Femoral Revision With a High Offset Long Stem Femoral Component

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Abstract

In this retrospective study, we evaluated the aseptic loosening rate and initial result of an extensively hydroxyapatite-coated high offset (127°) titanium femoral component in 27 consecutive femoral revisions. Fourteen men and 12 women (mean age, 68 years) were followed for 2 to 7 years. Preoperative, 3 month, 6 month, and yearly follow-ups included Harris Hip Scores and radiographic analysis. In this study group, the femoral stem length was 155 to 205 mm and the distal stem diameter was 12 to 20 mm. Extended trochanteric osteotomies were necessary on 7 cases. At a mean 53 months follow-up, there were no loose femoral components (ie, bone ingrown in all cases) and no subsequent femoral stem revisions. Thus far, this high offset stem has demonstrated an excellent rate of stable bone fixation.

Femoral component revision presents a challenge for the orthopedic surgeon. Preexisting poor femoral bone stock frequently forces the surgeon to obtain stable implant fixation in deficient proximal femoral bone. Various types of femoral components including cemented stems and cementless stems, both proximally-coated and extensively-coated, have all been used for femoral stem revision.

The purpose of this study was to evaluate the aseptic loosening rate and initial results of a high offset (127°) extensively hydroxyapatite (HA) coated, titanium femoral component for femoral revision arthroplasty.

Materials and Methods

Between October 1995 and September 2001, 39 revision total hip arthroplasties in 38 patients were performed by the 2 senior authors (RJK and RJF) using an extensively HA coated high offset (127°) titanium femoral stem (Restoration HA, Stryker Orthopaedics, Mahwah, New Jersey). This design was the only revision femoral component used by the authors during this time period.

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The Restoration HA femoral stem used in all cases was a press-fit titanium alloy stem with a 127° high-offset neck angle a chemically etched substrate, fully coated with PureFix-HA hydroxyapatite (Stryker Orthopaedics).

Three revisions were done for periprosthetic fracture and were excluded from the study. At the time of final review, 9 patients (9 hips) did not meet the minimum 2-year follow-up requirement. Of those 9 patients, 4 (4 hips) died prior to a minimum 2-year follow-up from causes unrelated to their hips, 2 patients (2 hips) were in nursing homes and unable to come in for further follow-up, and 3 patients (3 hips) refused to return for follow-up appointments, but denied having had additional femoral surgery. For these 9 patients, with a mean follow-up of 9 months, there were no femoral stem re-revisions. The remaining 26 patients (27 hips) had complete clinical and radiographic follow-up for a minimum of 2 years. All surgeries were performed at a single institution and all cases met institutional review board requirements for consent.

Clinical evaluation, using a modified Harris Hip Score (HHS), was completed preoperatively and at 3 months, 6 months, and yearly follow-ups thereafter. The HHS was modified so that the maximum score was 100, by making a maximum of 9 points for range of motion and deformity. Maximum pain and function scores were unchanged from the original score at 44 and 47, respectively. Functional data for the final HHS was collected using a questionnaire administered by a nurse without the presence of the surgeon, to decrease potential bias.

Prerevision x-rays and intraoperative notes were reviewed to classify femoral bone deficiency and placed into 5 categories according to the Mallory[1] classification of femoral bone deficiency. There was 1 case of Type I bone loss (cancellous and cortical intact), 7 cases of Type II bone loss (cancellous deficiency, cortical intact), and 19 cases of Type III bone loss (cancellous and cortical deficiencies). Among the Type III, there were 3 cases with Type IIIA bone loss (deficiency to lesser trochanter), 11 cases with Type IIIB bone loss (deficiency to isthmus), and 5 cases with Type IIIC bone loss (deficiency to distal isthmus).

Results

Fourteen men (15 hips) and 12 women (12 hips) met criteria for inclusion. The mean age at the date of the revision surgery was 68 years (range, 43-82 years), mean weight was 83 kg (range, 48-127 kg). Mean follow-up for

this patient group was 53 months (range, 24-98 months).

The initial primary arthroplasty was performed for osteoarthritis in 14 cases, subcapital fracture in 5 cases, avascular necrosis in 2 cases, rheumatoid arthritis in 2 cases, other inflammatory arthritis in 1 case, and for unknown reasons in 3 cases. The reason for femoral stem revision was aseptic loosening in 17 cases, osteolysis in 4 cases, acute femoral stem fracture in 1 case, polyethylene wear in 1 case, and revision following a girdlestone procedure for sepsis in 2 cases. There were also 2 cases of revisions of well-fixed femoral stems incidental to acetabular revision.

The current revision was the first femoral stem revision for 25 cases (9 prior uncemented stems; 16 prior cemented stems). In 6 of these 25 cases, the hips had 2 prior surgeries before the current first femoral stem revision. For the remaining 2 cases in this series, this was the second femoral stem revision: one with 2 prior cemented stems, one with 1 prior uncemented stem followed by a cemented stem.

In this study group, 23 revisions used a 28 mm head and 4 revisions used a 32 mm head. There were 14 straight stems (8 of 155 mm; 6 of 205 mm) with a mean distal diameter of 15 mm (range, 12-20 mm) and 13 bowed stems, all 205 mm with a mean distal diameter of 16 mm (range, 14-18 mm). The choice of bowed or straight stem was made depending on which appeared to provide the best fit on preoperative templating of the lateral x-ray of the hip or femur. Extended trochanteric osteotomies were necessary in 7 cases. Cerclage cables were used for osteotomy fixation. In one of these cases, a femoral osteotomy of the femur was necessary due to significant varus bowing of the femur. Femoral bone grafting was required in 20 cases. Allograft, synthetic, or a combination of the 2 was used for femoral grafting in 19 cases. In one case, autologous bone was used as well. A lateral femoral allograft strut secured with cables was necessary in 6 cases. In 12 cases, the acetabulum was revised as well. The rehabilitation protocol used at the time of the study was for all patients to maintain only light partial weight bearing for the first 6 weeks postoperatively.

The mean preoperative modified HHS was 52 (range, 23-79), excluding 1 patient who was unable to stand or walk preoperatively and, therefore, did not have a completed HHS. The mean postoperative modified HHS was 80 (range, 51-98), excluding 1 patient (1 hip) who had the incomplete score. Six patients (6 hips) had excellent results with scores between 90 and 100, and 6 patients (7 hips) had good results (between 80 and 89). Nine patients (9 hips) had fair results (between 70 and 79) and 4 patients (4 hips) had scores less than 70.

Preoperative pain was severe in 6 cases, moderate in 14 cases, mild in 2 cases, slight in 1 case and absent in 4 cases. Pain at latest follow-up was moderate in 1 case, mild in 2 cases, slight in 8 cases and absent in 16 cases. No patient had severe pain at latest follow-up. Preoperatively, 7 hips did not use walking support, 19 hips required walking support (cane or crutch in 12 cases, 2 canes in 2 cases, walker or 2 crutches in 5 cases) and 1 patient was unable to walk. At latest follow-up, 18 cases did not require walking support and 8 cases used 1 cane/crutch or 2 canes for support. No patients ambulated with a walker or 2 crutches and, as noted, 1 patient was wheelchair dependent both pre- and postoperatively due to disease unrelated to the hip.

Most recent x-rays were reviewed for bony ingrowth according to the criteria set forth by Engh and Bobyn.[2] All components were classified as having bony ingrowth, and all extended trochanteric osteotomies and the one femoral osteotomy appeared united. There was calcar rounding and some calcar resorption present in almost all cases, but no cases with clinically significant stress shielding.[2] There were no cases of subsidence greater than 3 mm, which was felt to be limits of reproducible detection on our plain films. In addition, there were no cases with distal pedestal formation.

Complications

There were 2 cases of intraoperative fractures: one patient sustained a non–displaced anterior medial fracture treated with cables; the other patient had a preexisting pathologic lesser trochanter fracture and sustained a fracture of the lateral femoral cortex, including the greater trochanter, in the process of trial reduction and was treated with a trochanteric grip and cables. Three dislocations were observed within the first year following surgery (2 initially treated with closed reduction, 1 recurrent requiring a reoperation with femoral head and liner exchange) and 1 initial dislocation was seen approximately 3.5 years postoperatively, which was treated with closed reduction. All of the dislocated hips had 28 mm heads. One patient underwent a reoperation (open reduction internal fixation and grafting) 1 year postoperatively for nonunion of the previously mentioned trochanteric fracture, which went on to heal. There was one case of Grade II-III heterotopic ossification. No loose femoral components and no subsequent femoral stem revisions were observed.

Discussion

Several approaches to femoral stem revision exist, including cemented stems, proximally porous-coated cementless femoral stems, and extensively porous-coated cementless femoral stems. The goal in each case is to achieve stable implant fixation despite the fact that proximal femoral bone stock is often deficient. Aseptic loosening rates for revisions done with cemented femoral components have ranged from 10% to almost 30% in long-term follow-up studies.[3-5] Poor early results in revisions using cemented femoral stems led to the use of various types of cementless femoral components in revision surgery.

The use of proximally porous-coated stems is one cementless alternative for femoral stem revision. In a study of 49 revision hips with a curved, long-stem

proximally porous-coated uncemented femoral stem, Peters and colleagues[6] reported a 4% revision rate for aseptic loosening at an average of 65 months follow-up. Mulliken and colleagues[7] reported on 52 revision arthroplasties using a long uncemented revision stem with proximal porous-coating at 4 to 6 year follow-up. Five femoral stems required revision with 7 additional radiographically unstable stems. In another study, Iorio and colleagues[8] included 36 cementless S-ROM (DePuy Orthopaedics Inc, Warsaw, Indiana) femoral revisions with a minimum 4-year follow-up reported only 1 case revised for femoral loosening in cases limited to Paprosky Type I and II femurs. Walter and colleagues[9] reviewed 62 S-ROM (DePuy Orthopaedics Inc) femoral revisions with 2-year minimum follow-up and found 3% had aseptic loosening and a 5% mechanical failure rate. Thorey and colleagues[10] reported that at 2-year follow-up, 4 out of 79 femoral components were loose when a proximally porous implant was used, specifically in cases selected for minimal bone loss.

Thus, proximally coated stems are associated with approximately 3% to 5% aseptic loosening rate and seem best suited to stems with only modest proximal bone loss. Substantial proximal bone loss or need for an extended trochanteric osteotomy can make use of this type of implant problematic.

Extensively porous-coated stems have become perhaps the most common approach for femoral revision because they provide a larger surface area for bone fixation, which is helpful in typical revision cases with femoral deficiency. Lawrence and colleagues[11] reported on 174 extensively porous coated uncemented femoral stem revision surgeries for aseptic loosening with an average 7.4 years follow-up. Six cases had femoral revision for aseptic loosening and only 2 radiographically unstable stems at final follow-up. Moreland and Bernstein[12] performed a retrospective review of 175 revision surgeries using an uncemented extensively porous-coated femoral stem. With a mean follow-up of 5 years, they reported 144 possibly ingrown stems, 27 stable fibrous stems, and 3 unstable stems. One stem was not included in this classification because it was revised early on and did not have a chance for bone ingrowth. Four stems were removed due to problems with fixation of the femoral stem. In a study of 170 femoral stem revisions utilizing an extensively porous-coated femoral stem, Weeden and Paprosky[13] reported 82% of femoral stems were bone ingrown, 14% of femoral stems were stable fibrous, and 4% were unstable by radiographic criteria at a mean follow-up of 14.2 years.

Kimura and colleagues[14] reported on 15 revisions with metaphyseal bone loss treated with a long stem fully porous coated implant with no loose stems at 2-year minimum follow-up. McInnis and colleagues[15] noted only 1 of 70 stems loose at minimum 2-year follow-up in a modular long stem component with an extensive titanium grit-blasted ongrowth surface. Koster and colleagues[16] found a 4% revision rate for aseptic loosening at 5 to 10 years using another modular titanium fully porous stem.

The current study does have limitations in that it is a retrospective study. However, it does have the advantage of having all surgeries done by only 2 surgeons using similar surgical techniques and postoperative protocols at a single institution with the same implant design. Also, the surgeons did not use any other revision femoral component designs during the period of this study.

The implant in the current study uses a chemically roughened extensively HA coated titanium high offset (127°) stem. A higher offset stem offers potential advantages including improved abductor mechanics with reduced tendency toward leg lengthening. However, it also raises theoretical concerns regarding increased load on the femoral component and a possible negative effect on fixation/aseptic loosening. The current study has not demonstrated any adverse affect on bone attachment associated with the use of this high offset stem. At a mean follow-up of 53 months (range, 24-98 months) in 27 consecutive femoral revisions, all stems were classified as bone ingrown. There have been no femoral stem revisions and no loose femoral stems.

We did find a dislocation rate of approximately 15% in this series. While revision surgery is associated with a higher dislocation rate than primary, we believe there are 2 additional factors that may have contributed to this rate. First, in the patients that dislocated, the use of a 28 mm head size combined with a relatively thick femoral neck geometry resulted in a comparatively small head to neck ratio, which has been shown to decrease prosthetic range of motion. Second, the anteversion that the femoral component was placed in was dictated by the proximal femoral geometry. These 2 factors have been addressed in the current version of this stem, which has a thinner femoral neck and modularity allowing for the femoral anteversion to be adjusted. We believe a high offset femoral component is quite useful in revision cases in which increasing soft tissue tension without excessively increasing leg length is frequently desirable. For intermediate follow-up, this high offset component has thus far demonstrated an excellent rate of stable bone fixation including those cases requiring extended trochanteric osteotomy.

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