



Advanced Reconstructive Approach for Recurrent Giant Cell Tumor of the Proximal Tibia: A Case Emphasizing Functional Limb Salvage with Megaprosthesis, Synthetic Extensor Repair, and Flap Coverage

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Received: September 10, 2025

Published: October 10, 2025

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Abstract

Background: Giant cell tumor (GCT) of the proximal tibia can be locally aggressive and prone to recurrence after standard curettage. In cases with multiple recurrences, limb preservation becomes increasingly challenging due to compromised soft tissue and extensor mechanism integrity. This case report highlights a multimodal reconstructive strategy following wide resection, showcasing the value of integrating synthetic tendon reconstruction with reliable soft tissue coverage to preserve knee function.

Case Presentation: A 38-year-old male presented with a second recurrence of GCT in the proximal tibia, despite two previous curettage and cementing procedures. Imaging confirmed aggressive local recurrence with cortical and soft tissue involvement. The patient underwent wide resection and implantation of a rotating-hinge megaprosthesis. Given partial patellar tendon excision, a polyethylene terephthalate (PET) mesh tube was used to reconstruct the extensor mechanism. To minimize postoperative complications and ensure durable prosthetic coverage, a medial gastrocnemius flap was used. At six months, the patient exhibited full active knee extension without lag, 95° flexion, and independent ambulation.

Conclusion: This case underscores the importance of a comprehensive limb-salvage approach when managing recurrent GCT. Combining synthetic tendon scaffolding with vascularized flap coverage offers a promising solution for preserving knee extension and functional mobility in patients requiring extensive proximal tibial resection.

Keywords: Giant Cell Tumor; Proximal Tibia; Megaprosthesis; Polyethylene Terephthalate; Extensor Mechanism; Gastrocnemius Flap; Limb Salvage Surgery

Abbreviations

GCT: Giant Cell Tumor; PET: Polyethylene Terephthalate; MRI: Magnetic Resonance Imaging; CT: Computed Tomography; DVT: Deep Vein Thrombosis

Introduction

Giant cell tumor (GCT) of bone is a benign but locally aggressive neoplasm with a predilection for the epiphyses of long bones. The proximal tibia is a common site, and while initial curettage and cementing can be effective, recurrence remains a significant clinical

cal concern. Rates of recurrence following intralesional treatment have been reported as high as 30% [1-3]. With each recurrence, the complexity of treatment increases due to destruction of bone, joint surfaces, and critical soft tissues.

Management of recurrent GCT in the proximal tibia is especially difficult given the need to preserve knee joint function. Resection often involves the patellar tendon, compromising the extensor mechanism essential for activities such as walking, rising from a seated position, and stair climbing. In addition, the anterior tibia has limited soft tissue coverage, increasing the risk of prosthetic exposure and infection.

Reconstructive options after resection must address skeletal support, restoration of extensor continuity, and robust soft tissue coverage. This report details the successful integration of a rotating-hinge megaprosthesis, synthetic PET mesh for patellar tendon reconstruction, and a vascularized medial gastrocnemius flap to restore form and function in a patient with recurrent GCT. This approach emphasizes the critical interplay of orthopedic oncology, reconstructive surgery, and functional rehabilitation.

Case Presentation

A 38-year-old male presented with localized swelling, pain, and limited range of motion in his left knee. He had a history of two previous surgeries involving curettage and cementing for histologically confirmed GCT of the proximal tibia. MRI revealed an expansile lytic lesion involving the metaphysis and extending into adjacent soft tissue, with cortical thinning and breach. CT chest was clear for pulmonary metastases.

Following tumor board discussion, the decision was made to proceed with wide resection of the proximal tibia and limb salvage using a modular megaprosthesis. Due to tumor involvement of the patellar tendon, partial resection of the tendon was required.

Surgical technique

Through a standard anteromedial approach, the proximal tibia was resected with a 3-cm margin. A rotating-hinge megaprosthesis was cemented into place. Since the patellar tendon had to be detached from the tibia during resection, the challenge was to re-establish a stable platform strong enough to bear extensor mechanism forces. To address this, a tubular polyethylene terephthalate

(PET) mesh was sutured securely around the megaprosthesis. The patellar tendon was then reattached to this PET construct, creating a durable interface between the tendon and prosthesis while maintaining the knee in full extension.

For soft tissue coverage, a pedicled medial gastrocnemius muscle flap was rotated over the anterior prosthesis and PET tube, followed by a split-thickness skin graft. Negative pressure wound therapy was used to promote graft adherence and minimize infection risk.

Postoperative care and follow up

The knee was immobilized in extension for 6 weeks. The patient began isometric quadriceps exercises after 2 weeks, followed by gradual range-of-motion and weight-bearing training. Antibiotics and DVT prophylaxis were continued per institutional protocol.

At the 6-month review, the patient was able to walk without support, had full active knee extension, and a flexion range of up to 95 degrees. There were no signs of local recurrence or hardware complications. The flap remained viable with complete graft uptake.

Discussion

This case illustrates the surgical complexity associated with recurrent GCT of the proximal tibia and the value of combining multiple reconstructive strategies. Wide resection is necessary to prevent further recurrence, but it results in significant structural and functional deficits.

Megaprotheses are a reliable solution for skeletal reconstruction following large bone resections, offering immediate structural stability and allowing early mobilization [4]. However, successful limb salvage hinges on restoration of the extensor mechanism. The patellar tendon, when partially or fully resected, poses a significant challenge. The use of PET mesh provides a synthetic scaffold that allows for gradual integration while immediately restoring continuity. It has been utilized in knee arthroplasty and tumor surgery with promising results [5-7].

Furthermore, the anterior proximal tibia lacks sufficient soft tissue coverage, and exposure of the prosthesis increases the risk of infection, which is a leading cause of implant failure [8,9]. The medial gastrocnemius flap is the preferred option due to its proximity,

reliable vascularity, and ease of rotation. This flap not only covers the implant but also supports tissue healing and reduces infection rates [9,10].

Importantly, this case emphasizes how coordinated orthopedic and reconstructive surgical planning can allow patients to retain limb function even after multiple recurrences. The favorable outcome in this case such as functional recovery, absence of complications, and excellent cosmetic result reinforces the importance of a multidisciplinary and technically nuanced approach in modern limb salvage surgery.

Conclusion

Managing recurrent GCT of the proximal tibia requires more than tumor resection-it requires a strategic approach to restore function and minimize complications. The integration of a megaprosthesis for bony reconstruction, PET mesh for synthetic extensor repair, and medial gastrocnemius flap for soft tissue coverage provided excellent structural and functional outcomes in this complex case. This approach may serve as a valuable model for future limb salvage reconstructions in orthopedic oncology.

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