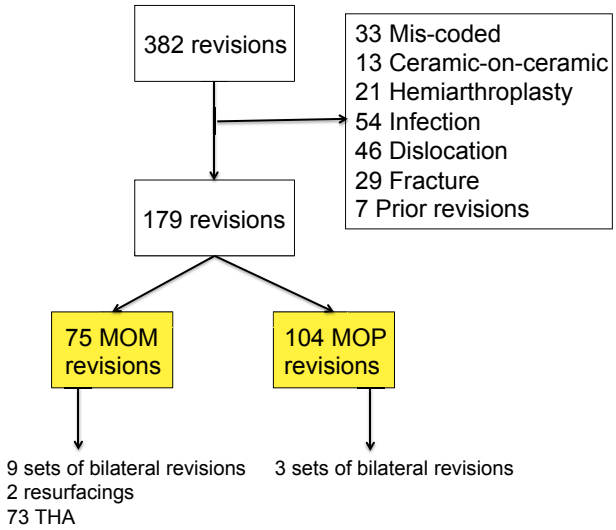

Fig. 1. Counts and exclusion criteria of the patient study population comparing MOM and MOP bearing surface among primary THA revision. THA, total hip arthroplasty; MOM, metal-on-metal; MOP, metal-on-polyethylene.

Methods

Institutional Review Board approval was obtained for the study. Using our internal data warehouse, which is linked to the electronic medical record system and includes both hospital and clinic institutional records, revision THAs were selected by Current Procedural Terminology code (27132, 27134, 27137, 27138). Additional inclusion criteria specified first-time THA revisions and that the bearing surface was either MOM or MOP. All surgeries were performed between September 2006 and December 2012 by 3 fellowship-trained arthroplasty orthopedic surgeons at a single rural tertiary academic medical center. A manual search of the operative reports in the electronic medical record was conducted to identify primary revisions of MOM or MOP THA and to include any variable values missing in the initial data warehouse search. Exclusion criteria consisted of miscoded THA primary revision, ceramic bearing surface, hemiarthroplasty, history of previous THA revision, and revisions related to infection, dislocation, or fracture. See Figure 1 for more information on the study population attrition.

Age at the time of revision, gender, laterality of revision, body mass index (BMI) at the revision preoperative visit, smoking status at revision, grouped comorbidity status at revision, a histologic diagnosis of ALVAL, and known complications were abstracted from the medical record. Due to low variation among older persons in rural New England, data on race and ethnicity were available but not pursued. BMI was grouped into categories based on accepted World Health Organization classification: normal (<25 kg/m^2), overweight (25-29.9 kg/m^2), and obese ($\geq$30 kg/m^2). Comorbidities were grouped by organ system; patients received a point for a diagnosis in each category and this was combined for a comorbidity score (0, 1, >1). Complications were defined based on the Technical Expert Panel Evaluation of Measures [20]. All our revisions included either removal of the monoblock acetabular component or exchange of the metal liner for a polyethylene liner when modularity existed; however, not all femoral stems were revised. Hence, complexity of revision was defined by whether femoral stem revision was required or not, in addition to the acetabular revision.

Our primary outcomes were the VR-12 Physical Component Scores (PCS) and Mental Component Scores (MCS). VR-12 is a validated patient-completed questionnaire that quantifies PCS and MCS based on patient responses using a nonproprietary scoring algorithm developed from Short Form 12/36 [19]. Prospectively collected PCS and MCS scores were recorded at each office visit, including the preoperative and postoperative visits. Lower PCS and MCS scores indicate poorer self-reported physical function and mental health respectively. PCS and MCS scores were grouped as preoperative, 1 month postoperative, 3 months postoperative, and 1 year postoperative. Secondary outcomes included postoperative medical and mechanical complications.

Statistical analysis was performed using Stata Version 12 (StataCorp, College Station, TX: StataCorp LP, 2012). Variable range definitions, such as age, were grouped together using standard conventions as data variance allowed. Chi-squared test was used for categorical variables and a 2-sample *t*-test was used for continuous variables. Bivariate linear regression was used to look for associations between bearing surface and primary and secondary outcome measures. We also developed multivariable linear regression models that adjusted for age at revision, BMI group, gender, and complexity of revision at each postoperative time period. Smoking status and presence of comorbidities were analyzed, but did not contribute to any model and were not investigated further. Statistical significance was defined as $P < .05$. Analyses were performed using robust standard errors and patient clustering to account for observational data that included patients who underwent bilateral THA revisions.

Results

The initial data search identified 382 THA revision episodes. Of these, 179 met inclusion criteria, including 75 MOM and 104 MOP THAs (Fig. 1). Of the 75 revised MOM surfaces, 73 were MOM THAs and 2 were resurfacings revised to THA. There were 9 patients with bilateral revisions of MOM THA and 3 patients with bilateral revisions of MOP THA. There were no differences in revision laterality, BMI, smoking status, and comorbidities between the revision types (Table 1). The MOM revision group was younger at revision than the MOP group (58 [standard deviation 9] vs 67 [standard deviation 12] years, $P < .001$) and contained fewer women (40.0% vs 54.8% female, $P = .050$).