The Journal of Arthroplasty 30 (2015) 435–438

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Use of a Modular Tapered Fluted Femoral Component in Revision Total Hip Arthroplasty Following Resection of a Previously Infected Total Hip: Minimum 5-year Follow-Up

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ARTICLE INFO

Article history:
Received 15 July 2014
Accepted 26 August 2014

Keywords:
revision
total hip arthroplasty
infection
tapered stem
2-stage reimplantations

ABSTRACT

Femoral reconstruction in the setting of two stage reimplantation can be difficult and substantial reoperation rates due to implant loosening have been reported. We retrospectively reviewed 28 male and 29 female patients who underwent a two-stage reimplantation using a modular, tapered femoral stem. The mean clinical follow-up was 62 months. The mean Harris Hip score at 5-year follow-up was 76. Two stems were revised for aseptic loosening. Reinfection occurred in 16% of patients. Stem survivorship was 87% at 5-years. Use of a modular tapered stem provided a high rate of stable femoral fixation and acceptable rate of reinfection in two stage treatment of infected THA.

Failed total hip arthroplasty (THA) due to a chronic infection most commonly is performed using a two-staged procedure in North America [1]. The goal of two stage surgery is to clear the infection, and ultimately allow the patient to return to activities of daily living (ADLs) by providing a stable hip reconstruction [2]. Infection and operation to remove the femoral component (and bone cement if present) often lead to bone loss. If there is extensive proximal bone loss, reconstructive options are limited [3–5] and there is a higher rate of failure of the femoral component [6]. Modular tapered fluted uncemented femoral stems have become a common method of femoral revision for aseptic failures and provide a logical option for two stage reimplantation of the infected hip arthroplasty as well [3,4,7–9]. Along with providing distal fixation by providing axial and rotational stability distal to proximal bone loss, modular tapered fluted stems also allow the surgeon to modify offset, version, and adjust leg-lengths [10].

We are not aware of any study focusing specifically on the results of revision after two-stage infected THA with modular tapered fluted stems [3,9,11]. The goal of this study was to evaluate clinical outcomes and survival rates for a modular, tapered fluted femoral stem in patients undergoing a two-stage revision arthroplasty for the diagnosis of an infected THA.

Materials and Methods

Following the approval of our institutional review board, we retrospectively reviewed all patients who underwent a revision THA for a periprosthetic infection using a modular fluted tapered uncemented stem of a single design (Link MP, Waldemar Link, Hamburg, Germany) from 2000 to 2006. Fifty-seven patients met the inclusion criteria. Medical records were reviewed for pertinent demographics, preoperative and postoperative physical examination findings, characteristics of the periprosthetic joint infection, details of the surgical procedure and results of reconstruction.

There were 28 males and 29 females in the cohort with a mean age of 65 years (range 44 to 85 years) and a mean body mass index (BMI) of 30.1 (range 18.1 to 49.3). One patient died prior to the 2 year follow-up (16 months postoperatively) with implants in place and no sign of recurrent infection and one patient was lost to follow-up at less than 2 years. The remaining 55 patients were followed a mean of 5.9 years (range 2 to 11.6 years).

All patients were treated with a two stage procedure, the first of which was resection arthroplasty with the placement of a methylmethacrylate spacer loaded with high dose antibiotics. For all resections, vancomycin and/or an aminoglycoside (tobramycin or gentamicin) were added to Simplex cement (Stryker, Mahwah, NJ, USA) at the time of surgery. Antibiotic spacers contained a median of 3 g/batch of vancomycin (range 0–4 g/batch) and 3.6 g/batch (range 0–4.8 g/batch) of aminoglycoside. A THA was in place for a mean 8 years (range 0.25 to 30 years) prior to resection. The decision to perform a static versus articulating

Source of funding: No disclosures of funding were received for this work from NIH, Wellcome, Trust, or HHMI.

The Conflict of Interest statement associated with this article can be found at http://dx.doi.org/10.1016/j.arth.2014.08.012.

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http://dx.doi.org/10.1016/j.arth.2014.08.012
0883-5403/

spacer was based off surgeon preference. The antibiotic spacer was an articulating spacer in 13 patients (23%), while 44 (77%) had a nonarticulating spacer. Once resected the median time to reimplantation was 13 weeks (range 8 to 624 weeks). On average, patients had undergone four surgical procedures (range 1 to 16) on the affected hip prior to resection. In nine (16%) patients the previous surgery was due to infection, either irrigation or debridement with component retention or previous two-stage revision.

For the second stage of the procedure an anterolateral approach was used in 29 patients, femoral osteotomy in 20 patients, and posterior approach in 8 patients. The most common stem lengths, diameters and femoral head sizes used are listed in Table 1.

Prior to the resection, the mean erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) levels were 55 mm/hour (range 4 to 106 mm/hour) and 55 mg/L (range <3 to 227 mg/L) respectively. The reference values for the ESR and CRP in our laboratory are: normal 0–22 mm/hour and ≤8.0 mg/L respectively. Prior to reimplantation, the mean values of ESR and CRP dropped significantly ($P = 0.0001$) to 15 mm/hour (range 1 to 76 mm/hour) and 14 mg/L (<3 to 97 mg/L). The most common organism infecting the THA was coagulase negative staphylococcus ($n = 13$) (Table 2). Culture negative patients were defined as patients with either no growth of aerobic or anaerobic bacteria from tissue or fluid from the periprosthetic joint, but meeting other inclusion criteria of a periprosthetic joint infection as outlined by the Musculoskeletal Infection Society [12].

Preoperative radiographs were reviewed for femoral bone loss as described by Paprosky, with the most common proximal femoral deficiency being type IIIa (Table 1) [13]. Follow-up radiographs were examined for stem fixation and subsidence, as well as the presence of heterotopic ossification based on the Brooker classification [14]. Axial migration of the stem was calculated by measuring the distance of fixed points on the femoral component to fixed points on the femur (anatomic landmarks or cable, wire, etc) present on the immediate postoperative and follow-up radiographs. Osteointegration of the femoral stem was judged by examining follow-up radiographs for the presence of spot welds and absence of radiolucent lines [15]. Clinical and functional outcomes were measured using the Harris Hip Score preoperatively, at 2- and at 5-year post reimplantation [16].

Continuous variables were compared using unpaired Student t-tests and categorical variables were compared with the Fisher exact tests. Survival estimates were made using the Kaplan–Meier survival method. Proportional hazard regression analysis was performed to assess the association of clinically relevant covariates with the risk of implant failure, reinfection, and reoperation. These included diabetes, presence of a sinus tract, use of a static or mobile spacer, corticosteroid use and an infection caused by an antibiotic resistant organism. Given the limited number of events, multivariate regression analysis was not performed. All statistic calculations were made using JMP version 9 (Statistical Analysis Software, Cary, NC) with statistical significance set at a $P< 0.05$.

Table 1
Operative Demographics of Two Stage Exchange Arthroplasty for Infection.

	Number of Patients	Number of Patients with Dislocation	Number of Patients with Subsidence >5 mm
Paprosky classification [5]			
Type II	11	1	0
Type IIIa	35	7	4
Type IIIb	10	3	2
Type IV	1	1	0
Stem length (mm)			
180	7	1	0
210	23	3	3
220	1	0	1
250	15	4	1
290	9	2	1
330	2	1	0
Stem diameter (mm)			
14	3	0	0
16	9	0	1
18	10	4	1
20	15	3	4
22	1	0	0
22.5	10	1	0
25	8	2	0
27.5	1	1	0
Femoral head size (mm)			
22	2	1	0
26	1	0	0
28	7	1	1
32	14	4	2
36	24	3	2
40	9	2	1
Surgical approach			
Anterior–lateral	29	7	3
Posterior	8	0	1
Femoral osteotomy	20	4	2
Heterotopic ossification			
Brooker grade 1	2	1	1
Brooker grade 2	5	1	0
Brooker grade 3	5	2	1

Table 2
Reasons for Reoperation Following Two Stage Exchange Arthroplasty.

Indications for Reoperation	Number of Patients
Infection	9
Instability	6
Hematoma evacuation	2
Loosening/stem subsidence	2
Periprosthetic fracture	2
Leg length discrepancy	1

Results

Over the study period eight patients (14%) had their fluted tapered stem removed. Five were removed for recurrent infection, two for aseptic femoral component loosening and one for a periprosthetic femur fracture.

Reoperation occurred in twenty-two patients (39%) (including the 8 revisions noted above) at a mean 23 months (range 2 weeks–110 months) following surgery. The most common causes for reoperation were repeated infection ($n = 9$) followed by hip instability ($n = 6$) (Table 3). Seven of these patients underwent multiple procedures, most commonly due to repeated irrigation and debridements ($n = 4$).

Recurrence of infection occurred in nine (16%) patients. In two of the patients the recurrence was due to the same organism, and in seven patients it was due to a new organism (Table 2). The mean time to recurrence was 36 months (range 6 to 110 months). In patients in whom the infection was due to the same organism, the mean time to relapse was 46 months (range 7 to 84 months) following surgery. In patients in whom the infection occurred with a different organism, reinfection occurred at a mean time of 33 months (range 6 to 110 months) following surgery. Repeated infection was treated with irrigation and debridement in 4 patients and immediate resection of components in 5 patients. In the patients who underwent irrigation and debridement, 3 were placed on chronic suppression and currently have their stems in place, 1 sustained a periprosthetic femur fracture and subsequently had a revision due to component loosening.

Prior to the resection for infection, the mean Harris Hip Score was 49 (range 11 to 96). At 2-years of follow-up the mean Harris Hip Score improved to 79 (range 35 to 100), and at 5-years of follow-up was 76 (range 29 to 100) (Fig. 1). There was a statistical improvement in the Harris Hip Score from preresection to 2-years follow-up ($P = 0.0001$) and from preresection to 5-years follow-up ($P = 0.0001$). There