

Knee arthrodesis with modular megaprosthesis as salvage procedure for the limb following in a patient with an infected knee tumor prosthesis: A case report

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ABSTRACT

Introduction: The management of periprosthetic knee infections is a complex event, especially in the context of megaprotheses. An accepted option in these cases is knee arthrodesis, aiming to salvage the limb with acceptable and pain-free functionality. We present a successful case of knee arthrodesis using a hybrid model of modular nail-prosthesis in a patient with massive bone stock loss following the removal of an infected tumor-type prosthesis.

Case presentation: A 65-year-old male patient with a chronic periprosthetic infection related to a resection prosthesis implanted 5 years earlier, experiencing knee stiffness and presenting a massive bone stock deficit after prosthesis removal. Initial management involved an osteo-cement spacer and antibiotics, along with a transarticular external fixator. Subsequently, knee arthrodesis was performed using a hybrid model of modular nail-prosthesis, coupled with targeted antibiotic treatment. The arthrodesis was deemed successful, with a pain-free limb and no signs of infection recurrence at the 52-month follow-up.

Conclusion: In the scenario of infection and massive bone stock deficit, knee arthrodesis using intramedullary devices such as nails, megaprotheses, or hybrids is an alternative that can be successful if accompanied by appropriate medical-surgical management of the infection. This approach allows for earlier functional recovery compared to other techniques.

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Fig. 1. Radiographs with Schatzker VI tibial plateau fracture, after fasciotomies and prior to prosthesis reconstruction.

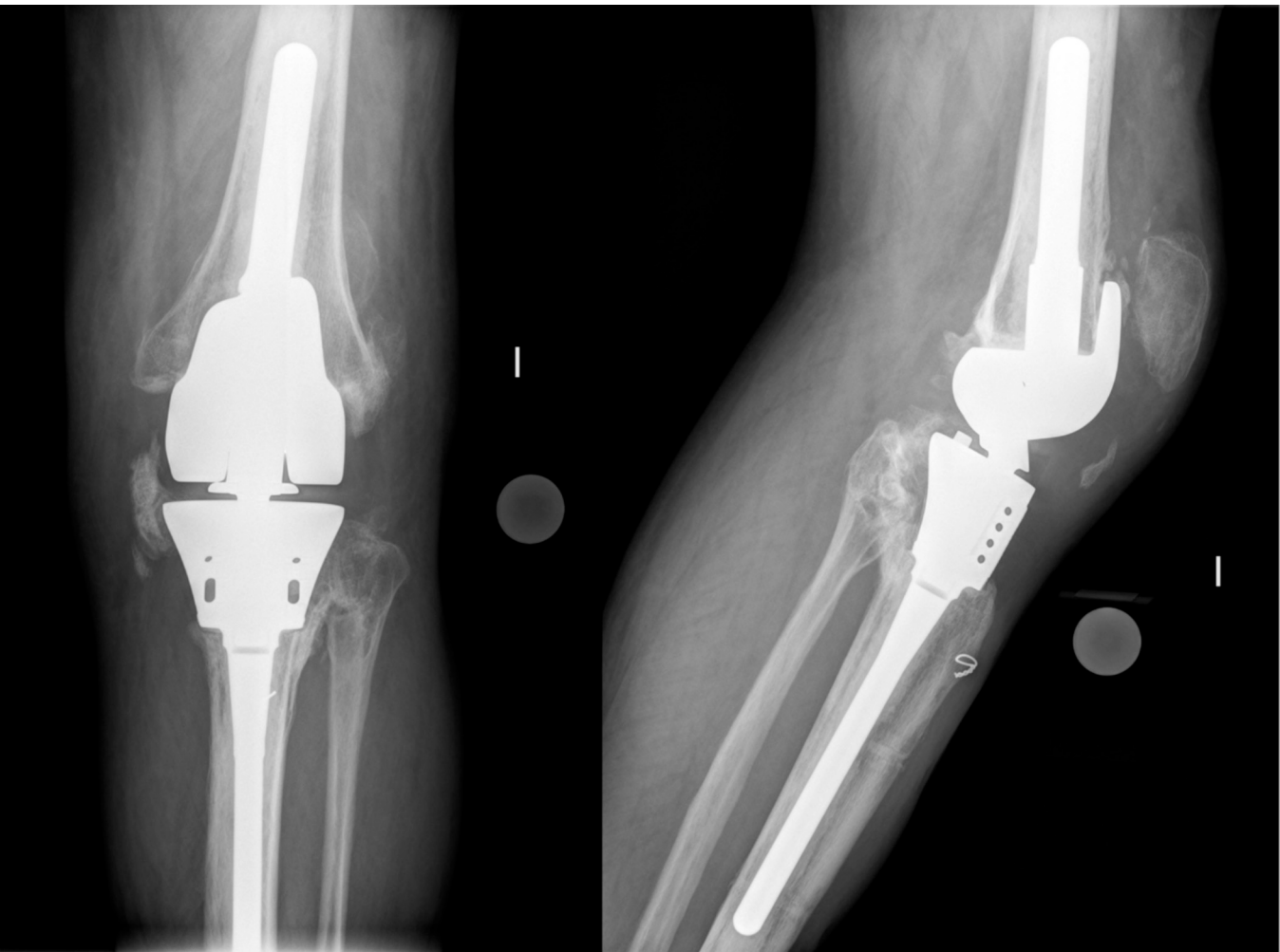


Fig. 2. Postoperative radiographs with resection prosthesis in the left knee.

Introduction

The treatment of periprosthetic knee infection is a clinically demanding event that occurs in approximately 1 % to 2 % of primary prostheses and up to 10 % of revision arthroplasties [1,2]. When this occurs in the context of patients with tumor-type megaprotheses, the scenario is even more complex, given the common loss of bone stock associated with the removal of such prostheses.

In these cases, a widely accepted option as a limb salvage measure in the face of potential amputation is knee arthrodesis (KA) [3,4], which aims to achieve a stable and painless limb.

KA can be performed using an external fixator, compression plates, or modular or monoblock intramedullary nails (IMN). All these alternatives have advantages and disadvantages. Among the advantages of using IMN is the allowance for earlier weight-bearing [5] and a higher union rate compared to external fixators [6,7]. Additionally, in cases of massive bone stock loss, modular implants allow knee fixation without the need for fusion. However, this may be associated with increased stress at their diaphyseal anchor points, with the consequent higher risk of fractures [8].

In this report, we present the successful case of KA using a hybrid model of nail-modular prosthesis in a patient with massive bone stock loss resulting from the removal of an infected tumor-type prosthesis.

Case presentation

A 65-year-old male patient with a history of arterial hypertension experienced a left tibial plateau fracture classified as Schatzker VI, coupled with ipsilateral leg compartment syndrome in 2014 following a fall from height. Initially managed elsewhere with leg fasciotomies and transeskeletal traction, he was transferred to our center after 2 months, presenting clear signs of malreduction of his fractures (Fig. 1). In this scenario, the decision was made to implement a tumor resection prosthesis OSS Orthopaedic Salvage System (Zimmer Biomet, Warsaw, Indiana, USA) (Fig. 2) to correct axis deviations and significant bone deficit. The patient developed an acute periprosthetic infection, managed through surgical debridement, antibiotic therapy, and implant retention (DAIR), successfully preserving the prosthesis. The patient was discharged at 12 months, at which point severe residual stiffness in the left knee was noted.

Five years later, in March 2019, the patient returned with a fistula and increased volume at the operative site, without associated trauma. Physical examination revealed a fistula on the anteromedial aspect of the proximal leg (Fig. 3). The knee was painless, without effusion, with a range of motion from 0° to 15°. Additionally, a laterally dislocated patella was palpated.

Laboratory tests showed a white blood cell count of 6900, erythrocyte sedimentation rate (ESR) of 41, and C-reactive protein (CRP) of 1.4 (normal value up to 1.0). *Enterococcus faecalis* was isolated from the joint fluid, sensitive to Vancomycin, Ampicillin, and Linezolid.

X-rays of the left femur, knee, and leg revealed no signs of prosthesis loosening (Fig. 4). Given the scenario of chronic periprosthetic



Fig. 3. Image of anteromedial fistula at the level of the left proximal tibia.

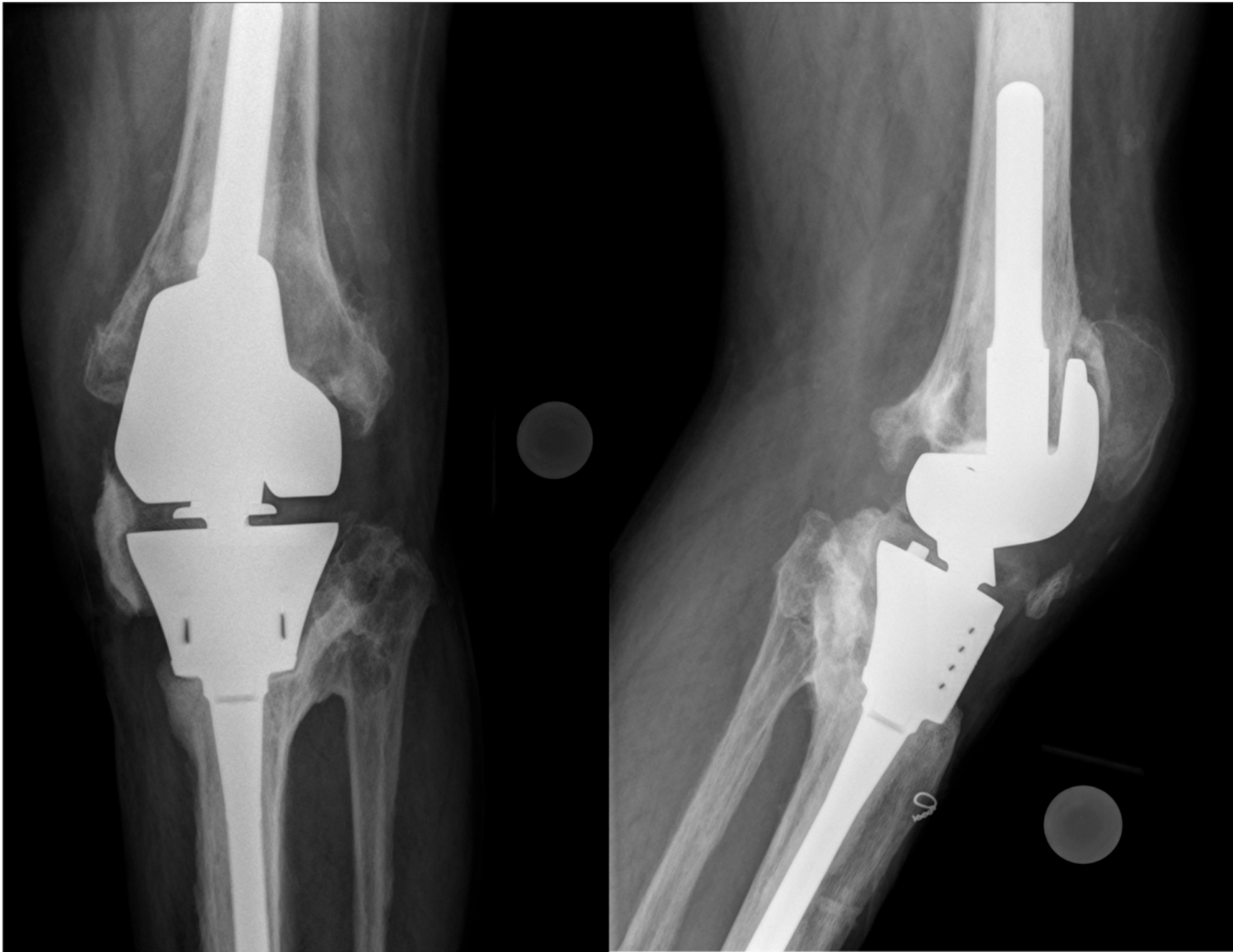


Fig. 4. Anteroposterior and lateral radiographs of the left knee at the time of fistula presentation. Noteworthy, dislocated patella.



Fig. 5. Postoperative tomography after prosthesis removal. External fixator and cement spacer installed. Massive bone stock loss.

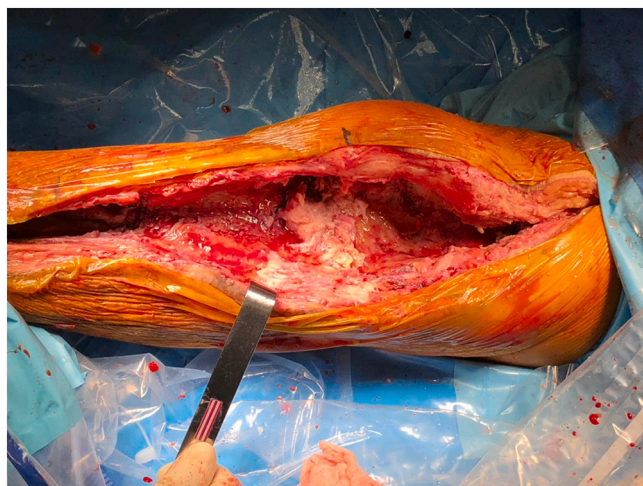


Fig. 6. Intraoperative image after removal of external fixator and cement spacer. Massive 31 cm bone defect.

infection, severe knee stiffness, and inveterate patellar dislocation, our team opted for a two-stage KA with IMN.

In the first surgical stage, the infected tumor prosthesis, which showed no signs of loosening, was removed, resulting in a significant bone defect of approximately 31 cm (cm). Surgical cleaning was performed, and a cement spacer containing Vancomycin was placed, stabilized with a transarticular knee external fixator (Fig. 5). Intraoperative cultures were positive for *Enterococcus faecalis*. After 2 months of intravenous antibiotic treatment with Ampicillin, the second surgical stage was carried out.

Through a broad anterior approach, total patellectomy and removal of the cement spacer were performed, revealing a complete bone defect from the healthy distal femur to the tibia, measuring 31 cm (Fig. 6). Subsequently, after thorough surgical cleaning and debridement, perpendicular cuts were made in the distal femur and tibial diaphysis.

In this context, given the extensive bone defect, the decision was made to use a hybrid model of nail-modular prosthesis, specifically the Endo-Model Link® (Waldermar Link, Hamburg, Germany). Following progressive reaming in the femur and tibia, a trial nail-prosthesis was installed, and finally, the modular arthrodesis nail Endo-Model Link® was implanted, modified with a diaphyseal replacement module of 10 cm, proximal midsection of 10 cm with a cemented 14 mm × 13 cm femoral stem, and tibial midsections of 5 and 6 cm with a cemented 12 mm × 13 cm tibial stem (totaling 31 cm of bone replacement) (Fig. 7). Third-generation cementation was utilized. The plastic surgery team provided definitive coverage during the same surgical session using a medial fasciocutaneous advancement flap and a bipedicle fasciocutaneous advancement flap. Cultures taken during surgery were negative.

The patient progressed favorably throughout the remainder of the hospitalization, completing 1 month of intravenous antibiotic treatment with Ampicillin and subsequently 3 months of oral antibiotics (Amoxicillin). After 52 months of follow-up, the patient remains in good condition, free of pain, ambulating adequately with the use of a single cane, without infection recurrence (Fig. 8), and with radiographs indicating appropriate fusion of the arthrodesis (Fig. 9) and a lower limb length difference of 22.1 mm (Fig. 10).

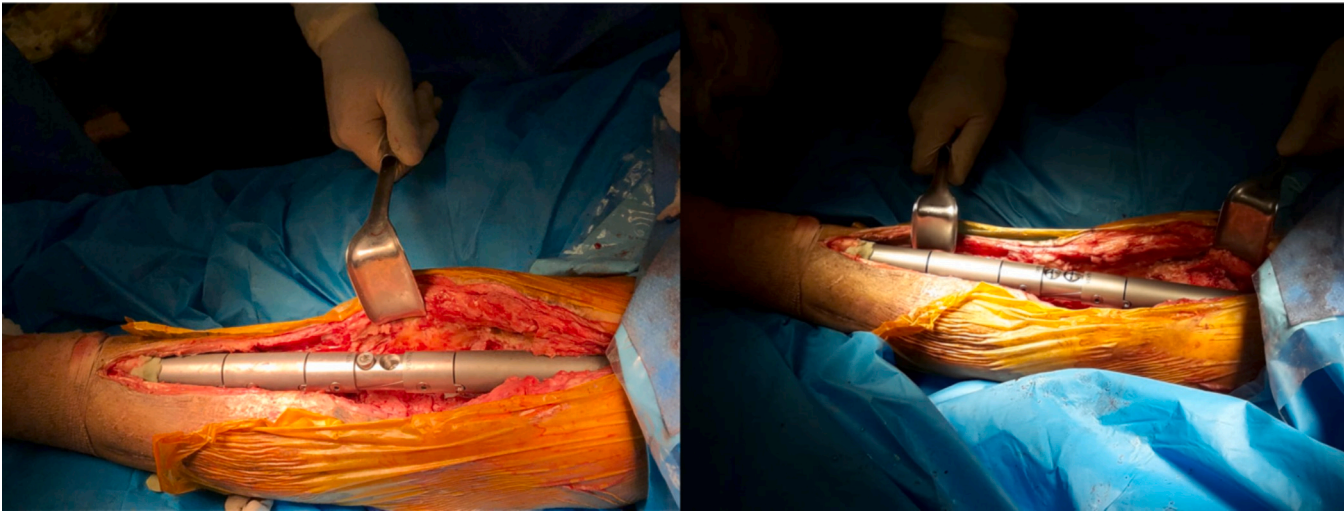


Fig. 7. Intraoperative image of the installation of Endo-Model Link® modular nail-prosthesis for left knee arthrodesis.



Fig. 8. Patient at 52 months of follow-up, showing no clinical signs of infection recurrence.



Fig. 9. Lateral knee radiograph displaying fused arthrodesis.

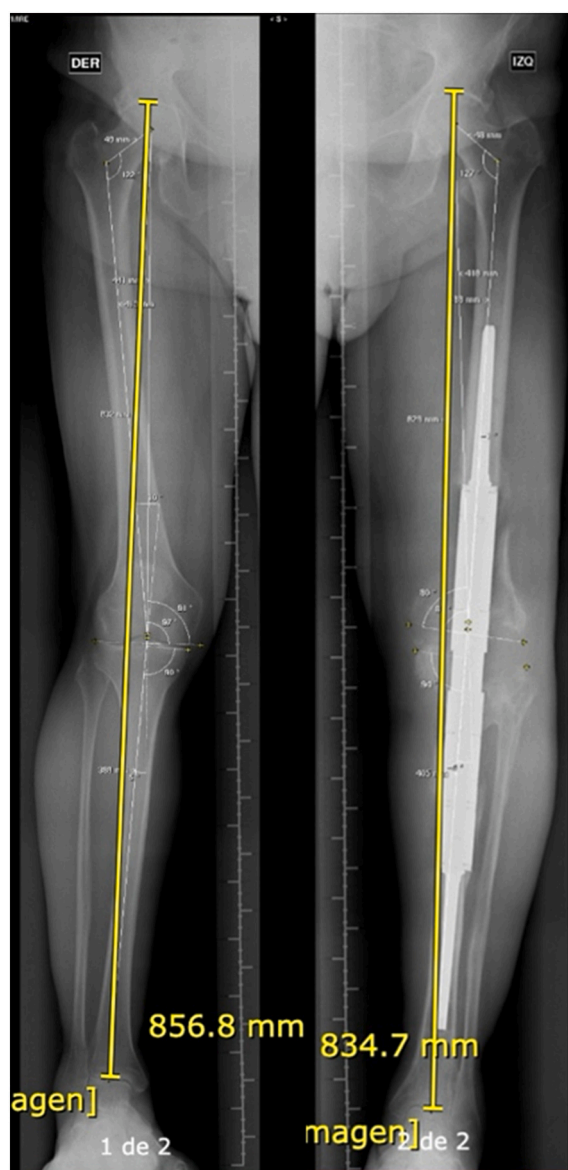


Fig. 10. Full-length teleradiographs illustrating a 22.1 mm discrepancy in limb length between both lower extremities.

Discussion

Periprosthetic knee infection occurs in 0. [4]2% of primary prostheses, but in high-risk cases such as surgeries performed in trauma contexts, incidences of up to [5]15% are reported [9]. This complication represents one of the most challenging scenarios for an orthopaedic surgeon, especially when it occurs in a patient with significant bone defects, coverage deficits, or joint instability, as management options in such cases are limited. Among the choices are debridement and exchange of modular prosthesis components or prosthetic replacement. However, in cases where a new revision is no longer feasible, salvage surgeries such as supracondylar amputation or arthrodesis become the available alternatives.

Regarding arthrodesis, there are multiple techniques for its implementation, including external fixators, locking plates, or intramedullary nails (IMN). Modern devices come with modular components. Among the mentioned alternatives, the implant of choice for patients with significant bone defects is the intramedullary nail. These not only allow for early weight-bearing but also make it feasible to restore limb length [10]. As mentioned earlier, one of the additional advantages of using IMN is the observed higher union rate compared to external fixators [6,7].

When comparing arthrodesis with supracondylar amputation, the literature is contradictory, but in general, no significant differences are observed in functional outcomes or quality of life. Complications reported for both procedures are similar (20–30 %), with persistent infection being the main issue [11]. Regarding mortality, the literature reports higher mortality in amputated patients with

periprosthetic infections compared to those managed with arthrodesis. This may be partly due to amputation being the preferred approach in patients with a systemic compromise due to infection [12].

The presented case exemplifies a successful KA in the context of infection and massive bone stock loss, addressing a situation where the choice between amputation and arthrodesis must be made. This decision is always challenging, as presented in the literature, where clear advantages of one over the other are not evident. In this instance, the decision is made to use a nail-prosthesis for arthrodesis, considering the patient's preference to preserve the limb. Another point considered is that, prior to the infection, the patient already had a rigid knee arthroplasty (ROM 0°–15°) with an inveterate dislocation of the patella, leading us to believe that amputation would have meant a greater loss of functionality compared to what the patient was already accustomed to.

Conclusion

The management of periprosthetic knee infections is always a complex clinical situation, often requiring a stepped and multi-disciplinary approach. In the case of an infection involving a megaprosthesis, the added challenge lies in addressing the resolution of massive bone stock deficits. In these cases, KA emerges as an alternative that provides enhanced functionality for the patient compared to above-knee amputation. The use of intramedullary devices such as IMN, megaprotheses, or hybrids can be successful when accompanied by appropriate medical-surgical management of the infection, enabling earlier functional recovery for the patient compared to other arthrodesis alternatives like external fixators or plates.

Additionally, prolonged clinical follow-ups are necessary in these cases, given the underlying risks of infection recurrence or long-term fractures.

Source of support

None.

CRedit authorship contribution statement

Rodrigo Olivieri: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Nicolás Franulic:** Writing – original draft, Investigation, Data curation. **Felipe Amoedo:** Investigation, Data curation. **José I. Laso:** Resources, Investigation. **Tania Rojas:** Resources, Data curation. **Carlos Rojas:** Resources, Methodology, Investigation. **Nicolás Gaggero:** Writing – review & editing, Validation, Supervision.

Declaration of competing interest

The authors declare no conflicts of interest regarding this case report.

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