

# Permanent Resection Arthroplasty of the Knee as Limb Salvage Following Recurrent Periprosthetic Infection Complicated with Osteomyelitis

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## Learning Point of the Article:

Permanent resection arthroplasty of the knee is a limb salvage option for recalcitrant periprosthetic infection in very carefully selected patients.

## Abstract

**Introduction:** Permanent resection or excision arthroplasty of the knee involves the removal of any infected prosthetic material and thorough debridement, with no further reimplantation. The more common alternatives to permanent resection arthroplasty include knee arthrodesis or above-knee amputation (AKA).

**Case Report:** We describe two cases of complex periprosthetic infections of the knee associated with subsequent osteomyelitis, which were unsuitable for re-revision arthroplasty. Both patients chose to remain with an excision arthroplasty, rather than undergo arthrodesis or AKA, respectively, and were satisfied with their quality of life at long-term follow-up.

**Conclusion:** Although permanent resection arthroplasty of the knee is rarely performed, it remains a limb salvage option in certain cases where bone loss is limited, functional demands are low, and further surgery may present a significant risk.

**Keywords:** Knee, resection arthroplasty, excision arthroplasty, revision, periprosthetic infection, osteomyelitis, limb salvage

## Introduction

Infection is a devastating complication following total knee arthroplasty (TKA) and can be difficult to eradicate, despite improvements in diagnostic methods and treatment strategies [1]. The incidence of periprosthetic joint infection (PJI) following primary TKA is around 1–2% and considerably higher following revision TKA [2]. Furthermore, the burden of PJI is likely to increase with rising numbers of primary and revision arthroplasty procedures [3, 4]. Late PJI typically occurs due to hematogenous spread or the delayed manifestation of a pathogen that was present during implantation and is more likely to

necessitate one- or two-stage revision than early infections.

In recurrent infections or patients with multiple comorbidities, revision surgery may no longer serve as a reasonable choice. We describe two cases of PJI around the knee associated with subsequent osteomyelitis, which were unsuitable for re-revision TKA. Both patients chose to remain with a permanent resection arthroplasty. Their management and outcomes are discussed in the context of alternative treatment options and the existing literature.

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## Author's Photo Gallery



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**Figure 1:** Anteroposterior (a) and lateral (b) right knee radiographs at 3 years following resection arthroplasty, with established fibrous ankylosis. (Reprinted from Razii et al. [11], with permission from Springer Nature).



**Figure 2:** Clinical photograph of the right knee at 11 years following resection arthroplasty, with no evidence of recurrent infection.

discussed [5], the patient was satisfied at this stage with both his quality of life and level of function, choosing not to undergo further surgery and instead remain with a permanent resection arthroplasty (Fig. 1). At 11-year follow-up (Fig. 2), he remained infection free and, despite some extensor lag, was able to mobilize with the aid of crutches.

## Case Report

### Case 1

A 70-year-old male developed a complex right knee PJI. His primary TKA had previously been revised due to a severe, late infection with alpha-hemolytic *Streptococcus*, which unfortunately recurred in the revision implant. Despite undergoing explantation, debridement, and insertion of interval prosthesis, with an extended post-operative course of trimethoprim-sulfamethoxazole, he was re-admitted within 3 months, having developed worsening pain and a draining sinus. The surrounding soft tissues were indurated and further radiological investigations indicated the presence of gross osteomyelitis, with the patella having effectively disintegrated. The patient was subsequently referred to our institution for further management and consideration of limb salvage.

Although he was otherwise healthy, it was unreasonable to attempt revision arthroplasty in the presence of a deficient extensor mechanism, and we initially planned a two-stage protocol for knee arthrodesis. Following excision arthroplasty and a further debridement of all infected and necrotic bone and soft tissues, we stabilized the patient's knee in a post-operative brace. He received extended courses of intravenous teicoplanin and vancomycin, followed by oral cefradine and co-amoxiclav, with regular follow-up to assess his clinical condition and monitor bloods.

The patient's wound healed satisfactorily, and his pain and inflammatory markers resolved. Although the option of a definitive fusion procedure with a long intramedullary nail was

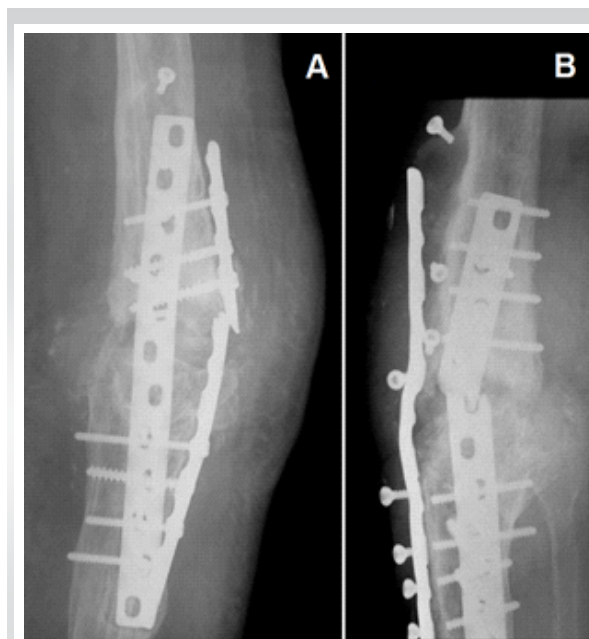
### Case 2

An 80-year-old female, with a past medical history of glaucoma and

hypertension, underwent attempted left knee arthrodesis with internal compression plating and screws, having developed recurrent infection of a revision TKA. Her primary implant had lasted for 18 years before developing a late infection, while the revision prosthesis required explantation after a further 4 years. 2 years following the fusion procedure, she was referred to our institution with knee pain, rigors, malaise, and raised inflammatory markers (C-reactive protein (CRP) 88 mg/L and erythrocyte sedimentation rate (ESR) >130 mm/h). Plain knee radiographs demonstrated that several screws had broken, the anterior plate had disengaged, the lateral plate had fractured, and there was no evidence of union (Fig. 3).

The patient was treated at our institution with removal of metalwork (although three screw fragments around the knee were irretrievable) and radical debridement using the Lautenbach method [6]. Suction irrigation with teicoplanin was used for 3 weeks following the operation, and she also received 5 weeks of intravenous followed by oral antibiotics, according to the sensitivities of multiple intraoperative cultures, which had grown coagulase-negative *Staphylococci* and coryneforms. Knee arthrodesis was re-attempted 5 weeks after the first stage procedure (Fig. 4) with the application of a Sheffield external ring fixator (Orthofix Medical Inc., Lewisville, TX, USA) [7, 8], and an extended post-operative course of oral co-amoxiclav, as per microbiology.

Shortly after being discharged home, she fell and sustained a displaced periprosthetic fracture of her left mid-femoral shaft,



**Figure 3:** Non-union of previous attempted fusion demonstrated on anteroposterior (a) and lateral (b) radiographs of left knee; the lateral compression plate has fractured, the anterior compression plate has disengaged, and several screws are broken.



**Figure 4:** Post-operative left knee radiograph demonstrates re-attempted arthrodesis with the application of a Sheffield external ring fixator.

which was reduced and managed with revision and reinforcement of the proximal ring of the external fixator. Although the fracture united with only a mild residual angular deformity within 4 months, there was no progress toward successful fusion of the knee. Unfortunately, serial radiographs revealed bony destruction, and white blood cell scintigraphy showed diffuse uptake in the distal femur, strongly indicative of osteomyelitis. However, the patient was clinically stable and bloods were normal, except for a moderately elevated CRP (35 mg/L) and ESR (60 mm/h).

The patient consequently underwent removal of the external fixator and further extensive debridement; the screw fragments within the distal femur and proximal tibia remained inaccessible. Multiple intraoperative samples grew methicillin-resistant *Staphylococcus aureus*, which was treated with an extended course of intravenous vancomycin and teicoplanin. Due to poor bone quality and previous recurrent infection, which had necessitated multiple operations, she was deemed unsuitable for reimplantation and we therefore discussed the options of above-knee amputation (AKA) or remaining with a permanent resection arthroplasty. The patient reported that she did not have any pain and wanted to retain her limb, despite this meaning that she would require ongoing antibiotic suppression with oral doxycycline. Regular follow-up indicated that inflammatory markers were quiescent. She remained clinically stable and was able to transfer independently to and from wheelchair. At 13-year follow-up (Fig. 5), there was no radiological evidence of osteomyelitis progression and,

particularly in view of her age and accumulating comorbidities (such as atrial fibrillation), the patient was satisfied with her decision, long-term antibiotic therapy, and functional status.

### Discussion

While Girdlestone resection arthroplasty remains an established salvage procedure for the definitive treatment of recalcitrant periprosthetic infections following total hip replacement [9], permanent resection or excision arthroplasty of the knee is performed much less frequently. It can only be undertaken in the presence

of relatively small bone defects and involves removal of any infected prosthetic material and thorough debridement of the synovium, with no further reimplantation. The more common alternatives to permanent resection arthroplasty include arthrodesis or AKA [10, 11].

Knee arthrodesis is preferable to AKA in older candidates, who generally find it more difficult using a prosthetic limb and are much less likely to achieve functional independence [12]. Although AKA might become necessary in certain situations (such as in the presence of peripheral vascular disease that prevents soft-tissue healing), there are functional and psychological advantages to limb preservation [13, 14]. Indeed, it is important for surgeons to understand and manage patients' expectations when treating PJI. Both patients in this scenario declined the opportunity to undergo further surgery – in case 1, this was despite the inevitable lack of function associated with remaining with an excision arthroplasty, and in case 2, the patient chose life-long antibiotic suppression therapy rather than AKA.

Permanent resection arthroplasty was described as an alternative to knee arthrodesis for salvage of the infected TKA by Kaufer and Matthews more than 30 years ago [15]. Compared with bony fusion, the development of a fibrous ankylosis is predictably less stable and has less load-carrying capacity, so ambulation is more difficult. However, a resection arthroplasty will generally allow a limited range of movement and is therefore likely to be more comfortable for sitting [11].



**Figure 5:** Anteroposterior (a) and lateral (b) left knee radiographs at 13 years following resection arthroplasty; three screw fragments (two in the distal femur; one in the proximal tibia) remained inaccessible during earlier debridement procedures and there is a mild residual angular deformity of the femoral diaphysis at the previous fracture site.

This is especially relevant to case 2, where the patient's frailty meant that she needed to use a wheelchair. Furthermore, the absence of a prosthetic joint makes biofilm formation less likely. Falahee et al. reported that infection was cleared in 25 out of 28 knees which underwent excision arthroplasty (89%) at mean 5-year follow-up, but the subjective rate of dissatisfaction was relatively high at 39% [16]. Importantly, they found that the procedure was tolerated better in patients with more severe pre-operative disability and lower functional demands.

Lettin et al. reported better results – an eradication rate of 100% and subjective dissatisfaction at 20% – although this was a smaller cohort of 15 patients and mean follow-up was 4 years [17]. Similarly, Mine et al. found that there was no infection recurrence in any of their nine patients following permanent resection arthroplasty combined with a pedicled muscle flap [18]. Mean follow-up was just under 3 years and the subjective rate of dissatisfaction was 33%; there was no obvious correlation between patient satisfaction, limb length discrepancy, and pain.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Interestingly, Lettin et al. described the use of local antibiotic irrigation [17], somewhat similar to the Lautenbach technique that we used [6], whereas the earlier study by Falahee et al. did not involve local antibiotics [16]. Both, however, have emphasized the importance of thorough debridement following explantation, which we regard as the most fundamental aspect of treating PJI [19], irrespective of whether revision TKA, permanent resection arthroplasty, or arthrodesis is performed. We concur that it is necessary to provide a period of stability to the knee following excision arthroplasty to allow the wound to heal and soft tissues to settle, whether using a cast or brace.

Nevertheless, it has been recognized that established osteomyelitis arising from PJI may be particularly difficult to eradicate [20]; in case 1, the patella had essentially disintegrated within a short period of time, and in case 2, it was on a complex background of previous failed arthrodesis and a periprosthetic femoral fracture.

### Conclusion

Excision arthroplasty of the knee is rarely considered a definitive solution for patients with recurrent PJI [21], even those associated with osteomyelitis. The lack of literature on long-term outcomes following the procedure reflects this, as reconstruction is inevitably favored where possible in the treatment of the infected TKA. Indeed, the management of PJI at our institution has evolved – both from microbiological and surgical perspectives – since these cases were undertaken, alongside the development of consensus-based guidelines [1, 22]. However, permanent resection arthroplasty remains relevant in certain cases, where bone loss is limited, functional demands are low, and further surgery may carry significant risks.

### Clinical Message

Recurrent infection in the multiply revised TKA is a significant challenge, particularly if complicated by the presence of established osteomyelitis. In carefully selected cases, permanent resection arthroplasty provides an alternative to knee arthrodesis or AKA; nevertheless, the quality of debridement following explantation remains paramount.

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