Prosthetic spacers in two-stage revision for knee periprosthetic joint infection achieve better function and similar infection control

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Aims

To explore the clinical efficacy of using two different types of articulating spacers in two-stage revision for chronic knee periprosthetic joint infection (kPJI).

Methods

A retrospective cohort study of 50 chronic kPJI patients treated with two types of articulating spacers between January 2014 and March 2022 was conducted. The clinical outcomes and functional status of the different articulating spacers were compared. Overall, 17 patients were treated with prosthetic spacers (prosthetic group (PG)), and 33 patients were treated with cement spacers (cement group (CG)). The CG had a longer mean follow-up period (46.67 months (SD 26.61)) than the PG (24.82 months (SD 16.46); p = 0.001).

Results

Infection was eradicated in 45 patients overall (90%). The PG had a better knee range of motion (ROM) and Knee Society Score (KSS) after the first-stage revision (p = 0.004; p = 0.002), while both groups had similar ROMs and KSSs at the last follow-up (p = 0.136; p = 0.895). The KSS in the CG was significantly better at the last follow-up (p = 0.013), while a larger percentage (10 in 17, 58.82%) of patients in the PG chose to retain the spacer (p = 0.008).

Conclusion

Prosthetic spacers and cement spacers are both effective at treating chronic kPJI because they encourage infection control, and the former improved knee function status between stages. For some patients, prosthetic spacers may not require reimplantation.

Article focus

- This study surveyed the effects of different types of articulating spacers in two-stage revision for chronic knee periprosthetic joint infection (kPJI).

Key messages

- The functional status and infection control of different types of antibiotic-loaded articulating spacers were compared, and lower rates of second-stage reimplantation and better joint function were observed following prosthetic spacer implantation.

Strengths and limitations

- This study directly compared the clinical outcomes, knee function status, and incidence of complications between two types of antibiotic-loaded articulating spacers.
- This study included a relatively small number of patients in each group, which made comparison difficult.

Introduction

Knee periprosthetic joint infection (kPJI) is considered a catastrophic complication of total knee arthroplasty (TKA) that is intractable and prone to recurrence. The main treatments for chronic kPJI include supervised neglect, chronic suppressive antibiotic treatment, one-stage revision, and two-stage revision. Two-stage revision is the gold standard for treating chronic kPJI.[1] The use of an antibiotic-loaded cement spacer (ALCS) to maintain the local release of high concentrations of antibiotics is essential for infection control.[2]

Spacers are categorized as articulating spacers or static spacers. Static spacers limit knee motion, thus greatly increasing the difficulty of reimplantation and reducing knee motion after revision. Static spacers are only used for patients with notable bone deficiency, a bad soft-tissue envelope, poor skin quality, or persistent infection.[3] While revision with articulating spacers improves knee motion, two-stage revision with articulating spacers can reportedly improve joint motion, thereby greatly improving quality of life.[4,5] In some studies, researchers have demonstrated that different articulating spacers, including cement spacers (Figure 1a) and component spacers, have good clinical outcomes.[4,6] The main component spacers are metal-cement spacers (Figure 1b) and metal-polyethylene spacers (Figure 1c). In several recent studies, researchers have reported that the use of primary arthroplasty implants as spacers in the management of PJI has yielded encouraging results (Figure 1d).[7,8] The friction surfaces in both the primary implants and the metal-polyethylene spacer were composed of a metal femoral component and a polyethylene insert; when antibiotic-loaded cement became the friction surface of the spacers, the thickness and strength decreased. Spacer fragmentation may occur during movement, thereby affecting joint function and possibly prompting early revision.[9,10] In contrast, some studies found that the metal component and polyethylene insert were not at risk of fragmentation, but the presence of many exposed metal components and polyethylene inserts during arthrography may increase the reinfection rate.[5,10,11] To our knowledge, few studies have directly compared the clinical outcomes of articulating spacers with different contact surfaces.

The purpose of this study was to explore whether there are differences between prosthetic spacers (metal-polyethylene spacers and primary component spacers) and cement spacers (all-cement and metal-cement spacers) in terms of controlling infection and improving postoperative knee function.

Methods

Patient demographic characteristics

In this continuous retrospective observational study, we analyzed the clinical data of 50 knees of 50 patients who underwent two-stage revision for chronic kPJI at a single institution from January 2014 to March 2022. Demographic data such as BMI, Charlson Comorbidity Index (CCI),[12] and hospitalization data (length of stay (LOS), operating time, blood loss volume) were collected. The inclusion criteria were as follows: 1) patients diagnosed with kPJI according to the Musculoskeletal Infection Society (MSIS) criteria;[13] 2) patients classified as Tsukayama type IV;[14] 3) patients underwent resection and debridement surgery, whose prostheses were all surgically removed; and 4) patients who were followed up for more than one year after first-stage revision. Exclusion criteria were: 1) patients with inflammatory joint disease and 2) patients with incomplete medical history or follow-up data. Surgeons used cement spacers more often in the early part of the study and preferred prosthetic spacers after January 2019. The choice of spacer was based on the patient's residual bone and soft-tissue conditions, economic ability, and treatment expectations.

According to the inclusion and exclusion criteria, 50 patients were identified in total (Table I), including 17 in the prosthetic group (PG) and 33 in the cement group (CG). The majority of patients were female. All the cases were unilateral, with 24 on the left side and the rest on the contralateral side. The mean age of the patients was 67.47 years (SD 5.98) in the PG and 67.79 years (SD 9.38) in the CG. There were no statistically significant differences in demographic data in terms of BMI or the CCI. The mean follow-up duration of the CG was significantly longer than that of the PG (46.67 months (SD 26.61) in the CG and 24.82 months (SD 16.46) in the PG; $p = 0.001$, independent-samples *t*-test).

First-stage revision

Arthrocentesis was routinely performed preoperatively when kPJI was suspected. Synovial fluid was collected for culture, and the white blood cell count was assessed. We used a medial parapatellar approach during resection. The major steps of the surgery were as follows: 1) complete implantation and cement removal; 2) debridement of the infected soft-tissue and bone, and irrigation with 6 to 9 l of normal saline; and 3) implantation of ALCSs. Patients with positive preoperative cultures received an implant of bone cement (Heraeus, Germany), mixed with vancomycin and sensitive antibiotics, in accordance with the International Consensus Meeting (ICM) guidelines.[15] If the preoperative culture results were negative, 3 g of vancomycin and 1 g of meropenem were empirically mixed into 40 g of cement.[16] The incision was closed routinely. Culture-positive patients who underwent preoperative drug sensitivity testing to determine the presence or absence of antibiotic sensitivity were treated according to recommendations from an infectious disease consultant (WZ). Culture-negative patients were switched to moxifloxacin combined with rifampicin after two to four weeks of empirical treatment with vancomycin and meropenem for four weeks. After two to four weeks of intravenous antibiotics, the oral antibiotics were replaced for another two to six weeks for all patients. The total course of antibiotics was six to eight weeks. Our indications for discharge were as follows: 1) the course of intravenous antibiotics was completed; 2) the local incision was completely healed; and 3) the patient recovered appropriate joint function to meet daily life needs.

Preparation of ALCSs

First, the position of the tibial component, the re-establishment of the joint line, and the extent of the defect in the distal and posterior condyles were measured using the test model, and the balance between the flexion and extension gaps and the alignment of the lower limb were restored. Next, some antibiotic-loaded cement was used to secure the metal tibial components (Chunlizhengda Medical Instruments, China; DePuy Orthopaedics, USA; Weigao Haixing Medical

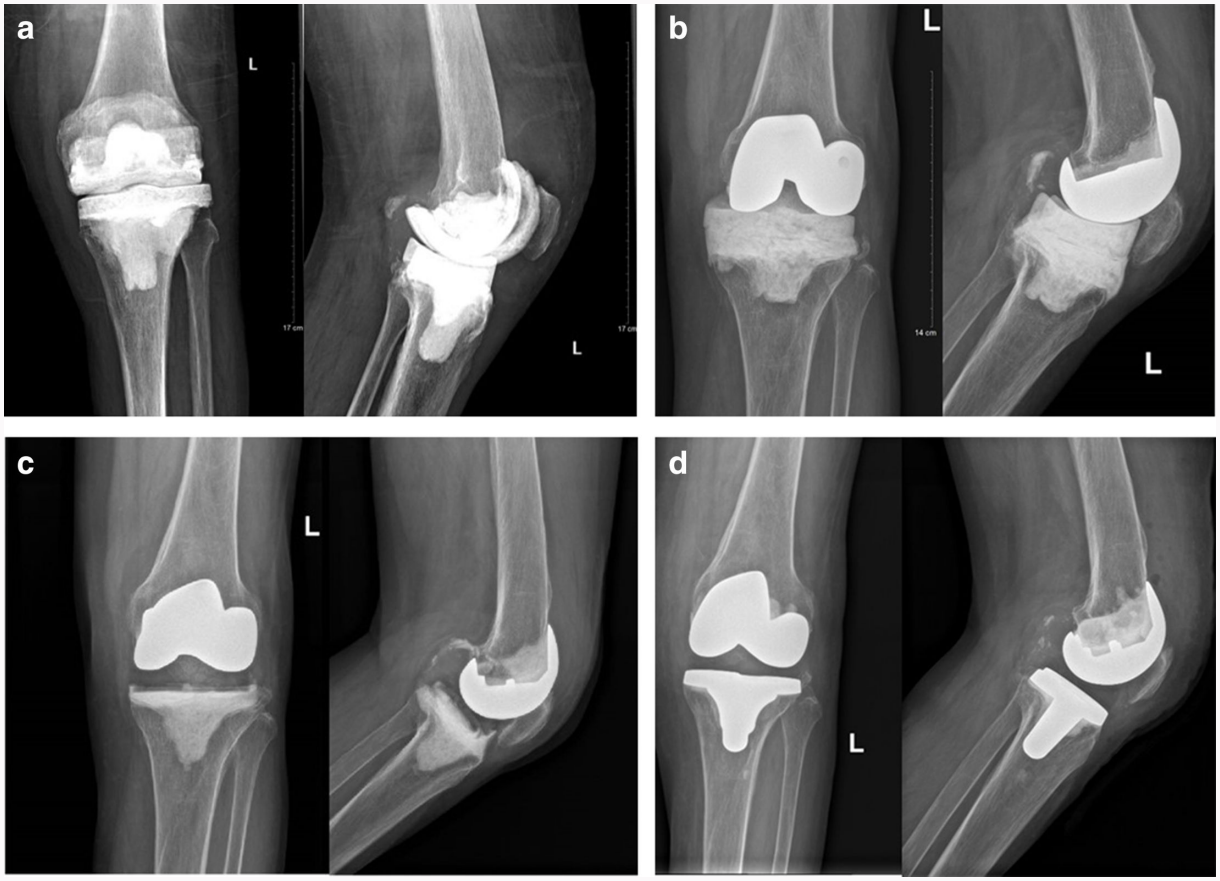

Fig. 1
Anteroposterior and lateral radiographs of different types of knee spacers. a) An 82-year-old male patient with a cement spacer one week after revision. b) A 72-year-old female patient with a metal-cement spacer one week after revision. c) A 62-year-old male patient with a metal-polyethylene spacer one week after revision. d) A 72-year-old male patient with primary arthroplasty implants as a spacer one week after revision.

Table I. Demographic data.

Demographic	PG	CG	p-value
Mean age, yrs (SD)	67.47 (5.98)	67.79 (9.38)	0.900*
Sex, n (%)			0.151†
Male	6 (35.29)	5 (15.15)	
Female	11 (64.71)	28 (84.85)	
Side, n (%)			0.616†
Left	9 (52.94)	15 (45.45)	
Right	8 (47.06)	18 (54.55)	
Mean BMI, kg/m^2 (SD)	26.48 (4.03)	24.81 (3.63)	0.225*
Mean CCI score (SD)	4.06 (1.12)	3.64 (1.37)	0.285*
Mean follow-up duration, mths (SD)	24.82 (16.46)	46.67 (26.61)	0.001*

*Independent-samples *t*-test.
† Pearson's chi-squared test.
CCI, Charlson Comorbidity Index; CG, cement group; PG, prosthetic group; SD, standard deviation.

Device Company, China), and the rest was used for augmentations corresponding to the previous tests. The thickness of the augmentation was determined according to the size of the bone defect (Figure 2). Then, after the augmentations hardened, the femoral component was removed (Chunlizhengda Medical Instrument; DePuy Orthopaedics; Weigao Haixing Medical Device Company) and augmentations were fixed with new cement. For patients with prosthetic spacers, the back of the polyethylene insert (Chunlizhengda Medical Instrument; DePuy Orthopaedic; Weigao Haixing Medical Device Company) was ground into a zigzag shape to increase the contact area on the tibial side, as reported in the literature.[17] According to the construction of the cement spacer, antibiotic cement was used to prepare and fix the spacer via models. The femoral component was implanted over the tibial insert in an extreme flexion position.

Reimplantation

After at least four weeks of antibiotic holiday, patients with non-infectious manifestations, as well as negative ESRs and CRP, were jointly evaluated by infectious disease specialists and orthopaedic surgeons to ensure that the infection had been eradicated and that reimplantation could be performed at their discretion.[7] The major surgical procedures included the removal of all the components and bone cement. The periprosthetic tissue was subsequently sent for culture and frozen sectioning. If the infection was not eradicated

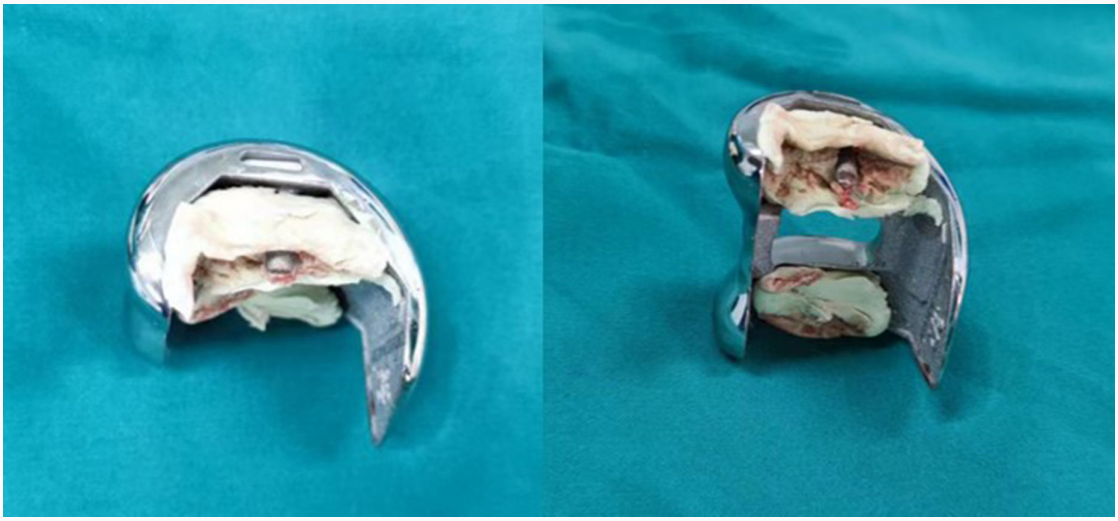

Fig. 2
Antibiotic-loaded cement as augmentations.

intraoperatively, the ALCS was reimplanted after debridement. Otherwise, the revision prosthesis (DePuy Orthopaedics; Zimmer Biomet, USA) was implanted instead. The removed spacers were sonicated, and the sonicated fluid was collected for culture.[18] Intravenous antibacterial therapy was administered for two weeks postoperatively; the duration of oral antimicrobial therapy thereafter was dependent on the intraoperative culture results.

Clinical outcome

The range of motion (ROM) and Knee Society Score (KSS)[6] were both evaluated preoperatively and postoperatively. All patients were followed up regularly, and the ROM, KSS, and extent of wound healing were recorded. The laboratory test results included routine blood test results and ESR and CRP levels, while plain radiographs were re-examined in a timely manner. According to the MSIS outcome reporting tool,[6,19] aseptic revision within one year of the initial operation for PJI is believed to represent a failed intervention for PJI. Infection control was defined as the absence of local inflammation, such as swelling, aseptic revision, or occurrence of PJI-related mortality one year after the first-stage revision, and the presence of well-controlled inflammatory markers.

Statistical analysis

The data are presented as the frequency and percentage for categorical variables and the mean and standard deviation (SD) for continuous variables. Fisher's exact test or Pearson's chi-squared test was used for categorical variables. Independent-samples *t*-test was used for continuous variables, which were normally distributed according to the Shapiro-Wilk test. All analyses were performed using SPSS v26.0 software (IBM, USA), and a p-value < 0.05 was considered to indicate statistical significance. All p-values were calculated using two-tailed tests.

Results

The ROM and KSS are shown in Table II. There was no significant difference in preoperative knee function between the two cohorts. After first-stage treatment, the PG had a greater mean ROM ($p = 0.004$) and mean KSS ($p = 0.002$, both independent-samples *t*-test). The mean δ ROM and KSS of the PG improved by 31.76° (SD 8.32°) and 31.64° (SD 10.11°), respectively, while those of the CG increased by 8.34° (SD 21.55°) and 24.76° (SD 10.55°) ($p = 0.003$; $p = 0.044$, both independent-samples *t*-test), respectively. At the last follow-up, the CG showed greater mean improvement in KSS scores ($p = 0.013$, independent-samples *t*-test). There were no significant differences in mean ROM or KSS between the two groups at the last follow-up. Among those who underwent second-stage reimplantation, the mean ROM and KSS did not significantly differ.

The clinical outcomes are shown in Table III. In total, 45 infections were successfully managed, with 16 and 29 cases in the PG and CG, respectively ($p = 0.650$, Fisher's exact test). A total of 33 patients underwent revision arthroplasty. The interval between antibiotic holiday and reimplantation was commonly four to 12 weeks, and there was no significant difference between the groups ($p = 0.852$, independent-samples *t*-test). Fewer patients in the PG opted for multiple revisions (ten in the PG, seven in the CG; $p = 0.008$, Pearson's chi-squared test), and most of them were satisfied with their local function. The joints underwent second-stage revision. The study showed that the operating time, intraoperative bleeding volume, and LOS did not significantly differ between the two groups during surgery. In terms of complications, there were four cases of spacer-related complications in the CG, including one case of spacer fracture and three cases of spacer subluxation; the rates of these two complications were not significantly different between the PG and CG (zero in the PG, four in the CG; $p = 0.285$, Fisher's exact test). Notably, spacer fracture occurred three years after the first-stage revision, and the patient subsequently underwent reimplantation according to the established procedure (Figure 3). Spacer subluxation occurred near the end of antibiotic holiday in three patients. These spacers were safely retained until second-stage reimplantation.

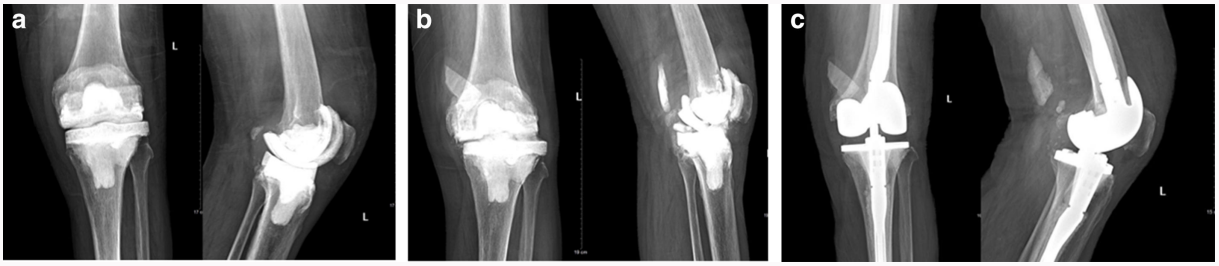

Fig. 3
Anteroposterior and lateral radiographs of a patient who underwent reimplantation three years after first-stage revision because of a cement spacer fracture. a) An 82-year-old male patient with a cement spacer one week after the first-stage revision. b) An 85-year-old male patient with a fractured cement spacer three years after the first-stage revision during the follow-up. c) An 85-year-old male patient with revision prostheses one week after reimplantation.

Table II. Infected knee functional status.

Variable	PG	CG	p-value*
Mean preoperative ROM, ° (SD)	67.65 (21.87)	72.63 (18.45)	0.404
Mean preoperative KSS (SD)	54.07 (6.47)	51.88 (9.99)	0.455
Mean first-stage ROM, ° (SD)	99.41 (21.36)	81.55 (19.10)	0.004
Mean first-stage KSS (SD)	85.87 (8.97)	76.64 (8.32)	0.002
Mean last follow-up ROM, ° (SD)	102.06 (25.56)	91.21 (22.03)	0.136
Mean last follow-up KSS (SD)	88.60 (10.84)	88.21 (8.39)	0.895
Mean preoperative to first-stage ROM δ, ° (SD)	31.76 (8.32)	8.34 (21.55)	0.003
Mean preoperative to first-stage KSS δ (SD)	31.64 (10.11)	24.76 (10.55)	0.044
Mean first-stage to last follow-up ROM δ, ° (SD)	2.65 (16.96)	9.28 (14.90)	0.173
Mean first-stage to last follow-up KSS δ (SD)	2.41 (11.61)	10.52 (9.28)	0.013
Mean second-stage ROM, ° (SD)	102.86 (12.54) (n = 7)	92.88 (20.41) (n = 26)	0.230
Mean second-stage KSS (SD)	91.71 (5.82) (n = 7)	89.54 (6.52) (n = 26)	0.430

*Independent-samples *t*-test.
CG, cement group; KSS, Knee Society Scale; PG, prosthetic group; ROM, range of motion; SD, standard deviation.

The pathogenic outcomes are shown in Table IV. The total percentage of positive cultures was 90% (45 in 50), and there was no significant difference in the distribution of pathogens between the groups. The most commonly identified infecting organisms were *Staphylococcus aureus* (n = 11) and methicillin-resistant *Staphylococcus epidermis* (n = 6).

Discussion

Two-stage revision was the accepted standard procedure for the treatment of kPJI.[20] The application of ALCS could enhance the local antibacterial effect and improve infection control. The cement femoral condyles were thinner and weaker than the tibial cement spacers, and more fractures were reported on the femoral side.[21] For this reason, we switched to metal femoral components later in the study in an attempt to reduce the incidence of spacer-related complications. Currently, both new and resterilized femoral condyles are reliable spacers for two-stage revision.[22] On the tibial side, when there were more bone defects, the thickness of the polyethylene insert decreased, so the cement insert could be considered to make a spacer on the tibial side to increase the thickness.

In this retrospective study, we directly compared the clinical outcomes of spacers with two different surfaces to verify whether different articulating spacers have differences in terms of infection control and outcomes. The observational results confirmed that patients who received prosthetic spacers had better temporary function after first-stage revision. However, there were no significant differences between the groups in terms of infection control or final clinical outcomes.

Function status

The ROM and KSS were considered perioperative indicators of infected knee function. In our study, there was no significant difference in functional status between the two groups before surgery. The mean ROM of the PG increased by 31.76° (SD 8.32°) after first-stage revision, and the mean KSS improved by 31.64 points (SD 10.11), which was significantly higher than that of the CG. Roof et al[1] compared 164 cases of infected knee function with different spacers and demonstrated that metal-polyethylene spacers could provide better ROM and KSS after first-stage revision. Our results were consistent with previous literature (mean ROM: 99.41° (SD 21.36°) in the PG, 81.55° (SD 19.10°) in the CG, p = 0.004; mean KSS (85.87 (SD 8.97) in the PG, 76.64 (SD 8.32) in the CG, p = 0.002, both independent-samples *t*-test). Greater motion may indicate a better prognosis. We speculate that a smoother surface of the joint spacer may produce less friction, which may be more conducive to the movement of infected knee joints. The prosthetic spacer could allow patients to bear weight partially or completely, or even walk at an earlier stage, prevent quadriceps atrophy, and improve quality of life.

Table III. Clinical outcome.

Outcome	PG	CG	p-value
Infection control, n (%)			0.650†
Yes	16 (94.12)	29 (87.88)	
No	1 (5.88)	4 (12.12)	
First-stage LOS, days (SD)	19.28 (7.87)	21.46 (5.11)	0.365*
First-stage operating time, mins (SD)	206.70 (40.59)	227.18 (59.25)	0.227*
First-stage blood loss, ml (SD)	277.78 (163.69)	304.55 (145.70)	0.641*
Second-stage LOS, days (SD)	17.76 (8.62) (n = 7)	19.73 (3.80) (n = 26)	0.485*
Second-stage operating time, mins (SD)	217.65 (38.25) (n = 7)	237.27 (59.18) (n = 26)	0.294*
Second-stage blood loss, ml (SD)	283.53 (141.82) (n = 7)	263.64 (158.26) (n = 26)	0.732*
Interval between antibiotic holiday and reimplantation, wks (SD)	7.14 (2.80) (n = 7)	7.65 (6.95) (n = 26)	0.852*
Preserved spacer, n (%)			0.008‡
Yes	10 (58.82)	7 (21.21)	
No	7 (41.18)	26 (78.79)	
Reason for spacer retention, n			
Awaiting reimplantation	1	2	
Refusing reimplantation: satisfied with local status	8	5	
Refusing reimplantation: other complications	1	0	
Spacer complication, n (%)			0.285‡
Spacer fracture	0 (0.00)	1 (3.03)	
Spacer subluxation	0 (0.00)	3 (9.10)	

*Independent-samples *t*-test.
†Fisher's exact test.
‡Pearson's chi-squared test.
CG, cement group; LOS, length of stay; PG, prosthetic group; SD, standard deviation.

Table IV. Pathogen results.

Pathogen	PG, n	CG, n	p-value*
Staphylococcus aureus	4	7	
MRSA	4	1	
Staphylococcus epidermidis	0	2	
MRSE	0	6	
CoNS	2	4	
Streptococcus agalactiae	1	0	
Enterococcus gallinarum	1	0	
Enterobacter cloacae	0	1	
Enterococcus faecalis	0	1	
Bacillus subtilis	0	1	
Mycobacterium tuberculosis	0	1	
Burkholderia cepacia	0	1	
Fungus	0	4	
Mixed infection	1	3	
Culture-negative	4	1	
Total	17	33	0.089

*Fisher's exact test.
CG, cement group; CoNS, coagulase-negative; MRSA, methicillin-resistant *Staphylococcus aureus*; MRSE, methicillin-resistant *Staphylococcus epidermidis*; PG, prosthetic group.

Notably, a larger proportion of patients in the PG chose to maintain the spacer (10 in the PG, 7 in the CG; p = 0.008, Pearson's chi-squared test) than to opt for multiple surgeries. Most of them were satisfied with their joint function in the short term because the spacer effectively controlled the infection. Retaining a well-functioning spacer potentially avoided the need for multiple procedures and reduced the financial burden. In a study by Lyons et al,[23] the metal-polyethylene spacer was called the "low-friction" spacer, while the cement spacer was called the "high-friction" spacer. Their results showed that the retention of low-friction spacers could still achieve adequate function without second-stage revisions. The similar results and similar functional status after reimplantation in the present study also indicated that the improvements in ROM and KSS between the two stages are real phenomena. In two-stage revision, whether a "low-friction" spacer or primary implant was used, the spacer surface, which consisted of a metal femoral condyle component and a polyethylene insert, provided greater motion and improved joint function. However, there was no statistically significant difference in joint function status between the two groups at the last follow-up. A meta-analysis,[4] which included metal-polyethylene spacers and three other kinds of ALCSs, reached similar conclusions, with no significant difference in post-reimplantation KSS between the different groups. We speculated that this might be because more patients in the CG underwent reimplantation and were implanted with revision prostheses, which are beneficial for ensuring soft-tissue and ligament balance. The greater increase in KSS from the first stage to the last follow-up also aligned with this difference (2.41 (SD 11.61) in the PG, 10.52 (SD 9.28) in the CG; p = 0.013, independent-samples *t*-test).

Infection control

Infection control is the main objective of two-stage revision for chronic PJI. In our cohort, the total infection control rate was 90% (45 in 50). Different spacers had similar efficiencies

in controlling infection.[24] In a multicentre cohort study of 533 patients with chronic PJI, the infection control rate was 68% in two-stage revision.[25] Our institution had a relatively high rate of PJI control, which may be due to the well-developed aetiological testing process. We believe that a higher percentage of positive cultures could improve the infection control rate because culture results are an important basis for clear diagnosis and guidance for antibiotic use. Due to factors such as the formation of biofilms, the history of antibiotic use, and the difficulty of culturing some pathogens, negative cultures of PJI account for 7% to 12% of all PJI cases.[26] In terms of pathogen diagnosis, similar results were obtained in this study. Currently, with the development of metagenomic next-generation sequencing (mNGS), broad-range polymerase chain reaction (BR-PCR), and other molecular diagnostic methods,[27,28] the molecular detection results could be used as a supplement for the diagnosis of PJI in addition to microbial culture. We achieved good clinical outcomes through standardized revision procedures, which indicated that, regardless of the kind of spacer, standardized treatment for pathogenic bacteria, including multiple specimen collection procedures, thorough debridement, and the combined topical and systemic application of antibiotics,[29] is the key to long-term infection management. However, polyethylene and metal components reportedly exhibit relatively high microbial adherence and affinity, and microbes can form new biofilms and cause infection recurrence.[30] Due to the lack of direct comparisons of pathogen loads on different types of spacers and the small number of patients who underwent reimplantation, we exercised caution, as these data represented only the short- to mid-term follow-up, which requires further investigation.

Clinical outcome

There were seven patients in the PG and ten patients in the CG who were satisfied with their current joint function and chose to retain spacers instead of undergoing multiple operations. Although three patients (one in the PG and two in the CG) reported at the follow-up that they would consider reimplantation at the appropriate time, which depended on their actual situation, they were currently satisfied with the implanted spacers. Therefore, we believe that these patients preserved spacers before they underwent reimplantation. A higher spacer retention rate confirmed patient satisfaction with the prosthetic spacers, which demonstrated that these spacers led to better short-term functional recovery. During our follow-up, no spacer complications occurred in the PG, which suggested the high safety of prosthetic spacers in the short to medium term. The use of prosthetic components may reduce cement wear and prolong the survival of spacers. Well-performing spacers may be a better choice for patients with multiple comorbidities, such as diabetes mellitus and congestive heart failure, and poor soft-tissue coverage.[31] Siddiqi et al[8] used primary TKA implants as spacers for definitive management of PJI and achieved satisfactory clinical outcomes. Nabet et al[7] referred to this approach as a 1.5-stage revision. In our view, the retained spacers are still part of the two-stage revision. In the future, if spacers are dysfunctional or if spacer-related complications occur, such as bone loss and spacer migration, even at a later stage they could still be managed through established procedures. To our knowledge, there have been no large studies that directly compare the clinical outcomes of long-term preservation of spacers and second-stage revision. The retrospective outcome seemed to be more favourable for PG, which may be due to the different contact surfaces between the groups. Compared with the relatively rough and lower strength bone cement contact surface, the surface of the prosthesis is smoother and stronger, which is conducive to functional recovery in patients in the early stage of treatment. The use of polyethylene inserts protects the bone cement from direct wear. It has been previously reported that cement particles can be found in the joint cavity of patients implanted with cement spacers due to long-term direct wear;[32,33] these particles locally mediate the occurrence of aseptic inflammation and even induce local osteolysis and spacer-related complications. In our cohort, metal components and polyethylene inserts were available in a variety of sizes, which was similar to what was observed in the initial TKA prosthesis. Prosthetic spacers of different sizes could fully adapt to the individual sizes of different patients to achieve better gap balance and cement augmentation. In contrast, there were fewer choices of the cement spacer model (large, medium, and small).

A limitation of this study is that it was retrospective. In addition, the small sample size and short follow-up period may have affected the incidence of spacer-related complications, such as wear, sinking, and periprosthetic fracture, which mostly occurred during the late follow-up period.[3] We did not consider the cost of the insert. It has been previously reported that polyethylene or cement femoral prostheses may be reliable.[24] In contrast, prosthetic components and polyethylene inserts are more costly than other materials, which may increase expectations. Based on the above considerations, first-stage revisions in our study were performed after fully informing the patients of the advantages and disadvantages of the different surgical procedures and obtaining informed consent. Therefore, it is necessary to design a standardized prospective randomized protocol to further analyze clinical outcomes, joint function, and economic benefits.

In conclusion, we directly compared the clinical outcomes of prosthetic spacers with those of cement spacers. There were no significant differences in terms of infection control, LOS, blood loss volume, operating time, or joint function at the last follow-up. Prosthetic spacers are a preferred choice because of their capacity to improve knee function status and quality of life between stages, and these spacers are suitable for patients and rarely require reimplantation.

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Data sharing

The authors confirm that the data supporting the findings of this study are available within the article [and/or its supplementary materials].

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