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ORIGINAL RESEARCH ARTICLE

Acetabular spacers in 2-stage hip revision: is it worth it? A single-centre retrospective study

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ABSTRACT

Purpose: The aim of this work is to evaluate an acetabular antibiotic loaded bone cement spacer in 2-stage revision surgery as a potential approach able to reduce complications during the inter-stage period (i.e. dislocation, acetabular wear), as well as simplify 2-stage hip revision surgery and improve hip biomechanics.

Methods: We performed a retrospective comparative study and evaluated clinical, radiological and surgical data of 71 patients affected by periprosthetic hip infection who were treated with 2-stage exchange. 31 patients were treated using an acetabular spacer in addition to the femoral (group A) while 40 underwent a standard revision surgery (femoral spacer only, group B).

Results: Mean time of surgery for the first stage was 148 ± 59 minutes and 142 ± 45 minutes for group A and B respectively; we noted a statistically significant reduction (26 min, p = 0.015) in the same parameter for the second stage (83 ± 35 minutes for group A and 109 ± 36 minutes for group B). We observed the following interstage complications: 5 femoral spacer dislocations (1 for group A and 4 for group B); 1 spacer fracture (group B), 1 spacer fracture (group A), 2 periprosthetic fractures (group B) and 2 patients with acetabular spacer instability (group B). Additionally, we observed a significant improvement in leg length restoration for group A (p = 0.03).

Conclusions: Our data show that the acetabular spacer technique is able to reduce the interstage complication rate and allow improved hip biomechanics restoration.

Keywords: Acetabulum, Antibiotic bone spacers, Periprosthetic joint infection, Revision total hip arthroplasty, Treatment outcome

Introduction

Periprosthetic Joint Infection (PJI) is the most feared complications of prosthetic joint implantation (1, 2). PJI is the second most common cause of implantation failure after primary total hip arthroplasty (THA) with an incidence rate of up to 15% (3, 4). In revision, PJI is the commonest cause of failure with rates reported as high as 30.2% (5). Moreover, the morbidity and mortality rate after septic hip revision is higher than that of aseptic revision surgery (6).

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There are multiple treatment options for PJI, including debridement with retention of the prosthesis, single or 2-stage revision and resection arthroplasty. Despite a renewed interest in the single-stage approach (7), the "gold standard" is currently the 2-stage exchange arthroplasty with an average reported success rate that ranges from 87% to 93% (8-11). 2-stage revision is preferred for a number of reasons. Firstly, the use of an antibiotic spacer in 2-stage revision is advantageous; it helps maintain tissue tension and soft tissue planes, locally releases antibiotic, decreases haematoma and scar formation, allows functional weight bearing (12). Moreover, the 2-stage approach allows the surgeon to perform a second debridement. The overall complication rate of the 2-stage approach reported in the literature varies from 13.2% to 58.8% (13, 14) with increased complications in bespoke rather than prefabricated spacers. The most frequent complication is spacer dislocation followed by peri-spacer fracture, spacer fracture and acetabular wear. While a general consensus has been achieved in literature regarding the use and safety of antibiotic loaded cement spacers on the femoral side no comparable evidence is available for the acetabular side.

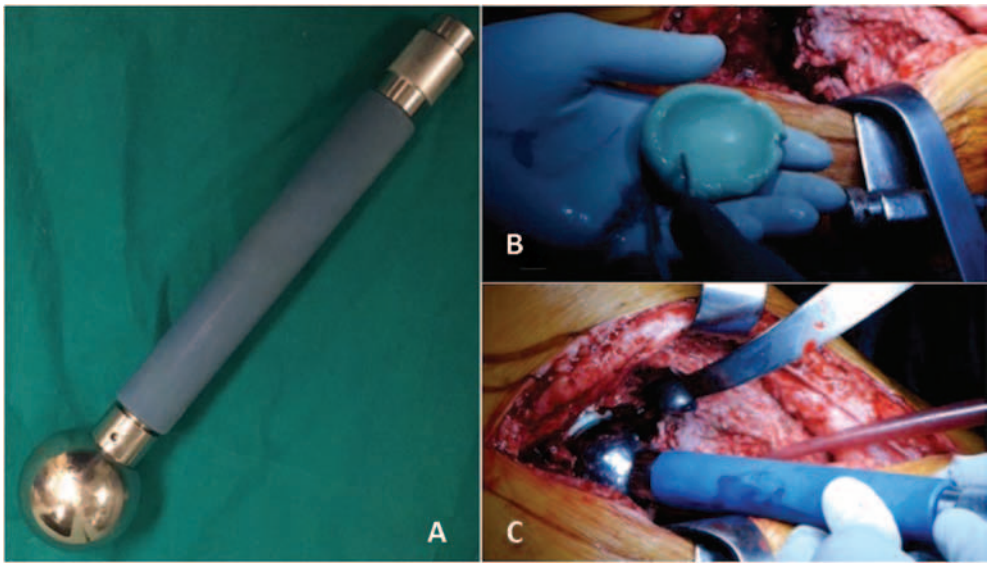

Fig. 1 - Intraoperative acetabular spacer molding: (**A**) the specific device for spacer molding; (**B**) the acetabular spacer before the implantation; (**C**) the acetabular spacer is molded in situ.

Our study aims to explore our hypothesis that the use of an articulating acetabular spacer could reduce the interstage complications whilst maintaining the effectiveness of a 2-stage procedure. These supposed advantages could lead to easier implantation of the definitive prosthesis at the second stage, especially on the acetabular side, and to improve hip biomechanics restoration.

We performed a retrospective study analysing and comparing the surgical outcomes for patients who underwent the standard 2-stage revision with femoral spacers only (control group), to patients who additionally received our novel surgical technique based on the use of an acetabular antibiotic-loaded cement spacer.

Methods

Clinical records of 71 patients who underwent 2-stage hip revision surgery were retrospectively reviewed. The inclusion criteria were: a definite diagnosis of periprosthetic hip infection according to the MSIS criteria (15) and the conclusion of a 2-stage revision procedure. We excluded 1-stage treated infections and patients that did not complete the second approach.

A 4-stage system as proposed by Tsukayama et al (12) was used to classify PJI. Demographic characteristics of the patients were recorded, which included age, sex, body mass-index (BMI) and baseline comorbidities. Microbiological data from pre- and intraoperative cultures were obtained.

Radiological data such as preoperative lateral offset (LO) of the unaffected hip, lateral offset of the spacer, lateral offset of the affected hip at the end of 2-stage procedure, leg length discrepancy (LLD), and mobilisation status, dislocation of components were also collected. Finally, clinical and surgical data were recorded: intraoperative grade of acetabular defect before the first and the second stage according to Paprosky classification (16); general mechanical complications; number of failures (defined as infection relapse); mean time of surgery in first and second stage; and mean time of interstage period.

All the patients were evaluated radiographically with a minimum follow-up of 8 months.

Patients were split into 2 groups: 31 patients with both a femoral and acetabular spacer (group A) and 40 patients with a femoral spacer only (group B).

Surgical technique

Antibiotic administration was started only after at least 6 biopsy specimens for culture had been obtained. A posterolateral surgical approach was always performed. If necessary, surgical excision of scars, sinus tracts and abscesses were carried out. Once the exposure was performed and the hip dislocated, femoral components were removed. At least 3 tissue samples from the femoral canal were collected. An extended lateral cortical window (ELW) was performed in 27 cases in group A and in 32 patients in group B. After a radical debridement and irrigation, a femoral reamer surrounded by surgical gauze was left in situ. The acetabular components were then removed. At least 3 biopsy specimens for culture were obtained and empirical antibiotic treatment (glycopeptide plus fluoroquinolone) was started intraoperatively. Cement was then prepared on a back table using a standardised procedure. The protocol was to use a preloaded gentamicin cement (PALACOS G®, Zimmer Inc.) with vancomycin added if needed. In order to obtain a proper shape of the acetabular spacer, the cement was first molded by hand with a “ball and socket” technique using a specific device covered by Vaseline for about 1 minute (Fig. 1). The acetabular spacer was then positioned and minimal pressure was applied, avoiding an excessive infiltration of the cement into the cancellous acetabular bone. This allows for easy removal of the spacer with gentle mobilisation with an osteotome. Excess cement was removed with a scalpel or by hand, thereby ensuring an appropriate coverage of the entire acetabular rim. Once the acetabular spacer had hardened, we selected the most appropriate size of the femoral component. A commercially available endoskeleton femoral spacer was cemented into the trochanteric area in provide rotational stability (Fig. 2). We typically used

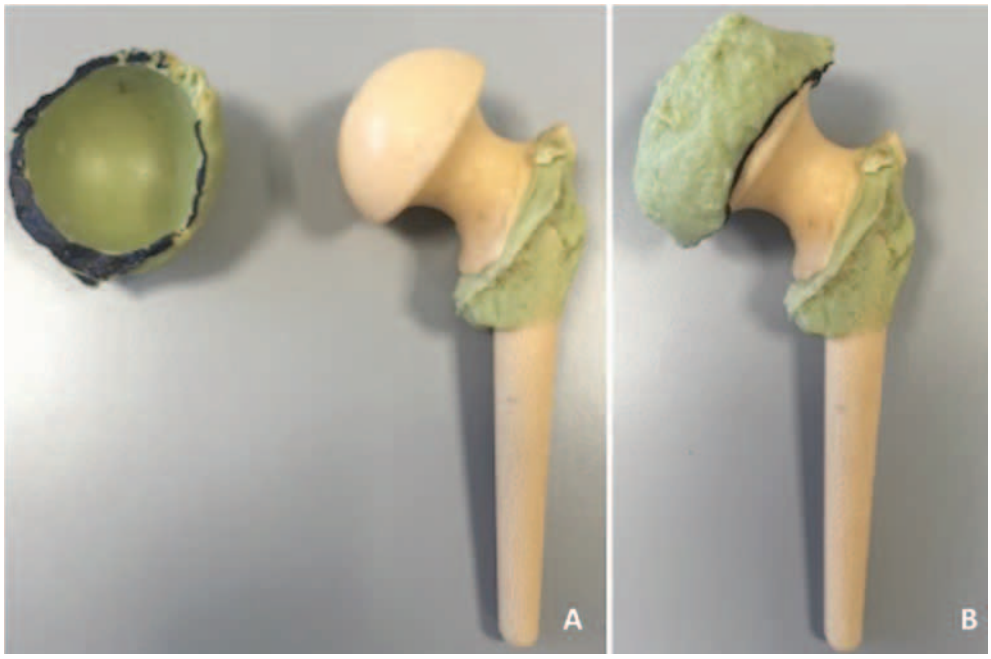

Fig. 2 - Acetabular and femoral spacers after removal; (**A**) separated components; (**B**) spacer assembled.

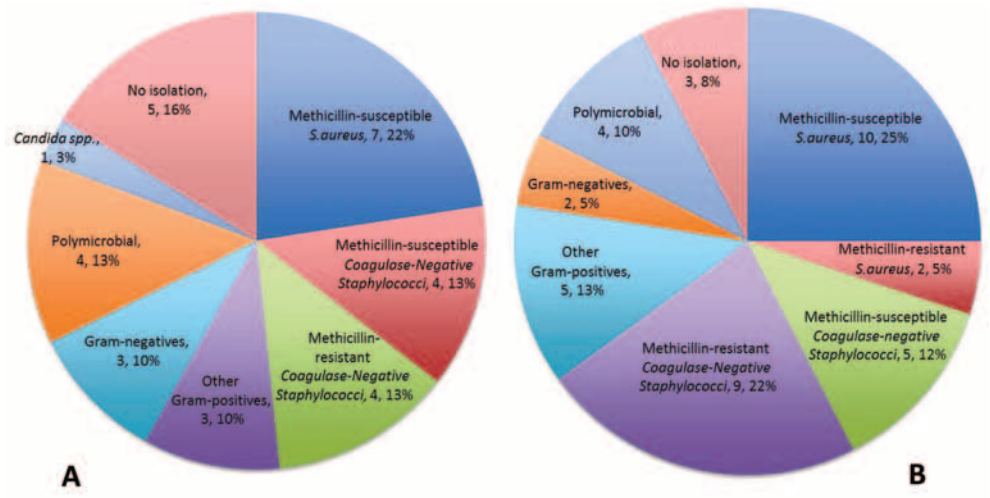

Fig. 3 - Microbiological data. The 2 pie charts show the isolated pathogens and their distribution among groups.

2 doses of antibiotic-loaded cement for each patient. Reduction was obtained and closure of the wound was performed in the standard manner for the approach used. 1 surgical drain was used until the second post-operative day. Patients were mobilised with partial weight-bearing, from the second postoperative day. An intravenous antibiotic course of at least 6 weeks was administered, tailored to intraoperative cultures. If intraoperative cultures were negative intravenous glycopeptides and fluoroquinolones were protracted for 3 weeks followed by oral fluoroquinolones for another 4 weeks.

Statistical analysis

Continuous variables were reported as mean ± standard deviations and compared using unpaired Student *t*-tests. Categorical variables were expressed as the number of cases and proportions and compared using the chi-squared or Fisher's exact tests. A p value of <0.05 was considered statistically significant.

Results

All the PJI were classified as late chronic. All patients completed 2-stage procedures. Group A was composed of 17 males (54%) and 14 females (46%) with mean age of 68 years (range 37-83). Group B consisted of 19 males (48%) and 21 females (52%), with a mean age of 67 years (range 32-81 years).

The mean BMI for group A and group B was 26.5 ± 5.5 and 27.2 ± 6.2 respectively. Baseline comorbidities were distributed as follows: 5 diabetic patients, 3 cardiac patients, 9 smokers and 1 affected by autoimmune disease in group A; 4 diabetic patients, 5 cardiac patients, 1 hepatopatic patient, 11 smokers and 2 affected by rheumatoid arthritis in group B. Mean follow-up period was 33.2 months (range 8-44) for the

TABLE I - Acetabular defects distribution according to Paprosky classification before the 1st stage and at the end of the interstage period (2nd stage)

Paprosky stage	N° of patients			
	Group A		Group B	
	1st stage	2nd stage	1st stage	2nd stage
No defects	7	5	18	8
1	6	6	8	12
2	5	7	6	10
3A	8	7	5	6
3B	5	6	3	4

TABLE II - Summary of complications and failures

Types of complications	Group A (n = 31)		Group B (n = 40)	
	N° Tot	%	N° Tot	%
Dislocation	1	3.2	4	10
Perispacer fracture	1	3.2	0	0
Spacer fracture	0	0	1	2.5
Periprosthetic fracture	0	0	2	5
Failures (infection relapse)	1	3.2	3	7.5

Tot = total number.

acetabular spacer group and 45.3 months (range 10-52) for the control group. Figure 3 summarises microbiological data for each group.

The Paprosky stage in group A before the first stage was: 6 type 1, 5 type 2, 8 type 3A, and 5 type 3B. Seven patients had no acetabular defects. In group B the classification was: 8 type 1, 6 type 2, 5 type 3A, and 3 type 3B. In 18 patients no acetabular defects were present. The mean time of surgery for the first stage was 148 ± 59 min and 142 ± 45 min for group A and B respectively; the difference between the 2 groups did not differ significantly (p = 0.65). For the second stage the mean time of surgery was 83 ± 35 minutes (group A) and 109 ± 36 minutes (group B); the difference was statistically significant (p = 0.015). A primary implant could be implanted in 68% of the cases in group A and in 46% in group B (p = 0.056). Partial weight-bearing was allowed in all patients during the interstage period.

The mean radiological leg length discrepancy was 1.1 ± 4.6 mm and 2.8 ± 7.2 mm for group A and B respectively (p = 0.03). The mean contralateral offset (unaffected hip) was 52.5 ± 6.4 mm (group A) and 53.4 ± 7.6 mm (group B). The same parameter of the affected hip at the end of the 2-stage procedure was 61.9 ± 9.4 mm (group A) and 57.1 ± 7.2 (group B). The mean time between the first and the second stage was 3 months (range 1.5-12 months) and 5 months (range 2-13 months) for group A and B, respectively. Table I shows the Paprosky stage distribution before the first stage and at the end of interstage period. Among patients without acetabular defects, 71.4% remained without bone loss in group A whereas only 44.4% of those patients was classified without bone defects at the end of interstage period in group B (p>0.05). The overall mechanical complication rates were 6.4% and 17.5% for acetabular group and control group respectively (Tab. II). We observed 5 femoral spacer dislocations: 1 for group A (3.2%) and 4 for group B (10%); 1 spacer fracture in the group B (2.5%); 1 perispacer fracture in group A (3.2%); 2 intraoperative periprosthetic fractures during the second stage in group B (5%); and 2 acetabular spacer instabilities in group B (6.4%). The authors did not observe more abrasive wear of bone cement in group A. No complications related to cement debris was observed in either groups. 1 patient failed after the second stage in the acetabular spacer group (3.2%) whilst 3 failed in the control group (7.5%). There was no difference in complication rates between groups (p>0.05).

Discussion

To the best of our knowledge, this is the first study that compares outcomes obtained from articulating and static hip spacers. Our study shows that articulating spacers help improve joint function, enable early mobilisation of the patient and better preserve leg length and periarticular tissues. This leaves the surgical area more suitable for reimplantation, especially on the acetabular side (17-19). Different methods

and surgical techniques have been described in literature for the fabrication of articulating spacers. Rogers et al (20) have illustrated a new surgical technique based on the fabrication of an acetabular augment fixed with three iliac screws. Several prefabricated articulating spacers are now available on the market. PROSTALAC (DePuy Orthopaedics) is a system for the 2-stage revision of infected THA (21). It consists of a constrained cemented acetabular component and a femoral component with a modular head with antibiotic-loaded cement surrounding a stainless steel endoskeleton. Encouraging results with this system have been reported in the literature (22). Tsung et al (23) reported good outcome in infection patients treated with a 2-stage revision procedure with a custom-made articulating spacer (CUMARS). This device consists of an Exeter Universal stem (Stryker Inc.) and an all-poly acetabular cup both coated with antibiotic-loaded cement (Kiwi procedure). The overall complication rate was 22%. Polyethylene can act as a substrate for infection relapse with a possible increase of failures. Moreover, this procedure is burdened by considerable costs. Currently there is a paucity of biomechanical evidence to support 2-stage procedures. Our data shows a statistical significant reduction in LLD for the acetabular spacer group despite the slightly worse mean acetabular erosion observed in these patients. Offset was always restored or lateralised in all of our patients, both in group A and B, with a good abductor lever arm recovery. Considering the mean surgical time, we noted a non-significant difference in surgical time for the first stage; conversely, a significant reduction in this parameter is detectable for the group A. This is probably due to the better acetabular bone stock preservation resulting from the use of the cup spacer. Preventing acetabular erosion helps surgeons in the second stage by simplifying cup implantation and, ultimately, reduces surgical time. Despite the lack of statistical significance, we noticed an increase in worsening of the acetabular bone stock in group B. In particular, more than 50% of patients without bone defects worsened their acetabular condition in group B. In terms of spacer complications, our results demonstrate that acetabular spacers reduced several mechanical problems, such as dislocation, which could improves the 2-stage procedure. The most recent data about spacer mechanical complications reveal an overall complication rate of 20% (13, 24, 25). In our study, the complication rates were 6.45% and 17.5% in group A and group B, respectively. When further analysed, our data underline highlighted a great difference in spacer dislocation between groups suggesting a role of the acetabular cement spacer in preventing this specific complication throughout the interstage period. Despite these data, we cannot succeed in demonstrating a statistically significant difference in interstage complications and acetabular bone stock worsening between groups. This is probably due to the low number of patients that do not afford the correct power analysis to our study. We reported 2 cases of acetabular spacer instability but this finding should be considered as a "radiological complication" as the clinical outcome and the bearing condition during the interstage period were not affected. 4 failures related to infection relapse occurred during the follow-up period (1 in group A and 3 in group B).

Undoubtedly, our study has several limitations. First of all, this is a retrospective non-randomised study. Moreover, we do not present objective clinical parameters or patient reported outcome measures. Lastly, spacer motion has not been investigated. This will be our priority in the future evaluation of our patients. The relatively small number of patients also means that drawing firm conclusions is difficult.

In conclusion, our retrospective study confirmed that the use of acetabular antibiotic-loaded bone cement significantly reduces mean time of surgery in the second stage, without reducing the effectiveness of the 2-stage procedure. No statistically significant increase in time of surgery was noted in the first stage. Our data suggest that the use of an acetabular spacer can reduce femoral spacer dislocation rate and acetabular wear during the interstage period. Moreover, it allows everyday life activities. Evidence about lateral offset and leg length discrepancy leads us to conclude that the use of this additional device allows an easier hip biomechanics restoration. Finally, our study suggests a reduction of failures related to infection relapse using the acetabular spacer, though not statistically significant. Although more detailed and powerful studies are recommended in order to firmly validate our technique, we suggest the use of this inexpensive acetabular antibiotic-loaded cement spacer in 2-stage hip revision surgery.

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Disclosures

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Conflict of interest: None.

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