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CASE REPORT

Lateral Tibial Plateau Reconstruction using a Pedicled Patellar Transplant in a Male Patient with a Recurrent Fungating Giant Cell Tumor: A Case Report

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ABSTRACT

Reported here is a surgical approach to a recurrent fungating giant cell tumor in a 35-year-old male. The patient presented with a lytic lesion on the epiphysis extending to the metaphyseal area of the lateral tibial plateau. Reconstruction was done using a pedicled patellar transplant following an extended curettage of the affected area. This was augmented with a suture anchor, a non-vascularized fibular strut graft, synthetic bone grafts, and soft tissue reconstruction.

Keywords. D'Aubigne, pedicled patellar transplant, lateral tibial plateau reconstruction, recurrent giant cell tumor

INTRODUCTION

This case report describes the treatment of a giant cell tumor (GCT) in the proximal tibia of a male adult, utilizing the D'Aubigne procedure. GCTs in weight-bearing areas like the proximal tibia are challenging because removing the tumor must be balanced with preserving joint functionality.[1] The D'Aubigne procedure, involving a pedicled patellar transplant, uniquely addresses these challenges by eradicating the tumor and reconstructing the joint, thereby maintaining limb functionality and reducing recurrence risk.[2] This case highlights the importance of specialized surgical techniques in orthopedic oncology, particularly for tumors in critical locations, emphasizing the need for both functional preservation and effective tumor management.

CASE

A 35-year-old male construction worker noted a progressively enlarging mass on the lateral aspect of his right knee beginning eight years before the consultation. There was no pain or limitation of motion. Eight months before being seen at our institution, he consulted a local clinic and underwent an excision biopsy of the mass. After two months, the wound dehisced, and the mass recurred and subsequently increased in size. After another four months, he consulted another tertiary hospital, where an MRI was requested and an incisional biopsy was performed, revealing a giant cell tumor. One week before admission, he suddenly experienced generalized body weakness and dizziness, accompanied by occasional blurring of vision. The patient was seen by the internal medicine service and was diagnosed with severe anemia, prompting admission to our institution.

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Patient was then referred to the orthopaedic oncology service for co-management of his right knee mass.

Physical examination revealed a 12 x 15 x 23 cm mixed soft to firm, non-mobile, non-tender, fungating mass on the lateral aspect of the patient's right knee with minimal bleeding and foul-smelling discharge (Figure 1). No sensory and motor deficits were noted on the right lower extremity, and the distal pulses were full and equal.

On radiographs, there was a large osteolytic lesion on the epi-metaphyseal region of the right lateral proximal tibia, with neocorticalization, a cortical break, and no matrix. There was also a large soft tissue shadow on the lateral aspect of the right knee (Figure 1D and 1E). Magnetic resonance imaging of the same knee showed involvement of the articular margin of the lateral proximal tibia with soft tissue extension of the mass (Figure 2).

A repeat incisional biopsy on the soft tissue was performed, revealing a keratinous cyst, infiltrated with foreign body giant cell reaction and granulation tissue formation. A chest CT scan with IV contrast revealed no abnormal enhancements or pulmonary nodules.

He was then diagnosed with a giant cell tumor of the right proximal tibia, Campanacci grade III, Enneking stage 3. His pre-operative musculoskeletal tumor society score was 1, denoting poor function (Table 1).[2,3]

SURGICAL TECHNIQUE

The patient was induced via general anesthesia and positioned supine with a tourniquet on the ipsilateral thigh. A wide resection of the mass was performed, identifying and preserving the common peroneal nerve. The cavitary lesion was curetted. The articular surface of the lateral tibial plateau up to the lateral aspect of the lateral tibial spine was excised. An extension of the mass to the fibular head was found and resected. The anterior cruciate ligament and lateral meniscus were also removed. Local adjuvant treatment was performed with a high-speed burr and 10% phenol (Figure 3). Instruments, drapes, and gloves were changed to avoid contamination prior to reconstruction.

Figure 1. Pre-operative assessment of the right knee: **(A)** Anterior, **(B)** posterior, and **(C)** lateral views of the right knee, displaying a 12 x 15 x 23 cm fungating necrotic mass on the lateral aspect of the proximal tibia. Radiographic images including **(D)** anteroposterior and **(E)** lateral views, reveal a large osteolytic lesion on the epiphysis extending into the metaphysis of the lateral proximal tibia, characterized by neocorticalization and a pronounced soft tissue shadow.

Table 1. Musculoskeletal Tumor Society (MSTS) Scoring System for Functional Assessment in Orthopedic Oncology, indicating the preoperative score of the patient at 1 out of 30, denoting poor function

	Pain	Function	Emotional	Support	Walking	Gait
5	No Pain	No restriction	Enthused	None	Unlimited	Normal
4	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
3	Modest/Non-disabling	Recreational restriction	Satisfied	Brace	Limited	Minor cosmetic
2	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
1	Moderate/Disabling	**Total restriction**	Accepts	One cane or crush	Inside only	Major cosmetic
0	**Severe disabling**	Total restriction	**Dislikes**	**Two canes of crutches**	**Not independently**	**Major handicap**

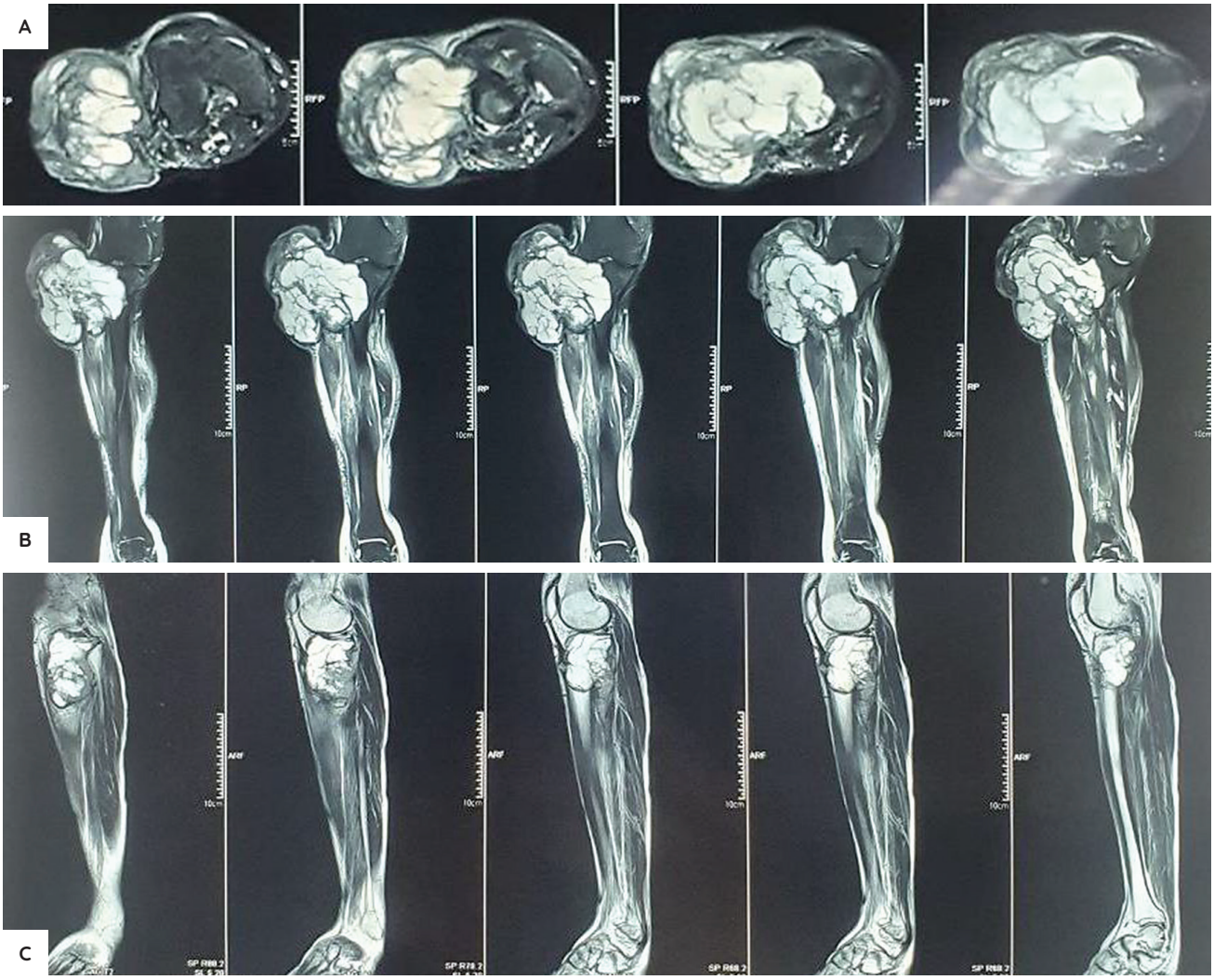

Figure 2. MRI with contrast of right knee in axial **(A)**, coronal **(B)**, sagittal **(C)** planes, showing an edematous marrow signal involving the lateral metaphyseal-diaphyseal region of the proximal tibia, measuring approximately 8 x 10 x 13 cm. The full extent of the lesion is illustrated: axial cuts **(A)** show cross-sectional spread, coronal cuts **(B)** show extent of involvement of the lateral proximal tibia, and sagittal cuts **(C)** reveal the anteroposterior extent.

The lateral tibial plateau was reconstructed using a pedicled patellar transplant. A midline incision exposed the quadriceps tendon, patella, and patellar tendon. The patella was separated from the quadriceps tendon, patellar tendon, and medial retinaculum with a 3-cm-wide cuff, leaving a 3-cm-wide muscular pedicle attachment to the vastus lateralis (Figure 4). The inferior pole of the patella was freshened and placed adjacent to the medial aspect of the proximal tibia, with the superior pole oriented laterally. The articular surface of the patella acted as the new weight-bearing lateral surface of the tibia. Two 4.0-mm cannulated cancellous tip threaded screws with washers were inserted from lateral to medial to fix the patella to the medial tibial plateau. The remaining fibula was harvested, leaving a distal length of 5 cm from the distal tibiofibular joint. Four fibular strut grafts were inserted and fixed with cortical screws in the gap between the patella and the tibial diaphysis. Synthetic bone graft with iliac crest bone graft was also inserted between the strut grafts and the tibia (Figure 5).

For the extensor mechanism repair, we isolated a 3 cm wide x 10 cm long distally based strip of rectus femoris from the quadriceps. We then used an absorbable suture to approximate the gap within the rectus femoris strip. We flipped the rectus femoris and attached it to the patellar tendon with a Krackow suturing technique, then augmented it with a suture anchor into the tibia shaft with the knee in 30 degrees of flexion.

The soft tissue defect was closed using a lateral gastrocnemius flap and a split-thickness skin graft from the contralateral thigh. We placed a drain and immobilized the lower extremity for six weeks in a half-cylinder splint with the knee flexed at 30 degrees (Figure 6). The patient was advised not to bear weight on the limb until radiologic signs of healing were seen.

Seven days post-operatively, the gastrocnemius flap was viable, with 90% take of the split-thickness skin graft, no wound dehiscence, and no signs of infection. The patient was sent home after one more week. The histopathology report of

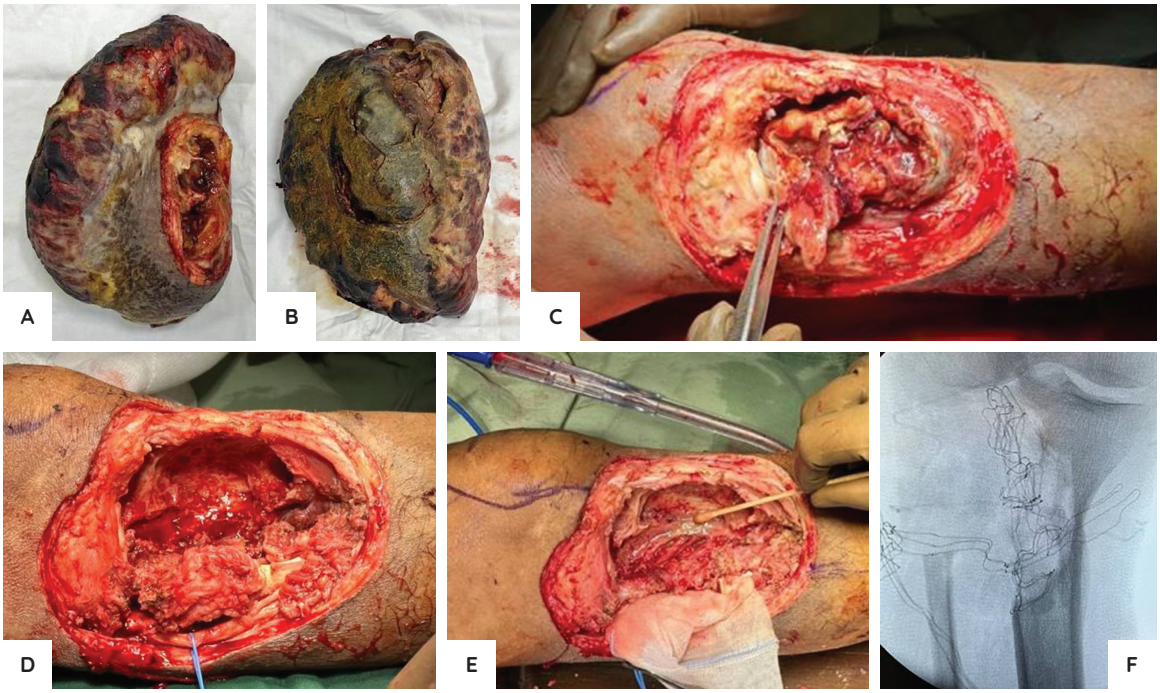

Figure 3. Surgical procedure overview: **(A)** and **(B)** show the resected soft tissue mass measuring 12 x 15 x 23 cm, featuring necrotic foci. **(C)** Removal of the necrotic portion of the bone tumor. **(D)** Resection of the fibular head. **(E)** Application of phenol to the tumor cavity following curettage. **(F)** Intraoperative imaging was captured after the tumor resection.

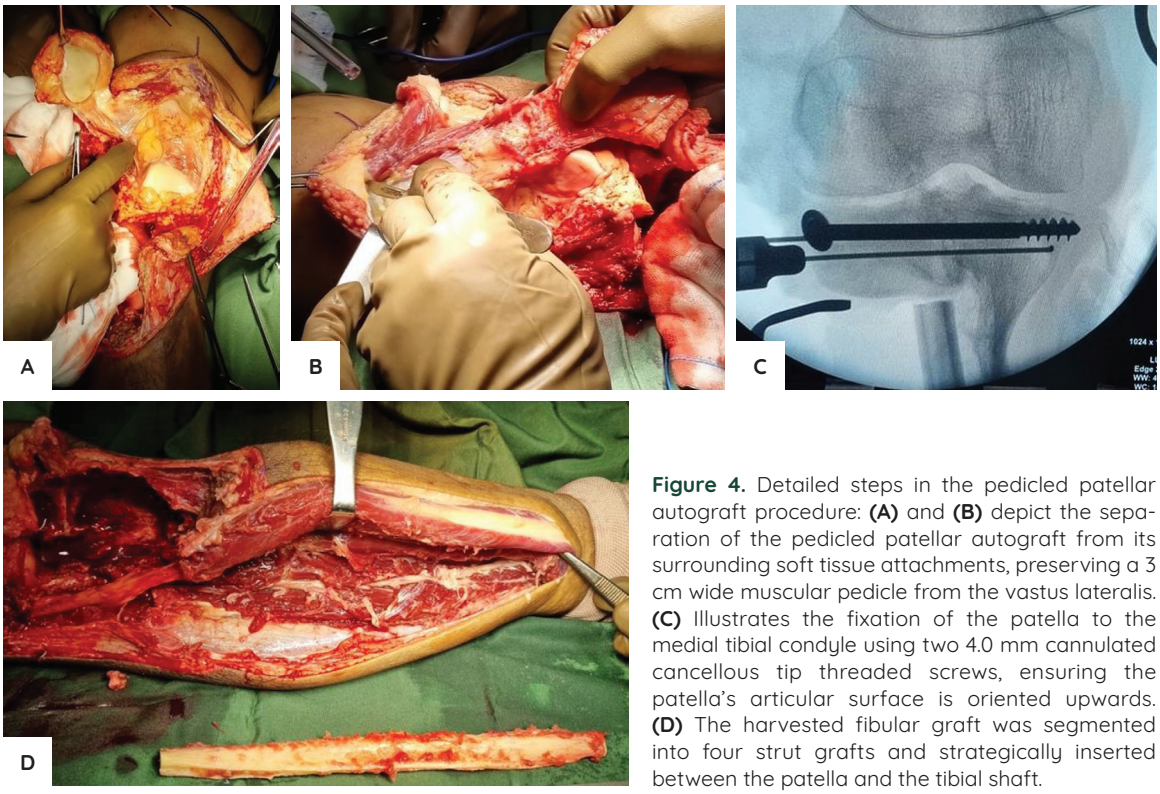

Figure 4. Detailed steps in the pedicled patellar autograft procedure: **(A)** and **(B)** depict the separation of the pedicled patellar autograft from its surrounding soft tissue attachments, preserving a 3 cm wide muscular pedicle from the vastus lateralis. **(C)** Illustrates the fixation of the patella to the medial tibial condyle using two 4.0 mm cannulated cancellous tip threaded screws, ensuring the patella's articular surface is oriented upwards. **(D)** The harvested fibular graft was segmented into four strut grafts and strategically inserted between the patella and the tibial shaft.

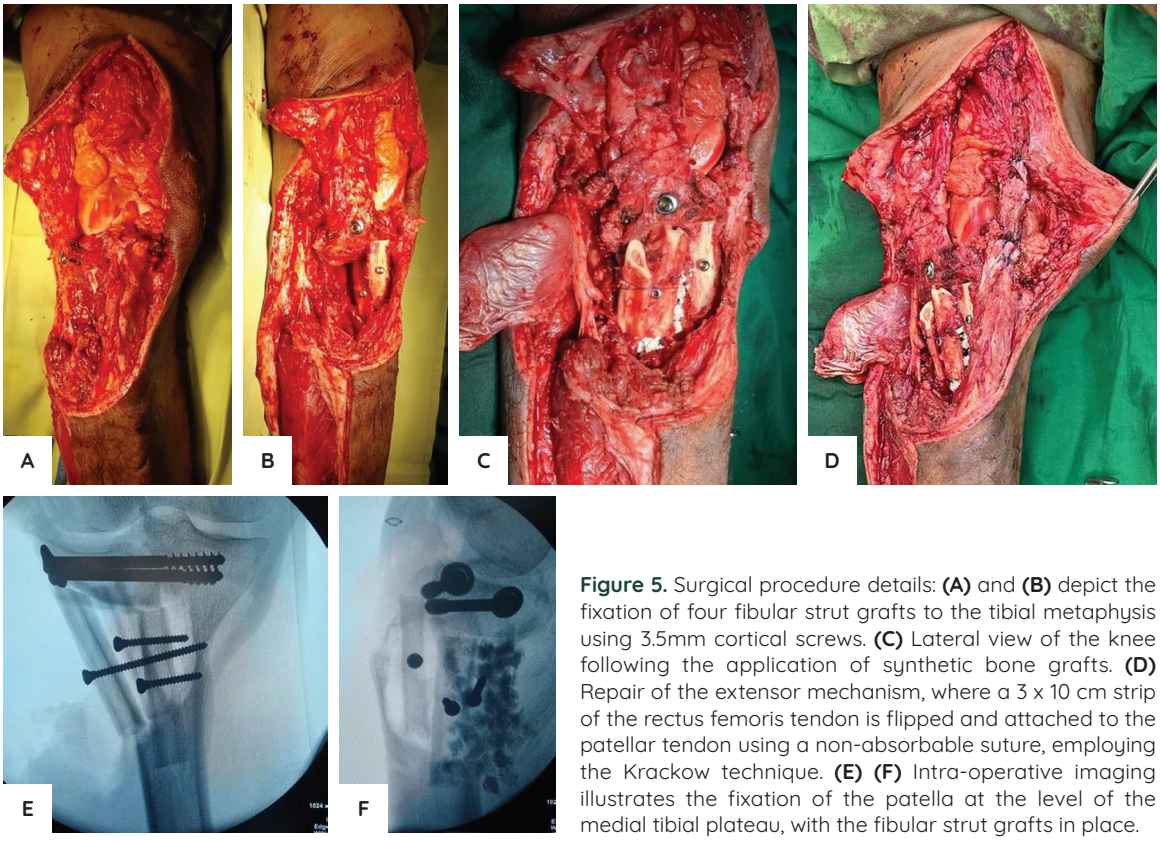

Figure 5. Surgical procedure details: **(A)** and **(B)** depict the fixation of four fibular strut grafts to the tibial metaphysis using 3.5mm cortical screws. **(C)** Lateral view of the knee following the application of synthetic bone grafts. **(D)** Repair of the extensor mechanism, where a 3 x 10 cm strip of the rectus femoris tendon is flipped and attached to the patellar tendon using a non-absorbable suture, employing the Krackow technique. **(E) (F)** Intra-operative imaging illustrates the fixation of the patella at the level of the medial tibial plateau, with the fibular strut grafts in place.

Figure 6. Surgical and post-operative details: **(A)** Attachment of the quadriceps tendon to the patellar tendon, reinforced using the Krackow technique and further augmented with a suture anchor on the tibia diaphysis. **(B)** Placement of the gastrocnemius flap. **(C)** Application of the split-thickness skin graft over the gastrocnemius flap. **(D)** Insertion of a drain at the proximal end of the incision. Post-operative radiographs of the right knee and leg in **(E) (G)** anteroposterior and **(F) (H)** lateral views show the patella's articular surface aligned with the medial tibial plateau, secured with two cancellous screws with threaded tips. Additionally, four fibular strut grafts, fixed with 3.5 mm cortical screws and supplemented with synthetic bone grafts, are visible.

Figure 7. Four months post-operatively, the patient demonstrated significant healing at the surgical site **(A) (D)**. He regained the ability to perform toe-touch weight-bearing with the aid of crutches. Functionally, he exhibited a knee extension-flexion arc ranging from 15 degrees to 95 degrees **(B) (C)**, indicating a substantial recovery of joint mobility. There were no sensory or motor deficits noted. Follow-up radiographs of the right knee and leg, taken in anteroposterior **(E) (G)** and lateral views **(F) (H)**, revealed a well-maintained reduction of the patella and strut grafts. There were no indications of tumor recurrence in these images.

Table 2. Post-operative Musculoskeletal Tumor Society Score of the patient, 16 out of 30, denoting improved function

	Pain	Function	Emotional	Support	Walking	Gait
5	No Pain	No restriction	**Enthused**	None	Unlimited	Normal
4	**Intermediate**	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
3	Modest/Non-disabling	Recreational restriction	Satisfied	Brace	**Limited**	Minor cosmetic
2	Intermediate	**Intermediate**	Intermediate	Intermediate	Intermediate	**Intermediate**
1	Moderate/Disabling	Total restriction	Accepts	One cane or crush	Inside only	Major cosmetic
0	Severe disabling	Total restriction	Dislikes	**Two canes of crutches**	Not independently	Major handicap

the resected mass revealed a giant cell tumor. After six weeks of immobilization, the patient was encouraged to do active-assisted range of motion exercises of the knee, focusing on isometric strengthening of the quadriceps and hamstrings. Exercises were slowly progressed to regain his knee range of motion. Four months post-operatively, the patient had a fully healed surgical site, a knee extension-flexion arc of 15 to 90 degrees, no pain, and no noted sensory or motor deficits. He was able to do toe-touch weight-bearing (Figure 7). Follow-up radiographs showed that the patellar and fibular grafts were in place and that there was no tumor recurrence. His follow-up musculoskeletal tumor society score was 16, denoting improved function (Table 2).

At 11 months post-operatively, his active knee extension-flexion arc was from 15 degrees to 95 degrees (Figure 8). Follow-up radiographs of the right knee and leg showed a stable reduction, further strut graft incorporation, and no tumor recurrence. The patient was able to ambulate without any assistance, without any pain or discomfort (Figure 9). There were no sensory or motor deficits. He was able to return to his previous work as a construction worker.

At 1.5 years post-operatively, his knee extension-flexion arc was 15 degrees to 95 degrees (Figure 10). He was able to do pain-free ambulation without assistance. There was no recurrence of the fungating knee mass. He was able to resume his role as his family's breadwinner.

Figure 8. Eleven months post-operatively, the incision was fully healed **(A)**. The active knee extension-flexion arc was 15 degrees to 95 degrees **(B) (C) (D)**. Follow-up radiographs of the right knee and leg, taken in anteroposterior **(E) (G)** and lateral views **(F) (H)**, showed maintenance of reduction and further incorporation of the strut graft. Tumor recurrence was not noted on the images.

Figure 9. Patient was able to ambulate without any assistance, without any pain or discomfort. There were no sensory or motor deficits noted. He was able to return to his previous work as a manual labourer.

Figure 10. 1.5 years post-operatively, the post-op site was fully healed **(A) (C)**. Active knee extension-flexion arc ranged from 15 degrees to 95 degrees **(B)**. He was able to do pain-free ambulation without assistance, and no recurrence of the fungating knee mass was noted.

DISCUSSION

Giant cell tumors (GCT) of the bone, particularly in weight-bearing areas like the distal femur or proximal tibia, present unique challenges in orthopaedic oncology, one of which is the need to preserve joint functionality in young, active individuals. Our case demonstrated a successful pedicled patellar transplant with suture anchor augmentation for articular reconstruction, augmented with suture anchors, following the resection of a GCT in the lateral proximal tibia, highlighting a novel surgical approach.

This case is particularly significant considering local findings from the Philippine Orthopedic Center by Carolino and Tud.[4] Thirty cases of histologically-confirmed GCT were reported over eight years, with a higher incidence in females (67%), and a predilection for the distal femur (47%) and proximal tibia (40%). Our case stands out as a male patient with a proximal tibia tumor, which was initially excised, recurred with a fungating mass, and was successfully treated with the D'Aubigne procedure.

Traditional joint reconstruction options, such as allografts, arthrodesis, or megaprostheses, each have their drawbacks. Allografts may cause immunogenic responses or infections,[5] arthrodesis can lead to ambulatory difficulties and accelerated degenerative changes in adjacent joints, and megaprostheses, though effective, are often cost-prohibitive, especially in resource-limited settings.[6]

In contrast, the D'Aubigne procedure, as applied to a 35-year-old male construction worker, demonstrated remarkable clinical benefits. The pedicled patellar transplant being an autograft precluded the risks of immunologic reactions and fibrosis. Additionally, the vascular pedicle facilitated rapid graft consolidation, enhancing recovery and joint stability. The patient's recovery trajectory of significant functional improvement in knee extension-flexion arc (from 15 to 95 degrees) and pain-free weight-bearing underlines the effectiveness of this approach in functional preservation.

Supporting this, D'Aubigne's original work[7] resulted in excellent long-term outcomes. Similarly, Claudio et al.[8] reported successful outcomes in patients with benign GCT of the distal femur treated with this technique, further validating its potential.

CONCLUSION

Our case, therefore, adds to the growing body of evidence supporting the use of pedicled patellar transplants in GCT treatment. The procedure's relatively lower cost, clinical effectiveness and reduced immunologic response make it a viable option in joint reconstruction surgeries, particularly in settings with limited healthcare resources.

However, it is critical to recognize the limitations of this study since long-term follow-up is important to establish the success of the procedure. Extensive studies and prolonged follow-up periods are essential to establish success rates, durability, and overall cost-effectiveness of the surgical technique.

ETHICAL CONSIDERATION

Patient consent forms were obtained before manuscript submission.

STATEMENT OF AUTHORSHIP

All authors certified fulfillment of ICMJE authorship criteria.

CREDIT AUTHOR STATEMENT

FGSSY: Conceptualization, Methodology, Validation, Investigation, Resources, Writing - original draft preparation, Writing – review and editing, Visualization; **VLB:** Conceptualization, Methodology, Validation, Investigation, Resources, Writing – original draft preparation, Writing – review and editing, Visualization; **MAPR:** Conceptualization, Methodology, Validation, Investigation, Resources, Writing – review and editing, Visualization, Supervision, Project administration.

DATA AVAILABILITY STATEMENT

No datasets were generated or analyzed for this research.

AUTHOR DISCLOSURE

The authors declared no conflict of interest.

FUNDING SOURCE

None.

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