Novel Articulating Medullary-sparing Spacer for the Treatment of Infectious Hip Arthritis

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abstract

Two-stage total hip arthroplasty (THA) is considered a safe choice for the treatment of primary infectious arthritis of the hip. In cases where the proximal portion of the femur is intact without infection, the use of a spacer with a femoral stem during the interim would disturb the normal femoral medullary cavity. The authors report the technical procedure and outcomes of cases using a novel medullary sparing, antibiotic-loaded hip spacer for the treatment of hip infections.

Five consecutive patients (5 hips) with infectious arthritis of the hip were treated in a 2-stage approach using an intraoperatively made medullary-sparing hip spacer. During the first-stage THA, after thorough debridement of potentially infected and necrotic soft tissues, the spacer was inserted into the femoral neck and fixed without opening the femoral canal. Antibiotics were administered for at least 6 weeks and were continued until the infection was controlled clinically, after which the second-stage THA was completed.

Infection was eradicated in all 5 hips. Average follow-up was 39.6 months (range, 30-59 months). At most recent follow-up, no recurrence of infection was observed. No specific complications were associated with the use of this novel spacer. Average Harris Hip Score improved from 35.2 (range, 28-43) before the first-stage THA to 61.6 (range, 54-71) between the 2 stages and to 93.6 (range, 89-99) at final follow-up. All patients ambulated with the aid of crutches during the interim period.
Primary infectious arthritis of the hip joint in adults is a potentially devastating disease.\(^1\) If articular cartilage has been destroyed, conservative therapies cannot preserve a pain-free native hip joint.\(^2\) Girdlestone resection helps eradicate an infection but is rarely indicated because of poor functional recovery.\(^3\) Two-stage total hip arthroplasty (THA) is considered a safe choice with better function.\(^2,4\)

Use of an antibiotic-loaded cement spacer between the 2 stages is a popular approach for the treatment of periprosthetic joint infections. Spacers function as temporary prostheses to provide mobility, thereby preserving soft tissue tension and minimizing disuse osteoporosis.\(^5,6\) This makes the subsequent prosthetic implantation easier.\(^2\) Recently, the effectiveness of a temporary spacer in the treatment of hip joint infection other than with THA has been reported.\(^1,2,7-10\)

Many hip spacers have been used, including the PROSTALAC system (Depuy, Warsaw, IN), preformed cement spacers, and hip spacers made intraoperatively using a plastic or metal mold.\(^5\) All of these spacers contain a femoral stem with or without a cement acetabular component. Some primary hip joint infections or hip infections secondary to articular trauma only involve articular cartilage, subchondral bone, and intracapsular soft tissues.\(^11\) The proximal portion of the femur is intact without infection. If a spacer with a femoral stem was used in such cases, the normal femoral medullary cavity would be disturbed.

In the current article, the authors report the outcomes of 2-stage uncemented THA for the treatment of hip infections using a novel medullary-sparing, antibiotic-impregnated polymethylmethacrylate hip spacer. This method provided effective control of hip infections without disturbance of the femoral medullary cavity after the first stage of THA. Good function and partial weight bearing could be achieved during the interim period between stages, which facilitated the second-stage THA.

**Materials and Methods**

This retrospective study was approved by the local institutional review and ethics board. Between December 2005 and April 2009, five consecutive patients (5 hips) who presented with clinical evidence of infectious arthritis of the hip were treated using this technique. Patients included 3 women and 2 men with an average age of 48.4 years (range, 35-62 years). Three patients had a primary hip infection, and 2 developed infections after internal fixation of acetabular fractures. All patients had at least 1 of the following clinical signs of infection: frank purulent fluid or pus found by operative exploration or high serum levels of C-reactive protein (15 mg/L or more), with a diagnosis of acute inflammation based on a histological examination of tissues obtained intraoperatively (more than 10 polymorphonuclear leukocytes per high-power field). All patients presented with pain but without a discharging sinus (i.e., a sinus with an open exit and secretion). Patients’ general conditions, surgical procedures, pathogenic organisms, times between stages, and follow-ups are summarized in the Table.

The first-stage THA was performed using a Gibson approach to the hip joint. After drainage of all abscesses and resection of the femoral head, a thorough debridement of the potentially infected and necrotic soft tissues was performed. Plates and screws were removed in the 2 posttraumatic cases. At least 3 intraoperative culture specimens were taken before the administration of intravenous antibiotics. Afterward, pulsatile lavage was performed with Ringer’s solution.

The bone cement used in the current cases was composed of antibiotic-loaded cement (Palacos, Zimmer, IN, gentamicin 0.5 g per 40-g package) mixed with vancomycin powder (3.5g per 40-g package). Acetabular components were made by inserting a bolus of cement while the cement was in a doughy state. It was then shaped with a hemisphere instrument.

A custom mold was made intraoperatively with bone cement and the standard big femoral head provisional trials with a diameter 2 mm smaller than that of the acetabular side. Sterile paraffin oil was used to prevent adherence of the cement to the mold. The articular surface of the provisional trials with sterile paraffin oil was inserted into a bolus of bone cement in the late doughy phase. After the bone cement had cured, the custom mold was coated with sterile paraffin oil. A bolus of antibiotic-loaded bone cement was poured into the cement mold with firm pressure to fabricate the femoral head spacer. Excessive cement was removed.

Steinmann pins, used as an endoskeleton, were inserted into the bone cement head before the cement was completely cured to create a stem. The Steinmann pins were inserted into the femoral neck, and the cement femoral head was fixed without opening of the femoral canal (Figure). Wounds were closed over a negative-suction drain, and drains were retained until daily drainage was clear and less than 50 mL.

Intraoperative cultures were reviewed to determine organisms. After the first-stage THA, antibiotics were prescribed for at least 6 weeks and continued until the infection was controlled clinically. The type of antibiotics given was modified according to the results of bacterial cultures performed postoperatively. Patients were encouraged to be mobile and bear weight with aids as tolerated. The laboratory tests, including leukocyte count, erythrocyte sedimentation rate, and C-reactive protein level, were measured every 4 weeks after discharge.

**Results**

*Staphylococcus* was found in 3 cases, and tuberculosis was shown in histological appearance in another patient. In the other patient with internal fixa-
tion, the pathogenic organisms were not identified because of long-term administration of broad-spectrum antibiotics. Antituberculous medications composed of isoniazid, rifampicin, ethambutol, and pyrazinamide were prescribed for the patient with tuberculosis for approximately 6 months postoperatively. Two weeks of intravenous antibiotics and 4 weeks of oral antibiotics, including cefuroxime, levofloxacin, and rifampicin, were prescribed to the other 4 patients. Infection was eradicated in all 5 hips after the first-stage THA and subsequent antibiotic treatment.

Average time between spacer implantation and second-stage THA was 18.6 weeks (range, 13-25 weeks). Results of all intraoperative cultures were negative for bacteria in all patients. Average follow-up was 39.6 months (range, 30-59 months). At most recent follow-up, no evidence of recurrent infection was found in any patient according to clinical symptom and serological parameters. None of the samples taken at the time of spacer removal and THA were positive for bacterial infection. No intraoperative complications occurred in the first-stage THAs. No complications were associated with the use of the spacer specifically, such as dislocation or spacer breakage, in any patient. After the second-stage THA, no patient had any intra- or postoperative complications, such as dislocation, fracture, deep vein thrombosis, or injury to major vessels or nerves.

Average Harris Hip Score improved from 35.2 (range, 28-43) before the first-stage THA to 61.6 (range, 54-71) between the 2 stages and to 93.6 (range, 89-99) at final follow-up. All patients ambulated with the aid of crutches during the interim period, with partial weight bearing on the affected leg. Hip pain decreased dramatically after the spacer was implanted in all patients. Mild shortening of the affected extremity was observed during the interim period, but no patient had a limb-length discrepancy of more than 1 cm after THA. No cases of prosthetic component loosening were identified during the course of the study. Radiographs revealed that all cementless femoral stems appeared stable with bone ingrowth and no acetabular

<table>
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<th>Patient No./ Sex/Age, y</th>
<th>Etiology</th>
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<th>Interim Period, wk</th>
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<th>Harris Hip Score</th>
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Abbreviations: C-C, ceramic-on-ceramic; CoNS, coagulase-negative staphylococci; M-M, metal-on-metal; MRSA, methicillin-resistant Staphylococcus aureus; MSSA, methicillin-sensitive Staphylococcus aureus; Neg, negative culture result; Preop, preoperative; TB, tuberculosis; THA, total hip arthroplasty.

Figure: Radiographs of a 54-year-old woman with a methicillin-sensitive *Staphylococcus aureus* infection in the left hip. Preoperative AP view radiograph showing acetabular erosion and joint space narrowing of the hip (A). AP view radiograph showing implantation of articulating medullary sparing spacer in left hip (B). AP view radiograph 3 years after total hip arthroplasty revision showing no prosthesis loosening. The patient was free from infection and had a good result (C).
component showed migration or osteolysis at final follow-up.

**DISCUSSION**

Primary infectious arthritis in adults is a rare but potentially devastating disease that causes pain and dysfunction. Resection THA followed by a 2-stage THA has been reported to successfully restore the function of the affected hip joints. However, it is inevitable that resection THA will cause leg-length discrepancy and dysfunction, which will decrease the patient’s satisfaction and increase the difficulty of the 2-stage THA. Recently, 2-stage THA with an interval antibiotic-loaded polymethylmethacrylate spacer was proposed to eradicate infection and improve hip function after infectious hip arthritis.

Hsieh et al reported 27 patients who contracted an infection after an intertrochanteric fracture and were treated by 2-stage THA. Antibiotic-impregnated cement beads were used in 15 patients and temporary cement spacer prostheses were used in 12. Better results were reported for the spacer prosthesis. Regis et al described a successful 2-stage hip reconstruction after septic arthritis with a commercially produced, preformed, antibiotic-impregnated cement spacer. Romano et al presented a prospective, nonrandomized cohort study reporting a 2-stage THA in 20 cases of septic hip arthritis. The same spacer was inserted after femoral head resection and debridement in the first-stage THA. After infection eradication, a cementless THA was performed in the second stage. Infection relapsed in only 1 case after THA.

Diwanji et al evaluated the results of 2-stage reconstruction for the treatment of primary hip infections with an antibiotic-loaded cement spacer. Smaller presterilized prostheses were used to provide an endoskeleton for the spacer. Of 9 hips, 8 were successfully converted to THA after an average of 23 weeks. Kelm et al reported the efficacy of antibiotic-loaded spacers in the treatment of proximal femur infections in 8 patients with bacterial proximal femur infections. The spacer was produced using a CAD (computer aided design)-planned and CNC (Computer numerical control)-milled 2-part mold of polyoxymethylene, but cement acetabulum was not performed in these cases.

Huang et al reported using a spacer for the treatment of recalcitrant septic arthritis. Custom-made plastic molds using a stainless steel rod as an endoskeleton were used to form the femoral components, and an acetabular component shaped into a hemisphere was formed from a bolus of antibiotic-loaded cement inserted into the acetabular cavity. The authors found that encouraging outcomes could be obtained through the 2-stage operation with uncemented THA and short-term antibiotic therapy. Bauer et al reported 13 cases of septic hip arthritis failing to react to conservative treatment and treated with 2-stage THA, but the fabricating procedure of the spacer was not described in detail, and infection relapsed in 2 cases after THA.

All of the described hip spacers were originally designed for infected THA and contained a femoral stem. However, infectious hip arthritis may not involve the proximal part of the femoral medullary cavity. If a spacer with a femoral stem was used in such cases, the normal femoral medullary cavity would be disturbed. Unnecessary medullary cavity disturbance may not only increase the degree of systemic trauma reaction after surgery and the incidence rate of systemic complications, but may also affect the osteointegration between uncemented stems and bone after 2-stage THA. In addition, opening the femoral canal may lead to the spread of intra-articular infections. Spacers used by the current authors only substituted for the destructive femoral head in the femoral side and preserved an intact medullary cavity for the 2-stage THA.

Although this method was effective for the treatment of hip infections in the acetabular side and hip joint space, it was not suitable for infected hips involving the proximal part of the femoral medullary cavity. If debridement must be performed in the proximal femoral medullary cavity, it is sensible to choose a spacer with a femoral stem because a cement femoral head would lose mechanical support from the proximal part of the femur in such cases. An antibiotic cement acetabular component shaped into a hemisphere was necessary to match the femoral head and avoid activity-related pain. In the current cases, articular cartilage in the acetabular side was injured completely. If a femoral spacer were used alone without a cement acetabulum, patients would feel acetabular pain when they were partially weight bearing and ambulatory, which was observed in the authors’ previous cases of infected THA.

The current study was limited by the small number of patients and its retrospective design. However, it is the first report describing the use of an articulating medullary-sparring spacer for the treatment of infectious hip arthritis. It provided practicable treatment to cope with hip infections in the acetabular side and in the hip joint space. Due to the relatively low prevalence of the disease, further case studies are needed to evaluate the long-term results of this technique.

**CONCLUSION**

This novel articulating medullary-sparring spacer provided effective control of hip infection without disturbing the normal femoral medullary cavity. Good function and partial weight bearing were achieved during the interim period between stages.

**REFERENCES**


2. Huang TW, Huang KC, Lee PC, et al. Encouraging outcomes of staged, uncement-


