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Revision Arthroplasty

Early Outcomes of Revision Surgery for Taper Corrosion of Dual Taper Total Hip Arthroplasty in 187 Patients

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ABSTRACT

Background: Modular dual taper femoral neck designs have been associated with taper corrosion requiring revision surgery. However, outcomes after revision dual taper total hip arthroplasty in patients with symptomatic adverse local tissue reaction due to taper corrosion remain largely unknown.
Methods: A total of 198 revision surgeries in 187 patients with dual taper femoral stem total hip arthroplasty with minimum 12-month follow-up were evaluated.
Results: At mean follow-up of 18 months, at least 1 complication had occurred in 39 patients (20%) of 198 revisions. Single episode of dislocation, treated with close reduction, occurred in 16, whereas 2 patients required rerevision due to multiple dislocations. Infection requiring rerevision occurred in 3 patients. Adverse local tissue reaction recurrence requiring reoperation occurred in 6 patients. Implant survivorship for revision for any cause was 86% at 30 months. The reoperation rate of revised dual taper was 8% (16 out of 198 hips). The median serum levels of cobalt, chromium, and cobalt/chromium ratio decreased ($P < .01$) from 5.3 μg/L (range: 2.3-48.5 μg/L), 2.6 μg/L (range: 0.2-64 μg/L), and 4.7 (range: 2.1-35) prerevision to 1.4 μg/L (range: 0.2-8.8 μg/L), 0.7 μg/L (range: 0.1-3.9 μg/L), and 2.2 (range: 0.4-8.8) postrevision, respectively.
Conclusion: This pilot study demonstrates that intraoperative tissue necrosis was associated with a high rate of early complications (20%) and revisions (8%), suggesting the importance of a systematic evaluation of these patients including metal ion levels and metal artifact reduction sequence magnetic resonance imaging in optimizing revision outcome, as early diagnosis will facilitate the initiation of appropriate treatment before significant adverse tissue necrosis.

Dual taper modular stems were introduced to provide greater flexibility and facilitate the adjustment of leg length, femoral anteversion, and offset in primary and revision total hip arthroplasty (THA) [1,2]. Recently, there is increasing concern regarding this stem design as a result of the growing numbers of clinical failures due to fretting and corrosion at neck-stem taper, initiating voluntary recalls from one manufacturers [3-5]. Current guidelines recommend revision surgery for symptomatic patients with high metal ion levels and adverse local tissue reactions (ALTRs) on magnetic resonance imaging (MRI) ("high-risk" group) [6,7]. However, in light of the technically challenging nature of the surgical procedure for removal of well-fixed femoral stems and the ALTR-associated periarticular tissue necrosis and osteolysis, revision surgery may lead to an increased complication rate [8].

Several studies have previously reported on the revision outcomes of failed THA associated with adverse tissue reactions. A high rate of major complications and rerevision was reported after revision of failed hip resurfacing [9,10] and metal-on-metal THA [11]. However, the outcomes after revision dual taper THA due to taper corrosion in patients with symptomatic ALTRs remain largely unknown. The purpose of this pilot study was to report (1) early complications, rerevision rate, and implant survivorship; (2) functional and radiographic outcomes; and (3) changes in serum metal

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ions after revision surgery of failed dual taper THA due to symptomatic ALTRs.

Methods

Patients

Between January 2013 and July 2014, a total of 198 revision surgeries in 187 patients (males: 122, females: 65) with dual taper femoral stem THA, with an average age of 60 years (range: 26-85 years) were performed at the authors' institution. The time between initial implantation and revision surgery for removal of the dual taper stem was 20 months (range: 13-116 months). The follow-up period after revision was 18 months (range: 14-30 months). All patients had dual taper femoral stems with beta-Ti alloy with cobalt chromium modular neck. Hundred fifty-four hips received Rejuvenate femoral stem (Stryker, Mahwah, NJ), whereas 44 hips received ABG II, (Stryker Howmedica Osteonics, Allendale, NJ) femoral stem. The bearing surface was ceramic on polyethylene in 130 cases and cobalt chromium on polyethylene in the remaining 68. Femoral head diameter was 28 mm in 60 hips (30%), 32 mm in 33 hips (17%), 36 mm in 75 hips (38%), and 40 mm in 30 hips (15%). The primary diagnosis was degenerative osteoarthritis in 157 hips (79%), avascular necrosis of femoral head in 20 hips (10%), congenital hip deformity in 13 hips (7%), and posttraumatic arthritis in 8 (4%) hips.

Revision Surgery

The indication for revision surgery was the presence of pain associated with elevated metal ion levels and/or the presence of ALTR on metal artifact reduction sequence MRI. Hundred twenty-four hips (63%) were revised with extended trochanteric osteotomy for removal of the well-fixed cementless stem [12], whereas 74 hips (37%) were revised using "top-out" technique for the femoral stem removal without extended trochanteric osteotomy using high-speed burrs.

All revisions were conducted through a posterior approach. In 38 cases (19%), the acetabular components were assessed to be loose intraoperatively and were revised with a highly porous tantalum acetabular cup (Trabecular Metal Modular Acetabular Cup; Zimmer Inc, Warsaw, IN). In the presence of adverse tissue reactions, the area of necrosis was extensively debrided except in the close proximity of neurovascular structures. All patients received revision titanium modular tapered femoral stems (Stryker) and a ceramic femoral head (V40 BIOLOX delta; Stryker). Femoral head size used at the revision surgery was 28 mm in 10 cases (5%), 32 mm in 14 cases (7%), 36 mm in 168 cases (85%), and 40 mm in 6 cases (3%).

Intraoperative tissue damage was determined and graded intraoperatively by the operating surgeon in accordance with a previously published grading system as follows: grade 0 = normal tissue; grade 1 = fluid collection ± mild synovial reaction ± pseudocapsular dehiscence; grade 2 = grade 1 + moderate-to-severe synovial reaction ± metallosis; or grade 3 = grade 2 + abductor damage and/or bone loss [13].

Post–Revision Surgery Follow-Up

The patients were evaluated clinically and radiographically at 6 weeks, 3 months, 1 year, and annually thereafter. Radiographs of each visit were compared to the initial postoperative radiograph and evaluated for component loosening. Medical records were reviewed including outpatient clinic notes, operative reports, and hospital records for readmission. For the purposes of this study, major complications were considered to include dislocation, infection, periprosthetic fractures, ALTR recurrence, neurovascular injury, and component loosening defined as >2 mm subsidence of the component and circumferential progressive lysis at bone-component interface [14]. Serum cobalt and chromium levels were measured preoperatively and at each follow-up. To characterize the post–revision surgery decline of metal ion levels, the postoperative cobalt and chromium levels were normalized to a percent of the preoperative value. A best fitted exponential decay curve was applied to describe the rate of metal ion decline and metal ion half-life after removal of the implants. The percentage rate of decline of cobalt and chromium serum ion level was calculated as a function of time (months) after revision surgery.

Statistical Analysis

Descriptive statistics were presented in the form of frequencies and percentages. Paired *t* test was applied to compare prerevision and postrevision functional scores. A Kaplan-Meier curve was generated to analyze postrevision implant survivorship. For the purposes of this study, failure was defined as rerevision of any cause. Multiple logistic regression was used to test for an association between postrevision complications and demographics, prerevision metal ion levels and ratio, intraoperative tissue grades, implant time in situ, or bearing surfaces. All the statistical analyses were performed using SPSS, version 22, software (SPSS Inc, Chicago, IL).

Results

Intraoperative Findings

At the time of revision, all cases demonstrated black metallic material at the base of the modular neck taper as well as on the bore of the modular stem consistent with corrosion debris from the neck-stem junction (Figs. 1 and 2). Findings consistent with adverse tissue reaction were found: 134 cases were described as grade 1, 32 as grade 2, and 12 as grade 3. A large amount of fluid was observed after entering the capsule in 160 hips (81%). Particulate debris was observed in 103 hips (52%), and there were 2 cases of solid lesions. In 38 cases (19%), the acetabular components was identified as loose intraoperatively. There were no loose femoral components.

Complication Rate and Implant Survivorship

At mean follow-up of 18 months, the complication and revision rate of failed dual taper was 20% (39 out of 198) and 8% (16 out of 198), respectively (Fig. 3). Single episode of dislocation, treated with close reduction under general anesthesia, occurred in 16 patients, whereas 2 patients required rerevision due to multiple dislocations (9% dislocation rate, 18 out of 198). Seven of these patients had 28-mm, 2 had 32-mm, and 9 had 36-mm ceramic femoral head sizes. Infection requiring rerevision occurred in 3 patients. ALTR recurrence requiring reoperation occurred in 6 patients (3%). All 6 patients underwent exploration and extensive debridement of the pseudotumour. Three patients underwent femoral head exchange (Table 1). The metal ion levels decreased in these patients at 6-week postrevision and increased again at 6-month postrevision coinciding with increasing symptoms clinically. One patient was found to have deep venous thrombosis after operation. Rerevision rate was 8% (16 out of 198 hips), whereas implant survivorship for revision for any cause was 86% (confidence interval: 81%-94%) at 30 months. Multiple logistic regression showed that the intraoperative tissue necrosis grading was the only factor associated with increased risk of dislocation and rerevision (Table 2).