RESEARCH ARTICLE

Two-stage primary Total Knee Arthroplasty (TKA) for Treatment of Refractory Septic Knee Osteoarthritis: A Retrospective Cohort Study

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Abstract

Objectives: Several case studies have reported the use of a two-stage primary total knee replacement as a last resort for managing infected, arthritic knee joints. However, the exact treatment protocol has not yet been clearly defined. The objective of this study was to assess the effectiveness of a two-stage primary total knee replacement, using an antibiotic-loaded cement spacer block, in treating patients with concurrent osteoarthritis and refractory joint infection.

Methods: This retrospective study evaluated the outcomes of a two-stage primary total knee arthroplasty (TKA) for the treatment of refractory septic osteoarthritic knees. A total of six cases were included. In the first stage, open debridement was performed, followed by insertion of a well-designed antibiotic-loaded static cement spacer. Systemic antibiotics were administered during the interval period between the two stages. Once the infection had been eradicated, the second-stage TKA was performed. No suppressive antibiotic therapy was prescribed after the second stage. Clinical outcomes were assessed using pre- and postoperative knee range of motion (ROM), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores, and visual analog scale (VAS) scores. The mean follow-up duration was two years (range, 1–4 years).

Results: Complete eradication of infection was successfully achieved within an average follow-up period of two years. Before the initial stage surgery, the average range of motion (ROM) was 60 degrees (range, 40–120 degrees). Following the two-stage TKA, the ROM significantly improved to an average of 118 degrees (range, 100–130 degrees). Additionally, the WOMAC scores improved from an initial score of 40 to 20 after TKA. The mean VAS scores also showed significant improvement, decreasing from 50 preoperatively to 19 after the TKA procedure.

Conclusion: The promising final clinical outcomes observed in this study suggest that this treatment protocol could serve as a reliable alternative for patients with infected osteoarthritic knees, providing a viable option for both restoring function and eradicating infection.

Level of evidence: III

Keywords: Antibiotic-laden static cement spacer, Refractory Septic knee arthritis, Range of motion, Total knee arthroplasty, Two-stage arthroplasty, TKA

Introduction

Joint infections are becoming increasingly prevalent, particularly among adults, with septic arthritis affecting 2 to 10 individuals per 100,000, and a higher incidence is observed in the elderly and young children.[1] Elderly patients and those with underlying joint conditions, such as osteoarthritis, are at an increased risk of developing persistent infections.[2,3] The combination of severe osteoarthritis and infection presents a complex

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medical challenge, often leading to significant knee dysfunction.[4-6] Traditional treatments for this condition include joint decompression, systemic antibiotics, arthroscopic or open debridement, irrigation, arthrodesis, and above-knee amputation. While arthrodesis can be effective in cases of treatment failure, it carries risks of complications and permanent morbidities such as nonunion and recurrent infections, particularly in elderly patients with multiple comorbidities. Converting knee arthrodesis to TKA is also a challenging and less successful procedure.[4] Above-knee amputation is an alternative solution, but only half of the patients regain the ability to walk post-treatment.[7] Currently, there is no established consensus or widely accepted guideline for managing septic arthritis in the presence of degenerative joint disease. The two-stage revision total knee arthroplasty (TKA), initially introduced by Windsor et al.[6] for infected TKAs, has proven effective and is now commonly utilized.[8] While the two-stage approach involving antibiotic-loaded cement spacers followed by delayed revision TKA has been extensively researched,[9-14] there are limited reports on its application in patients with advanced knee arthritis and joint sepsis.[4,15] In contrast, our approach involves a two-stage primary TKA utilizing well-designed antibiotic-laden cement spacer blocks to address infected osteoarthritic knees. Our technique aims to effectively control infection, alleviate pain, and enhance function in patients facing this challenging clinical scenario.

Materials and Methods

In this retrospective cohort study, conducted between June 2018 and January 2023, six patients with advanced knee arthritis and concurrent joint sepsis were identified. The patient group consisted of four men and two women, with a mean age of 60 years (range, 58–62 years). These patients had an average WOMAC score of 40 (range, 24–53), a VAS score of 50 (range, 38–63), and a mean knee range of motion (ROM) of 60 degrees (range, 40–120 degrees). All six patients were followed for a minimum of two years and were included in this series. The mean duration of follow-up was two years (range, 1–4 years) [Table 1]. Four patients had a history of knee steroid injections, and one had previously undergone knee arthrotomy for the treatment of septic knee arthritis. All six patients had received antibiotics for septic knee arthritis before being transferred to our institution. The diagnosis was confirmed based on laboratory parameters (ESR and CRP levels), radiologic examination (weight-bearing posteroanterior view, lateral view, and Merchant's view) [Figure 1], physical examination, and bacterial culture. The inclusion criteria for the study were as follows: patients aged 58 to 62 years with advanced knee arthritis and concurrent joint sepsis, with a minimum follow-up of two years after surgery. The exclusion criteria were the presence of septic arthritis of the knee without evidence of osteoarthritis and patients with inflammatory knee diseases, such as rheumatoid arthritis and crystal arthropathies.

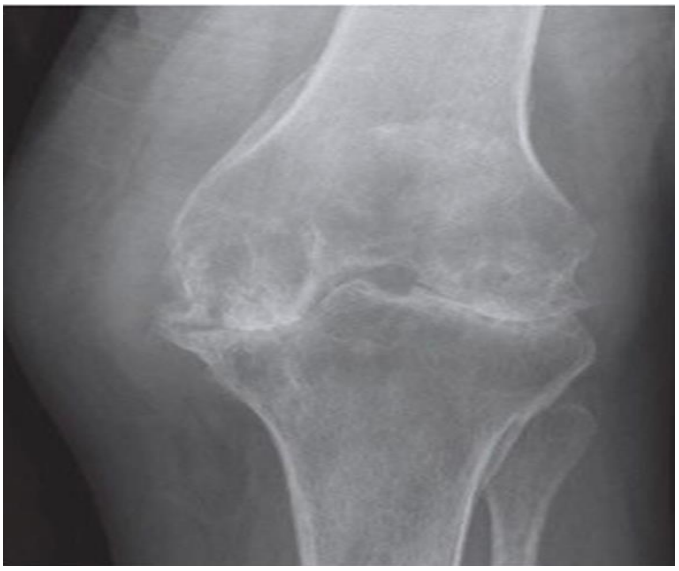

Figure 1. A knee anteroposterior radiograph showing osteoarthritis with infection

Table 1. Pre-Operative Information

	Age (years)/sex	Duration of F//U-YEARS	Pre[a]-ROM (degree)	Pre-WOMAC	Pre-VAS	Culture before FS[b]
1	F/59	1	0_40	53	63	Staph. Aureus
2	M/62	4	30_75	38	56	-
3	M/58	2	0_120	24	38	Staph. Aureus
4	F/60	1	30_80	45	54	Staph. Aureus
5	M/61	2	15_85	44	50	-
6	M/60	2	25_60	36	39	Staph. Aureus

[a]Pre- means before the first-stage surgery
[b]FS: first-stage surgery
ROM: range of motion
VAS: Visual Analogue Scale
WOMAC: Western Ontario and McMasre University Osteoarthritis Index

Surgical procedures

First stage

The surgical procedure involved a standard anterior longitudinal midline skin incision, a typical medial parapatellar arthrotomy with complete synovectomy, and thorough debridement of infected tissue. Intraoperative frozen section analysis and bacterial culture of synovium and joint fluid were performed to confirm the diagnosis and optimize antibiotic selection. The femoral canal was reamed, and an intramedullary femoral jig with a predetermined valgus correction angle was utilized based on preoperative joint alignment views. The distal femoral cut was made two millimeters shorter than standard, as per the preoperative plan. The proximal tibial cut was executed using an extramedullary jig, removing two millimeters of cartilage from the most intact side, with cultures taken from bone cuts. Femoral sizing was documented for the subsequent stage. The posterior condyles were left intact, with only cartilage removal using a curette to maintain tension over the posterior capsule. The patellar articular surface was refreshed, but no patellar resurfacing was performed. Manual traction was applied to keep the joint space open. The cement was inserted into the joint and over the cut surfaces using a K-wire as an intramedullary rod after adding vancomycin and gentamicin to the cement pack. Following cement hardening, the joint was irrigated and closed layer by layer over a drain [Figure 2]. A long-leg knee brace was then applied, and the patient was encouraged to bear weight with the assistance of a walker. During the initial two weeks, patients received intravenous antibiotics based on culture results from the first-stage samples, which were then continued orally for an additional four weeks. Patients underwent regular monitoring with serial quantitative CRP and ESR checks during this period. CRP and ESR levels were assessed daily in the first week and every two days thereafter. Any increase or lack of decrease in CRP values necessitated further debridement and spacer exchange.

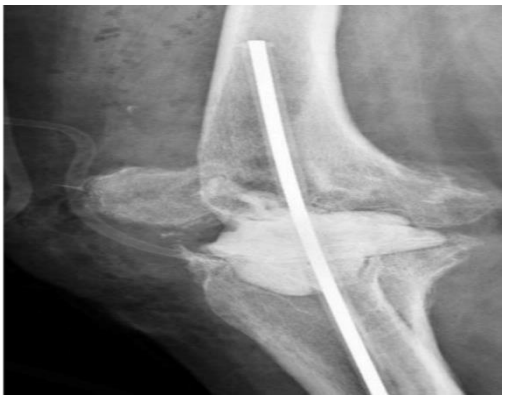

Figure 2. Static cement spacer with intramedullary K wire after performing distal femoral and proximal tibial cut

Second stage

Following six weeks of antibiotic treatment, patients underwent monitoring of CRP and ESR levels for the subsequent two weeks without antibiotics. Prosthesis implantation was scheduled once CRP levels normalized and ESR levels were below twice the high threshold value. The knee joint was exposed using a medial parapatellar approach. Upon removal of the cement spacer and K-wire, four samples from the tibial and femoral surfaces, as well as the synovium, were cultured. Extensive synovectomy and distal femoral recutting were performed based on the predetermined femoral size using an intramedullary guide from the initial stage. The proximal tibial recut was carried out with an extramedullary jig. The implantation procedure mirrored the primary TKA, with a posterior-stabilized prosthesis selected. A tibial stem was used for all patients, and a femoral stem was used for one patient only [Figure 3]. Patellar resurfacing was not performed.

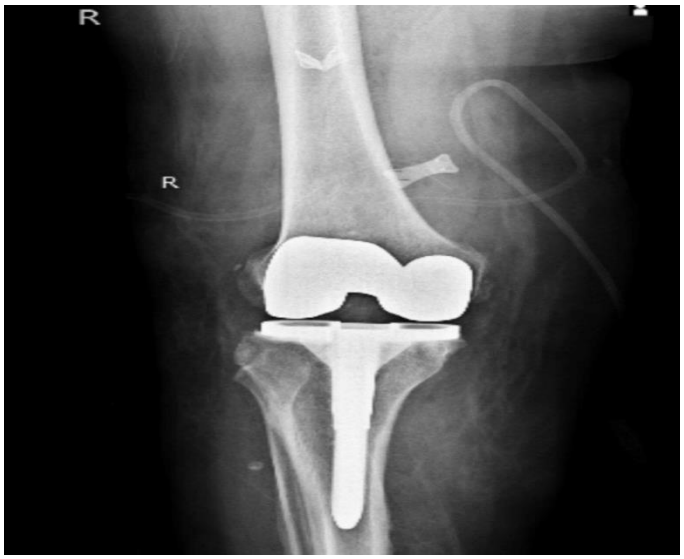

Figure 3. Post-operative image. Anteroposterior after arthroplasty

Antibiotic therapy was continued based on previous cultures until the results of the newly obtained cultures were available. In the absence of positive results, no further antibiotic regimen was prescribed. Standard rehabilitation and functional training were initiated, with patient follow-ups scheduled at two, six, and twelve weeks post-surgery, followed by annual visits thereafter. Outpatient clinic visits included serial monitoring of CRP and ESR levels, as well as assessment of clinical and radiological signs of infection.

Results

Joint aspiration cultures were positive before the initial stage in four patients, with one patient showing a positive synovial culture after the first stage. Conversely, all bone cultures taken during the first stage yielded positive results. Following a six-week course of antibiotics between stages,

the cement spacer was removed, and prosthesis implantation was performed at eight weeks. Cultures taken during the second stage were all negative, and the patients were discharged without any further suppressive antibiotics once the results were confirmed. Throughout the treatment, the knee joints remained stable with the primary prosthesis. The average knee range of motion (ROM) at the outset was 60 degrees (range, 40–120 degrees), which improved to an average of 118 degrees (range, 100–130 degrees) post-TKA. WOMAC scores showed improvement from an initial average of 40 (range, 24–53) to 20 (range, 14–32) at the final follow-up. Similarly, the average VAS pain scores decreased from 50 (range, 38–63) initially to 19 (range, 5–40) after TKA at the last follow-up [Table 2]. Successful infection control was achieved in all patients through the two-stage primary TKA approach, with no instances of infection recurrence observed in our cases.

Table 2. Post-Operative Information

	Post-ROM (degree)	Post-WOMAC	Post-VAS	Culture after FS
1	0-100	32	23	Staph. Aureus
2	0-125	18	20	_
3	0-130	8	5	Staph. Aureus
4	5-130	20	40	Staph. Aureus
5	5-130	18	14	E.coli
6	5-11o	24	12	Staph. Aureus

Post-ROM and Post-VAS scores and Post- WOMAC scores were assessed at the latest follow-up.

Discussion

Our findings demonstrate that employing a two-stage TKA approach can yield promising short-term outcomes in patients with prior treatment failure of septic knee arthritis and pre-existing joint degeneration. Current management strategies for septic knee arthritis in the setting of underlying joint degeneration do not always lead to successful outcomes,[2] and there is a paucity of established guidelines due to the limited treatment options reported in the literature.[12,16,17] However, Tahmasebi et al. have presented a treatment protocol for this challenging scenario.[18]

Using a two-stage total knee replacement (TKA) is a viable option for managing patients with prior surgical treatment failure of septic arthritis and concomitant joint degeneration. [19,20]Nazarian et al.[4] reported a 100% success rate with a two-stage approach to primary TKA in 14 patients with chronic knee sepsis, utilizing a non-articulating cement spacer. Kirpalani et al.[15] suggested that a two-stage procedure yields favorable outcomes in patients with arthritic knees and septic arthritis. Matsumoto et al.[12] described a case of knee septic arthritis and osteoarthritis treated with a two-stage procedure, involving three months of immobilization using an external fixator, followed by TKA. Mirza et al.[21] reported on three patients with knee sepsis who were managed with debridement and insertion of a cement spacer. In all of these studies, knee immobilization was employed during the infection control phase. In our research, static spacers with an intramedullary rod were used in combination with knee brace immobilization.

Several studies have demonstrated the benefits of using an articulating spacer over a static spacer in the treatment of infected TKAs.[14,22-24] Encouraging range of motion with an articulating spacer may lead to better final ROM after the eventual TKA compared to a static spacer. Additionally, knee function during treatment is superior with an articulating spacer. However, we do not advocate this approach due to the high likelihood of spacer fracture and potential bone loss.

Joint aspiration has proven helpful for detecting acute septic arthritis.[3] Our study showed a 67% positive culture rate before the first stage, similar to the findings of Nazarian et al.[4] and Yi et al.[25] We designed the protruding portion of the spacer into the medullary canal using a K-wire. While eradication of medullary canal infection is crucial, Freeman et al.[24] reported favorable results without placing antibiotic cement sticks or beads in the medullary canal.

This study achieved infection control at a minimum 2-year follow-up while maintaining knee function throughout treatment. Infection control is critical, as primary TKA in patients with a history of deep infection carries a high risk of recurrent infection. Jerry et al. reported a 4% recurrence rate after arthroplasty for simple septic arthritis and 15% for osteomyelitis.[16] Lee et al.[20] found a 5% reinfection risk in 16 primary TKAs with a 5-year follow-up in patients with prior knee sepsis. Patients in our study also demonstrated good functional outcomes after treatment, with all being discharged without extended antibiotic therapy. Although prolonged antibiotic courses have been common practice in two-stage TKA, many studies have concluded that there is no need for a prolonged antibiotic regimen.[4,21,25-29]

While constrained prostheses have been suggested in this setting, we utilized a four-in-one cutting jig in the first stage, cutting 2 mm less than usual for the distal femur and proximal tibia, enabling primary TKA in all cases.[4,27] Our study has limitations, including its retrospective nature and small sample size. However, a septic knee with pre-existing disabling arthritis is an uncommon but challenging presentation. All patients were examined and followed by the surgeon-researchers, without blinded examiners, and

there was no control group. Strengths of our study include the use of custom-made cement spacers, which reduces costs compared to industrial articulating samples. Performing fewer tibial and femoral cuts allowed us to proceed with primary TKA in all cases. Importantly, we did not prescribe suppressive antibiotics after the second stage.

Conclusion

Two-stage total knee replacement is a viable option for managing patients with previous surgical treatment failure of septic arthritis and concomitant joint degeneration. In this small series, this approach achieved infection control at a minimum 2-year follow-up while maintaining knee function throughout treatment. We advocate this technique only in patients with a current septic knee and pre-existing disabling arthritis.

List of abbreviations

Total knee arthroplasty (TKA); Visual analog scale (VAS); Range of motion (ROM); Erythrocyte sedimentation rate (ESR); C-reactive protein (CRP); Western Ontario and McMaster Universities arthritis index (WOMAC)

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Declaration of Ethical Approval for Study: This retrospective study was conducted utilizing patient data obtained through medical records. Prior to surgical intervention, all participants received comprehensive preoperative consultations detailing available treatment options, following which informed consent was secured. As the study involved retrospective analysis of anonymized clinical data, ethical approval for this specific investigation was waived by the institutional review board in accordance with local regulatory guidelines. The research adhered to established ethical principles outlined in the Declaration of Helsinki.

Declaration of Informed Consent: Informed consent was obtained from the patients regarding publishing their data and photographs for scientific purposes.

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