

Megaprotheses and custom-made implants in complex cases of revision surgery after TKA

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Conflict of interest

The authors have no conflict of interest to declare.

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SUMMARY

The use of megaprotheses or custom-made devices is an established treatment for orthopedic malignancies, but their indication has been expanded to some non-neoplastic conditions such as complex cases of re-revision surgery or failed osteosynthesis. A consecutive series of 5 patients were treated with megaprotheses as a solution for complex cases of re-revision surgery around the knee joint. Each patient was assessed clinically and radiographically at 1, 3, 6, and 12 months after surgery. One patient died for intestinal infarction after surgery. The 4 remaining patients resumed gait and knee function. We did not observe infections or mobilizations of the implants, and the only complication we described was patellar dislocation of the extensor mechanism when the implant with proximal tibia resection was used. Complex re-revision surgery after TKA represents a major challenge for the orthopedic surgeon due to poor bone stock and the presence of prosthetic revision components. The implant of megaprotheses or custom-made devices can play a crucial role in these rare but complex cases of non-oncological orthopedic surgery ensuring early functional recovery.

Key words: periprosthetic fracture, surgical revision, total knee replacement

Introduction

The use of megaprosthesis or endoprosthesis replacement is a widely accepted modality for the treatment of orthopedic malignancies. These devices are a promising alternative that can restore joint function, with rapid recovery and allowing for limb salvage¹. The indications for megaprosthesis implantation have been broadened to the treatment of selected non-neoplastic conditions of the hip and knee, all characterized by critical size bone defects such as acute trauma in severe bone loss and poor bone quality, post-traumatic failures and major bone loss in both aseptic and septic prosthetic revision, periprosthetic fractures with component mobilization, and poor bone stock condition and resistant non-unions despite multiple surgeries²⁻⁵. Massive bone loss can pose a significant challenge especially in revision knee arthroplasty (RKA) with distal femoral replacements that may allow for early mobilization and quicker return to function¹. It should be noted that along with the increasing number of total knee arthroplasties (TKAs) and the extended life expectancy of patients, the incidence of complications is also increasing, and their management can be challenging for the orthopedic surgeon. There are very

few systematic reviews available on proximal or distal femoral replacement for treatment of non-neoplastic conditions; however, it is widely accepted that megaprotheses can be used as a salvage procedure in case of massive bone loss with an acceptable long-term outcome that is superior or at least comparable to the neoplastic conditions.

The aim of this study is to describe our experience in the management of complex non-neoplastic conditions after TKA associated with severe bone loss.

Description of the case report

We chose to implant a megaprosthesis in a consecutive series of 5 patients as a solution for the treatment of complex cases of non-neoplastic conditions: 3 periprosthetic comminuted fractures of the distal femur, 1 septic mobilization of TKA and 1 non-union of periprosthetic fracture after TKA. Each patient (5 women, average age 78 years old) was assessed clinically with the Knee Society Score (KSS) and radiographically at 1, 3, 6 and 12 months after surgery.

Case 1

Case 1 was a 77-year-old woman who underwent right TKA for degenerative osteoarthritis at another hospital. Ten years later she underwent revision surgery for aseptic loosening of the TKA and a cemented constrained knee prosthesis was implanted. In 2018, she arrived at our emergency room after an accidental fall. Plain radiographs showed a periprosthetic fracture of the femoral shaft with mobilization of the femoral component. Surgery was performed eight days after admission and a cemented femoral megaprosthesis was implanted (Megasystemc®, Waldemar Link GmbH & Co. KG, Hamburg, Germany). After surgery, she was allowed early mobilization and full weight bearing. The post-operative course was characterized by the need for blood transfusion, and no other complications were observed. At 12-months follow-up (FU) she was able to walk using a cane only for long strokes. She felt only mild knee pain when climbing up stairs. Radiographs were unremarkable.

Case 2

Case 2 was an 81-year-old woman who underwent bilateral TKA and left THA for degenerative osteoarthritis at another hospital. In 2019, she visited our emergency room after an accidental fall; plain radiographs showed periprosthetic fracture of the left distal femur and signs of loosening of the TKA components. She was admitted to our Department and was submitted to pre-operative tests and pre-anaesthetic consultation. She suffered from medium-severe aortic stenosis and she previously had an episode of deep vein thrombosis of the left gastrocnemius veins. The anesthesiologist evaluated the patient to be at high-risk because of her comorbidities and recommended to

take the patient to the intensive care unit after surgery. Surgery was performed 20 days after admission; she was implanted a megaprosthesis with both distal femoral and proximal tibial resection (WLink Megasystem C). Additionally, considering the potentially stressed area between the two taproots in the femoral shaft, a preventive fixation with plate and cerclages was performed. At 12-month FU she was able to walk with a cane and climb up and down stairs with rail.

Case 3

Case 3 was a 72-year-old woman who suffered from osteomyelitis of the left lower limb at a young age. The disease resulted in severe knee pain and ankylosis of the knee junction. In May 2019, she underwent surgery with the implant of a constrained TKA and wedge femoral osteotomy at another hospital. Two months later, pseudoarthrosis of the osteotomy was observed. The patient underwent surgery for internal fixation with peri-prosthetic plate. In April 2020, she visited our emergency room and a periprosthetic joint infection (PJI) was diagnosed. She was admitted to the medical ward to start antibiotic treatment and a two-stage revision was planned. Eight days after admission she underwent surgery to remove the implants and place an antibiotic-loaded spacer. Intra-operative cultures were positive for *Enterococcus avium* and methicillin-susceptible *Staphylococcus aureus* (MSSA), and antibiotic treatment was based on susceptibility testing; the patient was administered daptomycin, meropenem, clindamycin, and linezolid for 8 weeks. In August 2020, the patient underwent second-stage revision surgery and an arthrodesis custom-made prosthesis was implanted. On post-operative day one, patient died for intestinal ischemia.

Case 4 (Figs. 1-2)

Case 4 was an 85-year-old woman who underwent right TKA for degenerative osteoarthritis at another hospital 20 years prior. In 2019, she underwent elsewhere internal fixation with a plate and screws for a periprosthetic femoral fracture (Fakler type A-I). She then arrived at our attention with a clinical picture of non-union of the periprosthetic fracture. She has been wheelchair bound for eight months. To our opinion, given the bone defect and poor bone quality, the only viable option was distal femur resection and a megaprosthesis. She was a high-risk patient, and was taken to the intensive care unit after surgery for 24 hours. The post-operative course was characterized by the need for blood transfusion and an episode of atrial fibrillation and rapid ventricular response. She was allowed early mobilization and full weight-bearing, and was able to walk with a walking frame during the hospital stay. The patient followed the scheduled assessment up to 12 months.

Case 5

Case 5 was a 77-year-old woman who already underwent



Figure 1. Case # 4. A-B) Pre-operative X-Rays showing non-union of the periprosthetic femoral fracture; antero-posterior (A) and lateral (B) views; C-D) Post-operative X-rays demonstrating distal femur resection and megaprosthesis implantation; antero-posterior (C) and lateral (D) views.

multiple revision surgeries because of septic loosening of her left TKA. During the last surgery, a constrained cemented knee prosthesis was implanted, and she suffered from common popliteal nerve palsy which caused drop left foot and gait impairment. In July 2019, after a minor trauma she experienced a periprosthetic femoral fracture (Fakler type C-II); she was admitted to our department. Given the presence of a stemmed cemented knee prosthesis and the type of fracture (Fakler type C-III), in our opinion the only viable surgical option was to implant a megaprosthesis with both femoral and tibial resection. At 12 month follow-up she had gained complete functional recovery of the knee and was

able to walk with a cane. At the last radiographic assessment, we described the dislocation of the extensor mechanism of the leg.

All patients, except for one who deceased, resumed gait and knee function. We observed progressive improvement in knee function. At 12-month FU we did not observe any infection or aseptic loosening of the implant, and the only complication we noted was dislocation of the extensor mechanism when the implant with proximal tibia resection was used. The average clinical assessment measured with the Knee Society Score was 72.25. Table I shows the scores obtained at each clinical assessment in detail.

Table I. Knee Society Score at each clinical assessment.

Case	1 month	3 months	6 months	12 months
1	54	65	77	77
2	56	56	66	66
3	56	66	77	78
4	42	48	67	68
Mean	52	58.75	71.75	72.25

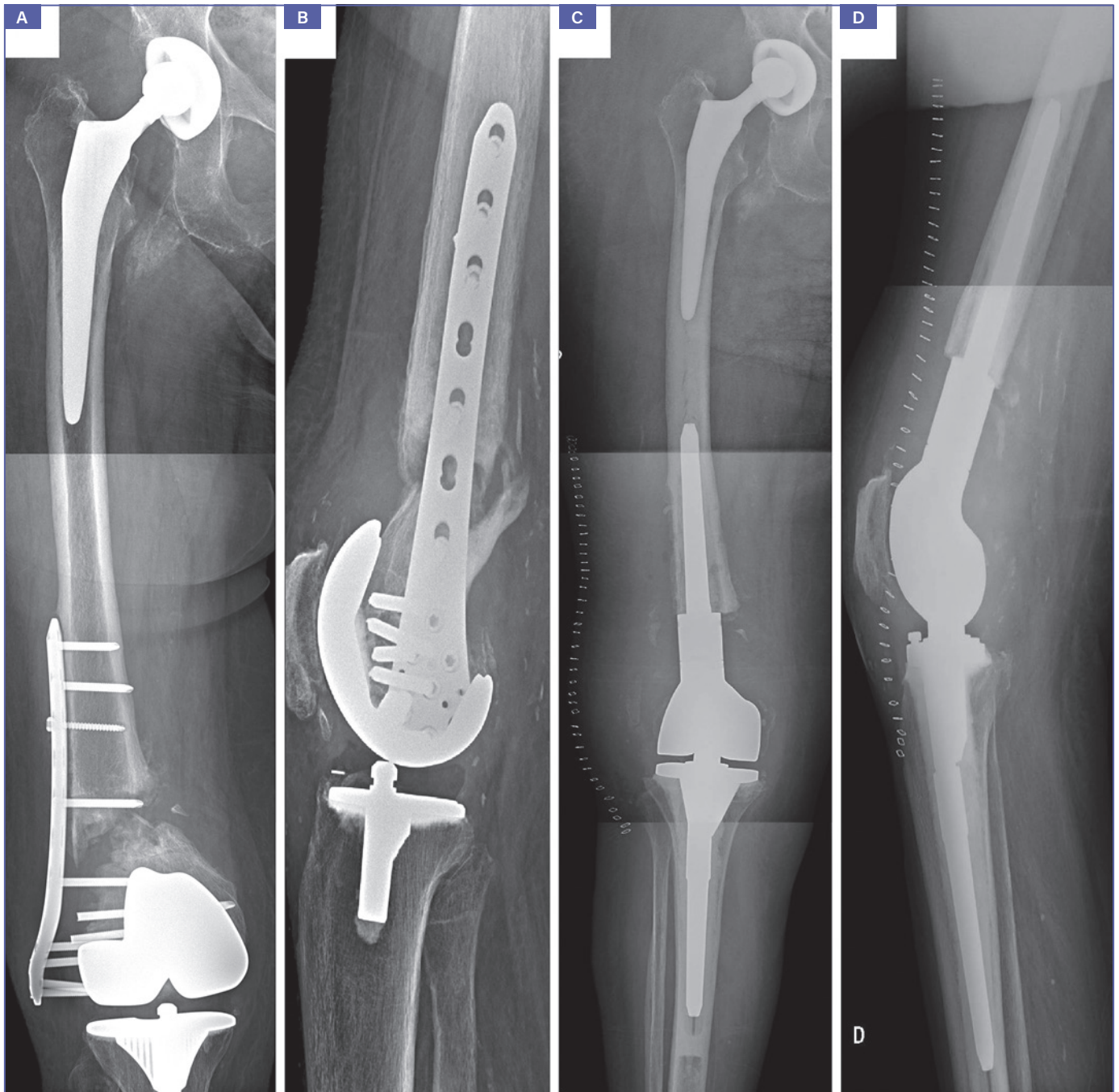


Figure 2. Case report # 4 evaluation at 12-months. X-ray examination in antero-posterior (A) and lateral (B) view. Clinical assessment of total range of flexion (C) and extension (D).

Discussion

Implanting megaprotheses or custom-made devices in complex cases of revision surgery after TKA is certainly an exceptional indication, as shown by the small numbers of cases and the few studies published on the topic. Nowadays, patients are

exposed to a major risk of revision surgery due to trauma or septic/aseptic mobilization given the increase in both the number of first implant prosthesis and the earliness of the implant itself. The main points to be considered to deal with these complex cases are the type of the implant⁵ and the patient's bone quality. In fact, revision implants are directly responsible for

reduction of the bone stock. The management of these patients is therefore more difficult and has fewer feasible solutions than complex periprosthetic fractures on total hip arthroplasty. Limb salvage and preservation of joint function and the prospect of rapid mobilization are the major advantages of distal femoral replacement for patients that have previously undergone total knee arthroplasty ². This could be especially true for geriatric patients or those with reduced physical conditions who are not able to adhere to protected weight bearing and who may be mobilized sooner ⁴. This study shows that megaprotheses in end-stage revision knee arthroplasty can provide good functional outcomes and allow for limb salvage. At any rate, there is a need to highlight that this kind of surgery is at high risk of mortality, and must be reserved only for selected cases and be performed in specialized centers.

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