Two-stage hip prosthesis for septic hip arthritis using preformed spacers and cementless prosthesis: a prospective, non-randomized cohort study.

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Abstract

Background
Few and non homogenus data are available as to concern the outcome of two-stage prosthesis for the treatment of deep infection after septic hip arthritis. Aim of this study is to present the results of a new standardized staged procedure, that include the use of a preformed hip spacer and a cementless hip prosthesis, in a series of patients, treated according to a same protocol.

Methods
Nineteen consecutive patients (twenty hips) were enrolled in this prospective, non-randomized, cohort study, from year 2000 to 2008. Femoral head resection, debridement and insertion of a preformed, commercially available, antibiotic-loaded cement hip spacer was performed in the first stage. After eradication of infection, a cementless total hip arthroplasty was implanted in the second stage. Patients were evaluated for infection recurrence, pain (Visual Analogue Score) and function (Harris Hip score).

Results
Mean interval between first diagnosis of infection and surgery was 5.8 ± 9.0 months. At an average 56.6 (range: 24 – 104) months follow-up, all of the 20 hips were successfully converted to prosthesis after an average of 22 ± 5.1 weeks from spacer implant. One patient experienced reinfection after total joint replacement. The Visual Analogue Scale improved from a mean 48 (range: 35 – 84) pre-operatively to 18 (0 – 38) prior to spacer removal and to 8 (0 – 15) at the latest follow-up after prosthetic implant. Average Harris Hip score raised from 27.5 before surgery to 61.8 between the 2 stages to 92.3 at final follow-up.
Conclusions
Two-stage arthroplasty using a preformed hip spacer and a cementless hip prosthesis provides satisfactory results for the treatment of hip infections with various aetiologies.

Background
Primary septic arthritis in an adult is a rare, but potentially devastating disease. Duration of symptoms is the most important factor in selecting the type of surgery required. Early onset infection can be treated with radical debridement whether it be open or arthroscopic. Beyond the first days from onset of symptoms, failure rates after debridement increase rapidly [1] and more radical surgery may be required as joint damage takes place. In the hip, resection arthroplasty helps to eradicate the infection but leaves the patient with a leg length discrepancy, dependency on ambulatory aids, and variable pain relief [2, 3].

Two-stage revision with the use of an antibiotic-loaded acrylic cement spacer is a well-established procedure in the management of chronically infected total hip replacement [4–6]. Two stage total hip arthroplasty with an interval antibiotic loaded polymethylmethacrylate spacer has been also recently proposed to cure the infection and improve the hip function after septic hip arthritis [7–9]. Regis et al. [10] recently presented a case report of a successful two-stage reconstruction of the hip after septic arthritis using a commercially produced, preformed antibiotic-impregnated cement spacer.

The purpose of this study was to assess medium-term results of a consecutive series of patients affected by septic hip arthritis, treated according the same protocol, that included the use of a preformed, commercially available, antibiotic-loaded cement spacer and a cementless implant for the 2-stage reconstruction of the hip.
Methods
Nineteen consecutive patients (twenty hips), referred to our departments for the
treatment of an established chronic deep hip joint infection, from year 2000 to 2008,
were included in this prospective, non-randomized, cohort study. All patients were
consented and Ethical committee approval was obtained prior to the start of the study.
The diagnosis of infection was attained using the criteria established by Spangehl et
al. Patients had at least three positive results: sedimentation, C-Reactive Protein,
positive aspiration, positive frozen section or positive intra-operative cultures [11].
Clinical, laboratory and radiographic assessments were performed by an independent
observer pre-operatively, at the time of spacer removal and at the latest follow-up
after reimplantation. Epidemiological data was gathered using a standard data sheet.
The patients were clinically reviewed using the Visual Analogue Scale (VAS) (a 100
mm scale was used: 0 = no pain, 100 = maximum tolerable pain) and the Harris Hip
score [12]. Clinical signs of infection recurrence were also recorded (redness,
swelling, pain, fistulae) whenever at follow-up.
Laboratory tests consisted of complete blood count with differential, erythrocyte
sedimentation rate, C-reactive protein, urea and creatinine and creatinine clearance
test.
Plain radiographs included anteroposterior and translateral views of the hip joint.
Radiographic examination was performed pre-operatively, at spacer removal, at
reimplantation and then at 3, 6 and 12 months postoperatively, followed by yearly
intervals thereafter.
Primary outcomes, at the latest follow-up after revision, were the rate of infection
recurrence, re-revision for infection and for aseptic loosening and clinical outcome.
Secondary outcomes included, at the time of spacer removal: eradication rate of
infection, spacer integrity and stability and clinical outcome.
Surgical procedure and postoperative care.

The surgical procedure was similar in all patients in this series. All were operated by one of us (CLR or EM) through a lateral approach, with the patient laying in the supine position, both in the first and second stage operation.

A radical synovectomy, debridement and excision of all infected parts was followed by femoral head resection onto healthy bone and gentle reaming of the acetabular cavity. Synovial fluid and synovium were obtained for cultures. After debridement, the joint was rinsed with approximately 10 litres of saline solution. A preformed antibiotic-loaded hip spacer (InterSpace® Hip, Tecres SpA, Verona, Italy - Hexactech Inc. Gainesville, Florida) (Fig. 1) was then implanted, after reaming of the femoral canal. The InterSpace® Hip is an off-the-shelf polymethylmetacrylate antibiotic-loaded pre-formed hip spacer. The inner part of the spacer features a stainless still rod, that increases mechanical resistance. The cement is pre-loaded by the manufacturer with gentamycin at a concentration of 1.9 %. The InterSpace® Hip is available with three in different head sizes and with two stem sizes, short (260 mm) and long (360 mm), that may be intra-operatively chosen.

In all the cases the spacer was fixed only in the proximal part, to prevent implant rotation, with one pack of antibiotic-loaded cement (Cemex Genta, Tecres Spa, Italy) containing gentamycin 1.9 % and vancomycin 5 %. The vancomycin powder was thoroughly mixed with the cement powder into a fine consistency before the addition of liquid monomer. No bone grafts were used at the time of spacer implant. All the patients received a minimum of 4 weeks of organism-specific antibiotics postoperatively and returned for clinical follow-up at the completion of their antibiotic course.
Patients with successful eradication of their infection, as evidenced clinically and by complete blood count with differential and C-reactive protein within the normal ranges underwent the second stage of their reconstruction. If clinical suspicion for persistent infection remained, joint aspiration before reimplantation was performed for cultural examination and white blood cells count. In all cases, intraoperative cultures were obtained at the time of the second stage procedure. At revision the hip was exposed through the same lateral incision and the spacers were removed. Revision was performed with modular titanium cementless femoral components (Profemur, Wright, or S-ROM Johnson&Johnson DePuy). Unconstrained cementless acetabular components were used in all cases. Partial weight bearing with two-crutches was allowed for 6 weeks followed by one-crutch walking for 4 - 6 more weeks. Full weight-bearing was permitted at 10 - 12 weeks after surgery. After operation, systemic antibiotics were administered for 4 weeks. No drains were used after either procedure.

All the patients underwent enoxaparin 0.4 ml/die for 30 days after surgery to prevent thrombo-embolic complications and celecoxib 200 mg/die was administrated for 14 days after revision surgery to prevent heterotopic ossifications [13].

Results
Demographic and pre-operative information for all 19 patients is presented in Table 1. 14 of 19 (73 %) patients were identified as Type B hosts according to Cierny-Mader classification [14]. There was a mean 5.8 ± 9.0 months interval between the diagnosis of infection and the index-surgery. 4 out of 19 (21 %) patients received one surgery (respectively two open and two arthroscopic) after diagnosis of infection and prior to the spacer implant.
Aspiration was performed prior to surgery at our institution if previous cultures were not available or negative. At least 5 different tissue samples were taken peroperatively. Cultures were positive in 15 of 20 hips (70%). Staphylococcus aureus and Coagulase-negative Staphylococci (13/20) were predominantly identified (Table 1).

All of the 20 hips were successfully converted to THA after an average of 22.3 ± 5.1 weeks from spacer implant. Complications included two spacer dislocations, one transient femoral nerve palsy and two deep vein thrombosis. At the time of spacer removal in two cases a single intra-operative specimen gave a positive result (a coagulase negative bacteria in both cases), in the absence of pre-operative signs of infection.

At a mean follow-up of 56.6 months (range: 24 – 104), none of the patients was lost, but one died four years after surgery in a car accident. One patient (AP) showed an infection recurrence and sinking of the femoral stem and required re-revision two years from intervention.

None of the remaining patients required reintervention and they showed no local or general signs or laboratory data of infection and never had to restart antibiotics at any point.

The Visual Analogue Scale averaged 48 ± 20 (range: 35 – 84) pre-operatively, 18 ± 15 (0 – 38) prior to spacer removal and 8 ± 10 (0 – 15) at the latest follow-up after prosthetic implant. Pre-operative Harris Hip score was 27.5 ± 15.3, 61.8 ± 18.6 at the time of spacer removal and 92.3 ± 17.4 at the final follow-up.

A leg length discrepancy between 1 and 2 cm could be noticed in 3 patients, while in the remaining the length discrepancy was less than 1 cm.
There were no hip prosthesis dislocation. No component showed migration or osteolysis at radiographic evaluation (Fig. 2 - 4).

**Discussion**

Based on the most recent available literature, staged reconstruction of the hip after septic arthritis may well be seen as a reliable option, instead of the traditionally performed resection arthroplasty.

However, the limited series available and the different technical approaches used by the various authors provide results that may look unpredictable and difficult to standardize.

Chen et al. [15] reported a re-infection rate of 14% and a complication rate of 36% after two-stage THA without temporary devices for the treatment of primary septic arthritis of the hip.

Morshed et al. [16] described a case of post-injection septic arthritis of the hip, successfully managed with the implantation of an antibiotic-impregnated cement block and a hip prosthesis, after a failed previous surgical debridement and partial femoral head resection. Another case report has been described more recently by Barrett and Bal [17] while Regis et al. [10] were the first to report on another single case of haematogenous infection successfully treated with a preformed hip spacer and a cementless hip prosthesis.

Apart from those case reports, as far as we know only four papers have described a series of patients, treated with a temporary device and a hip prosthesis in the second stage for septic hip arthritis. Schoellner et al. [18] were probably the first to report a preliminary experience with five individually manufactured bone cement spacers for septic hip revision. The adaptability of this mechanically tested stem was emphasized.
and its indication in primary joint infection was discussed with no additional details.

The relevant data from the other three, more detailed, published papers are reported in Table 2. and compared with those of the present study. The infection recurrence rate after prosthesis implant ranges from 0% to 12%. Our data are in line with those previously presented, at a longer follow-up and in a larger series of patients. Our is also the first paper documenting, in a prospectively followed cohort of patients, the safety and efficacy of use of a preformed spacer and cementless hip prosthesis. Preformed antibiotic-loaded spacers are readily available from the shelf and offer a standardized and reproducible technique, known mechanical resistance [19, 20], predictable antibiotic release [21] and reduced surgical time [22, 23], being available in short and long stemmed shapes [24], that can be chosen intra-operatively.

**Conclusions**
Two-stage total hip arthroplasty with a preformed hip spacer and a cementless implant is a reliable solution in the medium term follow-up for septic hip arthritis and should be offered to the patients as a valuable option.

**Competing interests**
The authors declare that they have no competing interests.
Authors' contributions
CLR and EM designed the study, performed surgeries and drafted the manuscript. DR and NL collected and processed the data. LD revised the manuscript and performed laboratory testing and microbiological analysis.

Authors informations
CLR is currently the Vice-President of the European Bone and Joint Society and incoming President elect, while EM is a Past-President of the same Society. Both of them are Past-President of the Italian Group of Study on Bone and Joint Infections.

References


**Figures**

*Figure 1 - The preformed spacer used in the study*
The preformed spacer is available in two stem lengths and three head sizes (not shown).

*Figure 2 - Clinical case (patient GF)*
Pre-operative X-ray and intra-operative finding. Haematogenous septic hip arthritis.

*Figure 3 - Clinical case (patient GF)*
Post-operative X-ray prior to hip spacer removal.

*Figure 4 - Clinical case (patient GF)*
Radiographic control four years after cementless hip prosthetic implant.
Tables

**Table 1 - Pre-operative patients data**

Abbreviations: MSSA: methicillin-sensitive Staphiloccus aureus; MRSA: methicillin-resistant Staphiloccus aureus; Coag neg: Coagulase negative Staphilococci; Neg: negative cultural examination.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Sex</th>
<th>Aetiology of infection</th>
<th>Age (years)</th>
<th>Habits and co-morbidities</th>
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Table 2 - Data from the literature
Two-stage hip prosthesis in septic hip arthritis. Comparison of results between authors and pooled data

<table>
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<tr>
<th>Author</th>
<th>Number of hips (patients)</th>
<th>Follow-up (average, months)</th>
<th>Time to spacer removal (weeks)</th>
<th>Re-infection recurrence rate (at spacer removal)</th>
<th>Re-infection recurrence rate (after total hip replacement)</th>
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<td>42</td>
<td>23</td>
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<td>12</td>
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<td>0/8 (0%)</td>
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<td>Huang et al., 2010</td>
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<td>This study</td>
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