Case Report

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Successful implant salvage of a delayed tibial megaprosthesis infection using continuous local antibiotic perfusion: a case report

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Introduction: Postoperative infection following megaprosthetic reconstruction is a challenging complication due to extensive metallic surfaces, poor vascularity, and biofilm formation. We report a rare case of delayed tibial megaprosthetic infection managed using continuous local antibiotic perfusion (CLAP).

Case presentation: A 22-year-old male previously underwent wide resection and tibial megaprosthetic reconstruction for osteosarcoma and developed chronic osteomyelitis 2 years after revision surgery. CLAP was performed using intramedullary and subcutaneous double-lumen catheters combined with negative-pressure wound therapy. *Cutibacterium acnes* was identified intraoperatively. Systemic minocycline and clindamycin were administered. Infection control was achieved without implant removal, with normalization of inflammatory marker levels and radiographic improvements. The Musculoskeletal Tumor Society functional score improved from 70% to 90%, and no recurrence or loosening was observed after 1 year.

Clinical discussion: Megaprosthetic infections are particularly difficult to manage because of implant surfaces, dead space, and poor local vascularity. This case demonstrates that CLAP may provide an effective limb-sparing strategy for infection control while preserving the implant. The key advantage of CLAP is its capacity to deliver high concentrations of antibiotics directly to infected bone and surrounding soft tissues, even in poorly vascularized regions, allowing sustained bactericidal activity against biofilm-embedded bacteria. The successful eradication of *C. acnes* infection in this case suggests that CLAP may be a promising strategy for managing indolent biofilm-associated infections.

Conclusion: Given the complexity and limited vascularity associated with megaprosthetic reconstructions, CLAP represents a promising adjunctive strategy for managing difficult implant-related infections, as demonstrated in this rare case of delayed tibial megaprosthesis infection.

Keywords: case report, chronic osteomyelitis, continuous local antibiotic perfusion, megaprosthesis infection, osteosarcoma

Introduction

Recent advances in surgical resection and functional reconstruction of malignant bone tumors have significantly expanded the indications for limb-salvage surgery. Reconstruction using megaprostheses has become widely adopted in patients with lower limb osteosarcoma. However, postoperative infection remains a major challenge, with reported infection rates ranging from 10% to 20%[1–3].

The primary difficulty in treating such infections lies in the formation of bacterial biofilms on the extensive metallic surface of the implant, which renders conventional systemic antibiotic therapy ineffective. Furthermore, wide tumor resection often leads to poor local vascularity, thereby reducing antibiotic delivery to the affected area[3–5]. Consequently, implant removal or even amputation may be required for infection control, leading to substantial loss of limb function and reduced quality of life. Therefore, therapeutic strategies that effectively control infection while preserving the implant are urgently needed.

HIGHLIGHTS

- Continuous local antibiotic perfusion (CLAP) successfully treated a delayed tibial megaprosthesis infection without implant removal.
- High local antibiotic delivery enabled biofilm eradication in a poorly vascularized area.
- *Cutibacterium acnes* chronic infection was effectively controlled using CLAP.
- Functional outcome improved significantly, with the the Musculoskeletal Tumor Society score rising from 70% to 90%.
- CLAP represents a promising limb-sparing option for complex implant-related infections.

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Among such strategies, continuous local antibiotic perfusion (CLAP) is a novel method that delivers high local antibiotic concentrations directly into the infected area through intramedullary (iMAP: intramedullary antibiotic perfusion) and soft-tissue (iSAP: intrasoft-tissue antibiotic perfusion) routes. This technique enables sustained local antibiotic delivery within the infected site and has demonstrated potential efficacy against biofilm-associated infections[6,7].

Successful outcomes using CLAP have been reported for fracture-related infections[8], chronic osteomyelitis[9], postoperative spinal infections[10], and prosthetic joint infections[11,12]. However, reports on its use in controlling infections involving megaprostheses remain extremely limited.

We report a rare case of delayed tibial megaprosthesis infection, successfully managed with CLAP therapy, achieving infection control and implant preservation.

This case report has been reported in line with the SCARE 2025 checklist[13].

Case presentation

A 22-year-old male patient was diagnosed with osteosarcoma of the proximal left tibia at the age of 17 years. After receiving preoperative chemotherapy (methotrexate, cisplatin, doxorubicin, and ifosfamide), the patient underwent wide tumor resection and reconstruction using a tibial megaprosthesis.

Three years later, the patient sustained a periprosthetic fracture during soccer, for which the original compress-type implant was replaced with a stem-type megaprosthesis (Fig. 1a–d). Eight months after revision surgery, the patient developed left lower-leg cellulitis following simultaneous coronavirus disease 2019 (COVID-19) and influenza infections. The cellulitis improved with intravenous antibiotics, and blood cultures were negative.

Two years later, the patient reported progressive pain during ambulation. Radiographs showed a clear zone around the stem (Fig. 1e and f), and bone scintigraphy revealed increased uptake at the same site. Serum C-reactive protein (CRP) levels ranged from 1.5 to 2.0 mg/dL. Based on these findings, delayed chronic osteomyelitis was diagnosed, and CLAP therapy was selected.

During surgery, following the iMAP protocol, a bone marrow needle was inserted into the intramedullary space between the distal stem tip and the ankle joint. For iSAP, two 20 Fr double-lumen nasogastric tubes (Salem Sump tube; Covidien) were placed in the subcutaneous tissues proximal and distal to the implant, between the soft tissue and prosthesis (Fig. 2a–d). A negative-pressure wound therapy (NPWT) device (Renasys®, Smith & Nephew) was applied to the incision site at 60 mmHg to 70 mmHg continuous suction.

Each Salem Sump tube was used to continuously infuse a solution consisting of 60 mg of gentamicin diluted in 50 mL of saline at a rate of 2 mL/h. Simultaneously, NPWT was applied to provide continuous suction and facilitate drainage of the

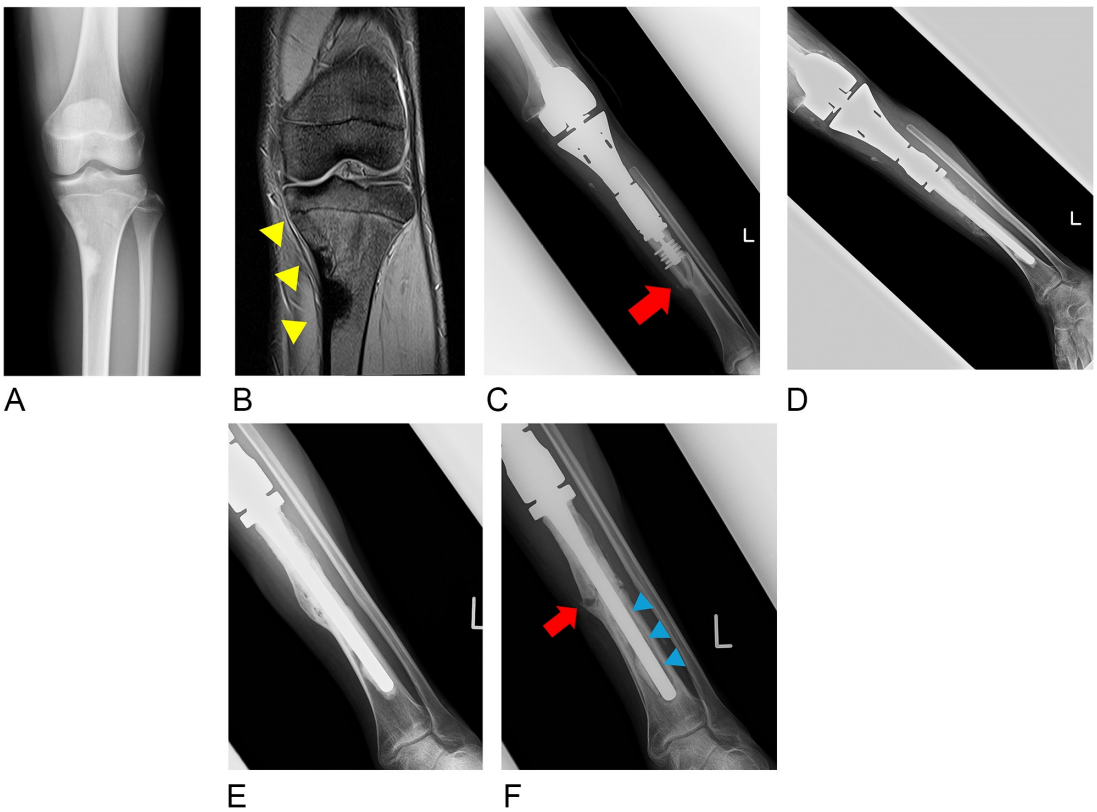


Figure 1. Preoperative imaging of the left proximal tibia. (A) Anteroposterior radiograph at initial presentation showing an osteolytic lesion. (B) Coronal T2-weighted magnetic resonance imaging demonstrating the tumor location (△). (C) Postoperative radiograph following reconstruction with a compress-type tibial megaprosthesis. The radiograph shows a periprosthetic fracture around the stem (→). (D) Radiograph after revision surgery with a stem-type megaprosthesis. (E) Radiographs obtained after revision surgery. Anteroposterior view showing callus formation indicating bone union after 1 year. (F) Two years after cellulitis, radiograph showing a clear zone around the stem (△) and bone resorption at the previous callus site (→), suggesting chronic infection.

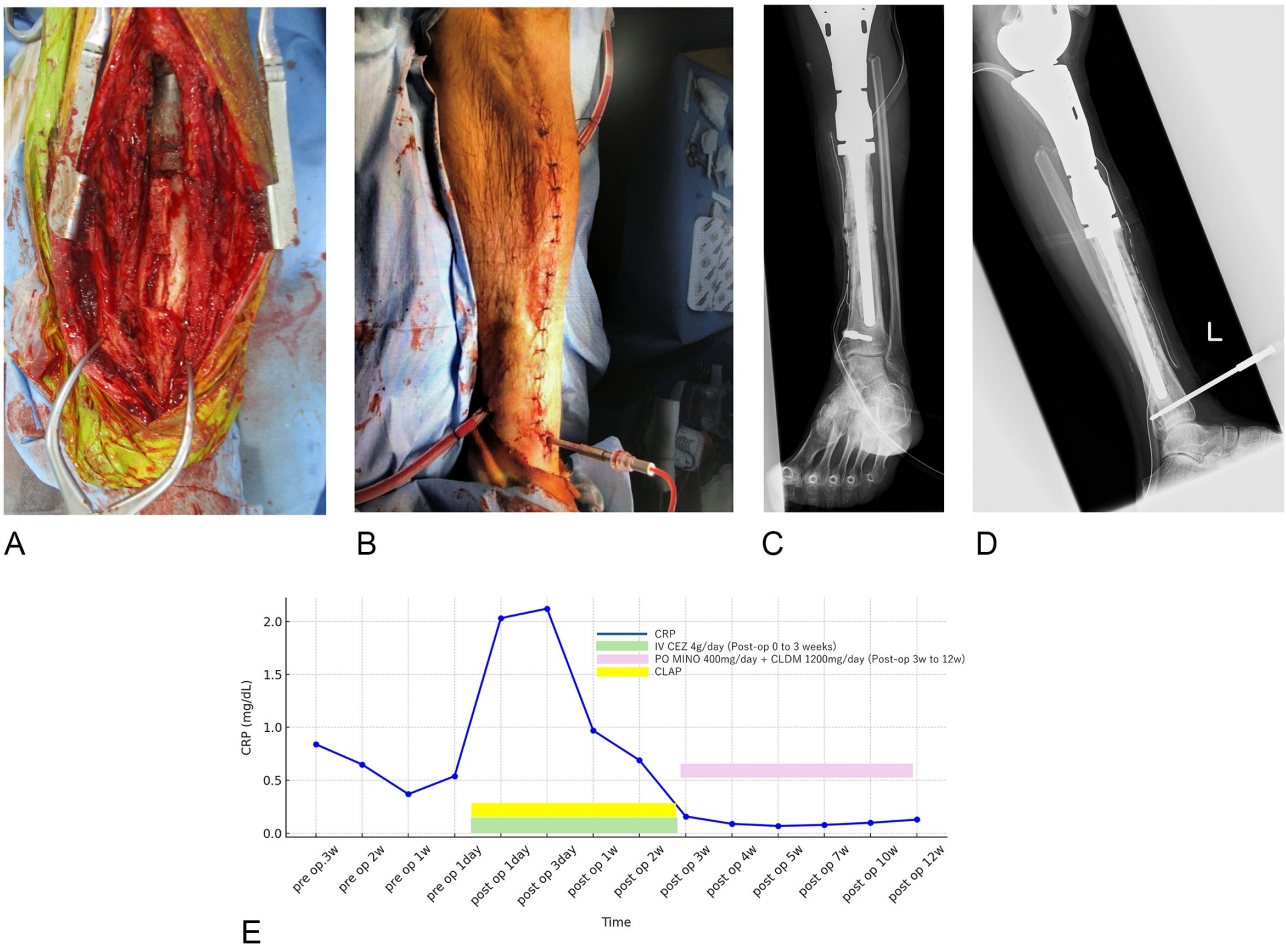


Figure 2. Intraoperative and postoperative findings during CLAP setup. (A) Intraoperative photograph after irrigation of the implant–bone junction showing no obvious loosening. (B) Intraoperative view of CLAP catheter placement: double-lumen iSAP tubes placed proximally and distally, and one intramedullary iMAP pin inserted into the tibial metaphysis. (C) Anteroposterior and (D) lateral radiographs confirming proper placement of iMAP and iSAP catheters. CLAP, continuous local antibiotic perfusion; iMAP, intramedullary antibiotic perfusion; iSAP, intrasoft tissue antibiotic perfusion. (E) Trend of CRP levels and antibiotic therapy timeline. The graph illustrates CRP reduction to normal levels within 2 weeks postoperatively. Duration of CLAP therapy is shown in yellow, intravenous antibiotic administration in green, and oral antibiotic therapy in pink. CRP, C-reactive protein; CLAP, continuous local antibiotic perfusion; IV CEZ, intravenous cefazolin; PO MINO, oral minocycline; CLDM, clindamycin; pre op, preoperative; post op, postoperative; w, week(s); d, day(s).

perfusate. To maintain catheter patency and prevent obstruction, careful flushing with saline or air was performed every 2 days. This ensured uninterrupted perfusion throughout the treatment period. The iMAP pin was inserted such that its tip remained within the medullary cavity, and continuous perfusion was administered at the same infusion rate as that used for the soft tissue catheters. Potential complications of local aminoglycoside perfusion, including nephrotoxicity and soft tissue injury, were carefully monitored. In the present case, serum gentamicin trough levels were measured serially and remained below the toxic threshold (maximum: 0.9 μg/mL), while serum creatinine levels remained within the normal range throughout treatment. No adverse events were observed.

Intraoperative anaerobic culture of the bone tissue yielded *Cutibacterium acnes*. CLAP was continued for 20 days, and after catheter removal, oral minocycline (400 mg/day) and clindamycin were administered for 9 weeks. Non-weight-bearing status was maintained for 1 month, followed by progressive ambulation. The CRP levels normalized (<0.1 mg/dL) (Fig. 2e).

Postoperatively, the radiographs showed no progression of loosening or clear zone widening. Bone scintigraphy performed at 6 months demonstrated reduced uptake around the implant (Fig. 3). The Musculoskeletal Tumor Society/International Society of Limb Salvage (MSTS/ISOLS) functional score improved from 21 (70%) preoperatively to 27 (90%) postoperatively. This functional improvement was primarily associated with pain relief, restoration of independent ambulation, and improvement in gait pattern. At the 1-year follow-up, no recurrence of infection or radiographic evidence of loosening was observed.

Discussion

Previous studies have demonstrated favorable infection control rates using CLAP in fracture-related infections and conventional periprosthetic joint infections[8,11,12]. However, megaprosthetic joint infections remain more difficult to manage because of the larger implant surface area, extensive dead

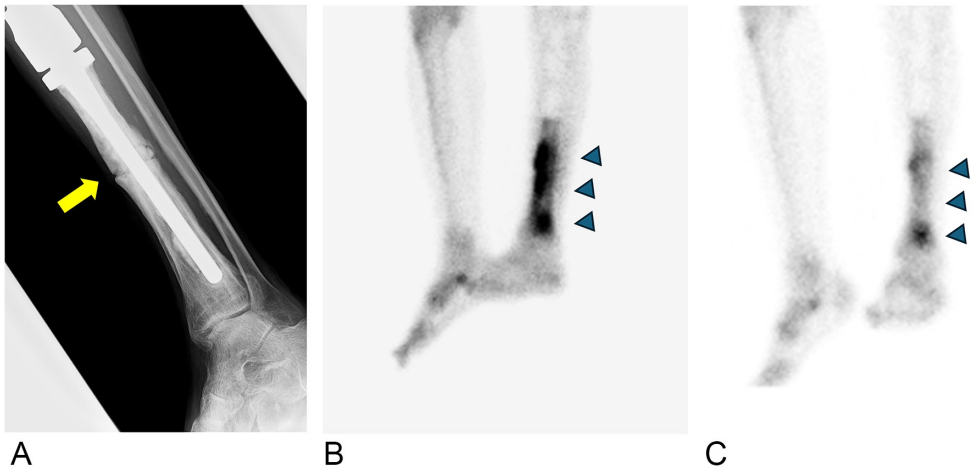


Figure 3. Follow-up imaging 6 months after continuous local antibiotic perfusion. (A) Radiograph showing resolution of moth-eaten bone resorption at the previous infection site (→). (B) Preoperative 99mTc-MDP bone scintigraphy showing intense uptake (△) in the left distal tibia around the stem, consistent with chronic osteomyelitis. (C) Postoperative 99mTc-MDP bone scintigraphy demonstrating markedly reduced uptake (△), indicating successful infection control.

space, compromised soft tissue coverage, impaired vascularity, and post-chemotherapy[2,14,15]. Compared with conventional arthroplasty infections, successful implant retention in megaprosthetic infections is less frequently achieved. To our knowledge, there are currently very few reports describing the successful use of CLAP specifically for infections involving megaprostheses. Therefore, the present case is particularly noteworthy, as it suggests that CLAP may be a valuable adjunctive limb-sparing strategy for infection control and implant preservation in selected cases of megaprosthetic infection.

Megaprosthesis reconstruction is an essential option after tumor resection; however, the extensive metallic surface and complex geometry of the prosthesis predispose it to biofilm formation, rendering infection control extremely challenging. Historically, megaprosthesis infections have been refractory to systemic antibiotics, and management often requires implant removal or even amputation[3,4,16]. Berger *et al* reported 35 cases (30%) requiring revision surgery due to periprosthetic joint infection among 114 patients who underwent tumor-type megaprosthetic reconstruction. Among patients with infection, 51% retained their implants, 37% underwent amputation, and 9% underwent arthrodesis[17]. The ability to preserve the implant in the current case is of notable clinical importance.

The key advantage of CLAP is its capacity to deliver high concentrations of antibiotics directly to the infected bone and surrounding soft tissues, even in poorly vascularized regions. This allows sustained bactericidal activity against biofilm-embedded bacteria, surpassing the efficacy of systemic or intermittent local administration[7].

The concurrent use of NPWT in the current case facilitated uniform antibiotic distribution and effective drainage, which likely contributed to the resolution of the infection. Intraoperatively, the perfusion distribution was verified by injecting povidone-iodine-containing saline to visually confirm adequate spread around the megaprosthesis and to ensure homogeneous drug delivery.

C. acnes is a low-virulence, slow-growing bacterium commonly implicated in prosthetic joints and postoperative spinal infections[18,19]. Its indolent nature often delays diagnosis and leads to chronicity. Due to its low metabolic activity, *C. acnes* is relatively resistant to conventional antibiotic therapy. The successful eradication of *C. acnes* infection in this case suggests that CLAP may be a promising strategy for managing indolent biofilm-associated infections.

Functionally, the patient in this case achieved substantial recovery, with the MSTS/ISOLS score improving from 21 (70%) to 27 (90%). Thus, CLAP controlled the infection and preserved limb function and quality of life.

Recent literature has emphasized that biofilm formation on large metallic implants significantly reduces the effectiveness of systemic antibiotic therapy, often necessitating aggressive surgical intervention. In this context, local antibiotic delivery strategies have gained increasing attention as adjunctive treatments to improve infection control while preserving limb function.

Despite recent advances in the management of megaprosthetic infections, treatment outcomes remain suboptimal because of high reinfection rates, frequent implant failure, and the substantial risk of amputation[3,16,17]. Current treatment strategies, including debridement and staged revision surgery, often fail to achieve durable implant retention in this complex patient population. Although the present case suggests that CLAP may be a promising adjunctive strategy for implant preservation, its long-term efficacy, optimal indications, and standardized treatment protocols remain unclear. Further multicenter studies with larger cohorts and longer follow-up are required to establish the role of CLAP in the management of megaprosthetic infections.

Strengths and limitations

A key strength of this case is the successful implant preservation in a delayed megaprosthesis infection using CLAP, a technique with limited prior reports.

However, this report has several limitations. First, this is a single-case report, which limits generalizability. Second, although no recurrence was observed at 1 year, longer follow-up is necessary because chronic megaprosthetic infection may recur late. Third, no control treatment was available for comparison. Further multicenter studies with longer follow-up are needed to establish the efficacy and safety of CLAP in megaprosthesis infection.

Patient's perspective

The patient expressed satisfaction with avoiding implant removal and amputation and reported significant improvement in pain and daily activities.

Conclusion

We report a rare case of delayed tibial osteomyelitis following megaprosthesis reconstruction, successfully treated with CLAP. This approach achieved infection control and implant preservation without compromising limb function. Given the complexity and limited vascularity associated with megaprosthetic reconstructions, CLAP represents a promising adjunctive strategy for managing difficult implant-related infections. Further accumulation of clinical evidence is warranted to establish its role in standard infection management protocols.

Ethical approval

Ethical approval was not required for this single-case report, according to institutional policy.

Consent

Written informed consent was obtained from the patient for the publication of this case report and accompanying images.

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Author contributions

S.N. performed the surgery, managed the patient, collected data, and drafted the manuscript. K.H. assisted in surgery and contributed to clinical management. T.I. contributed to diagnostic evaluations and clinical investigations. A.M. provided expert advice regarding CLAP therapy and infection management. K. G. supervised the study and critically revised the manuscript. All authors read and approved the final manuscript.

Conflicts of interest disclosure

The authors declare that they have no conflicts of interest.

Guarantor

Shunji Nishimura.

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Not applicable.

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