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Case Report

Navigating complexity: Surgical management of giant cell tumor of fibula with CPN nerve entanglement

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Abstract

This report discusses a 26-year-old male presenting with swelling over the posterolateral region of the knee. Given that a giant cell tumour is a locally aggressive lesion, the knee joint X-ray reveals a cortical break suggestive of a likely pathological fracture. later, it was diagnosed with GCT of the proximal fibula, emphasizing the surgical decision-making and post-operative outcomes. This case highlights a rare occurrence of a giant cell tumor located in the proximal fibula. The patient underwent the elective surgical procedure with the meticulous dissection of the lateral compartment, followed by the excision of the tumour, done with intraoperative identification and salvage of the peroneal nerve and branches. The surrounding lateral soft tissue structures were meticulously aligned and secured through layered suturing. Intraoperative knee stability was checked. The rehabilitation strategy included guarded weight-bearing and use of a brace. At the five-month and one-year follow-up, clinical evaluation revealed maintained knee stability and full mobility of the ankle and foot. This case exemplifies the importance of individualized surgical planning and highlights how selective standard reconstructive procedures can still yield favourable functional and oncologic outcomes in rare GCT locations.

Keywords: GCT fibula peroneal nerve meticulous dissection, Lateral collateral ligament

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1. Introduction

Giant cell tumour (GCT) of bone is a locally aggressive yet histologically benign neoplasm that comprises approximately 5% of all primary bone tumours. It predominantly affects individuals between the ages of 20 and 40, often presenting around major weight-bearing joints such as the distal femur, proximal tibia, and distal radius.[1] Characterised by its osteoclastic giant cell-rich composition, GCT demonstrates a spectrum of clinical behaviours, ranging from mild cortical erosion to extensive soft tissue extension and rare metastatic potential.

Although most cases are solitary, a small proportion may exhibit multicentricity, posing challenges in diagnosis and treatment. Histologically, the tumour features three distinct cellular populations: stromal cells of osteoblastic lineage, mononuclear histiocytic cells, and multinucleated giant cells responsible for active bone resorption. Clinical presentation typically includes pain, swelling, and restricted mobility, with pathological fractures occurring in more advanced cases.[1]

Accurate diagnosis hinges on radiological and histopathological evaluation. Surgical excision remains the cornerstone of management, with extended curettage complemented by adjuvant treatments such as bone cementation, chemical cauterization, and cryotherapy showing promising results in minimizing recurrence and improving patient outcomes. This paper aims to further explore the pathological characteristics, diagnostic modalities, and evolving surgical strategies in the management of bone tumours.

2. Case Report

A 26-year-old male patient presented with dull aching pain and swelling over the posterolateral side of the right knee and proximal part of the leg for 4 to 5 months, which used to aggravate by walking or strenuous activities, relieved by taking rest or painkillers.[2] Pain was progressive in nature and in severity. He was not able to walk or sleep properly for the past 2 months due to pain that was present all the time

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and not relieved by rest. Swelling; this was progressive in nature and associated with a feeling of tightness in the knee. Swelling was firm to hard in consistency. Overlined skin was normal without any local rise in temperature. Movements of the knee were painful. There was no distal neurovascular deficit with normal common peroneal nerve function. There was no history of associated trauma, fever, evening rise of temperature, night sweats, or loss of weight. Radiograph showed a defined, expansile, geographic, lytic lesion in the proximal fibula and revealed a cortical break suggestive of a likely pathological fracture. Resection of the proximal fibula was done with a thick muscle cuff in all dimensions. The peroneal nerve and its motor branches were preserved, and the tibiofibular joint was excised intraarticularly. Around 8 cm of the tumour was removed. Excision of the tumour was done with intraoperative identification and salvage of the peroneal nerve and branches, and the surrounding lateral soft tissue structures were meticulously aligned and secured through layered suturing. Intraoperative knee stability was checked. During excision of the tumour, bleeding from the anterior tibial artery occurred, which was managed and repaired by a vascular surgeon. Postoperatively, the extremity was immobilized in a knee brace for 3 weeks in 20° flexion to allow soft tissue healing. After 4 weeks, full weight bearing and active range of motion (ROM) around the knee were allowed. At 5 months and one year follow-up, there was no evidence of local recurrence. The patient was pain-free and satisfied with full knee range of motion. The patient was walking, full weight-bearing, and performing all his daily activities unhindered.[3]

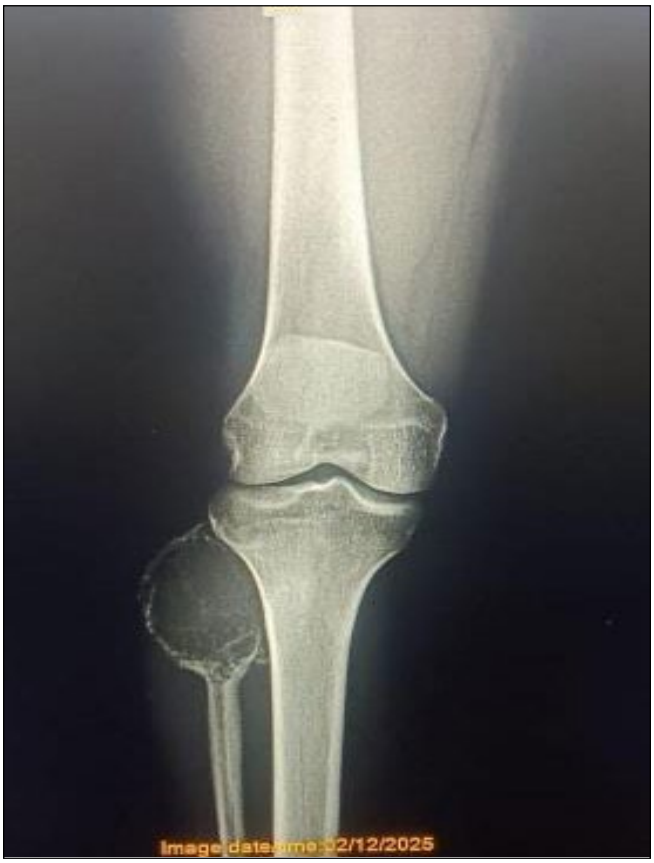

Figure 1: Preoperative Xray

3. Radiological Findings

On AP radiograph of the knee, an ill-defined lytic lesion on the proximal metaphyseal region of the fibula with cortical thinning was observed, revealing a cortical break suggestive of a likely pathological fracture. **(Figure 1)**

Later, an MRI was done to confirm the findings, which showed a Multilobulated destructive mass lesion seen arising from the head, neck, proximal fibular shaft, with large abnormal soft tissue extending beyond the bony margins into the muscles of the upper third of the right leg, with involvement of the anterior, lateral, and posterior muscle compartments. Surrounding soft tissue oedema in the muscles, subcutaneous fat of the lateral aspect of the proximal neck. Cystic spaces are seen in the lesion. It measures 8.1 x5.5x 7.2cm in AP, transverse, and craniocaudal extent. **(Figure 2)**

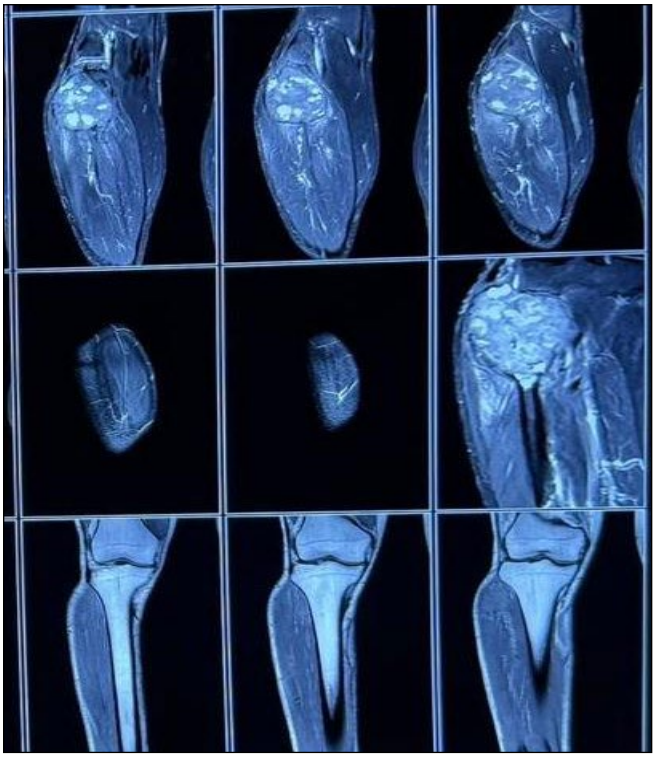

Figure 2: MRI coronal cuts

4. Histopathological Findings

Microscopic analysis of the cellular smears revealed abundant sheets, clusters, and individual spindle-shaped cells. These cells appeared plump with pale oval nuclei and subtle chromatin features. Intermixed among them were multinucleated giant cells, morphologically similar to osteoclasts. The background shows haemorrhagic material.

Histologically, giant cell tumours are characterized by stromal cells whose nuclei resemble those found in multinucleated giant cells, aiding in the differentiation of GCT from other giant cell-containing lesions.[1] A notable feature is the high nuclear count within the giant cells, occasionally reaching several hundred. In certain cases, these giant cells may appear to absorb additional nuclei from neighbouring stromal cells.

Histopathology of giant cell tumours of the bone: With special emphasis on fibrohistiocytic and aneurysmal bone cyst-like components.[1] **(Figure 3)**

Differential diagnosis for such presentations, especially in young adults and at similar anatomical locations, includes Aneurysmal Bone Cyst, intraosseous sarcomas, and Desmoplastic Fibroma.

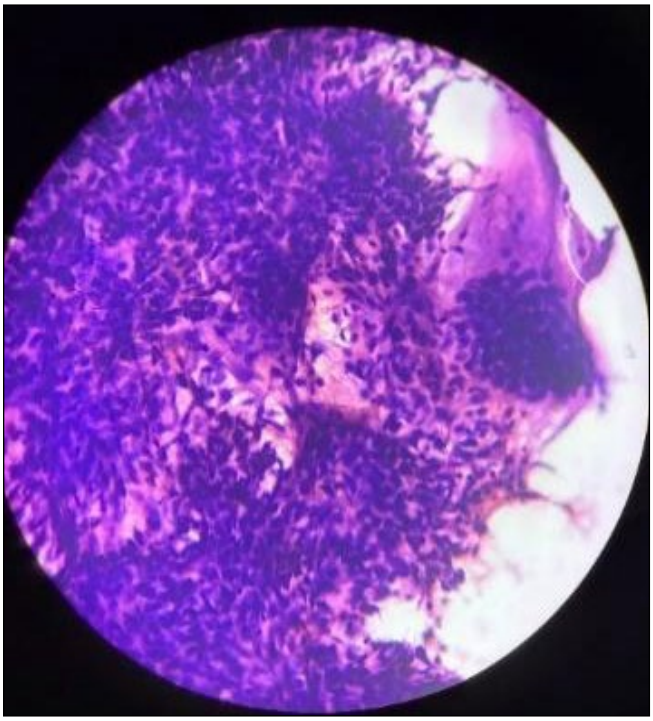

Figure 3: Histopathological slide image

5. Surgical Treatment

The patient underwent a wide excision surgery under spinal anaesthesia in the supine position. A posterolateral surgical approach was employed to access the lesion and associated neurovascular structures. Initial dissection focused on identifying and mobilizing the common peroneal nerve. **(Figure 4)** with care taken to expose its branches both superficial and deep within the fibromuscular tunnel.

Following careful separation of the lateral head of the gastrocnemius muscle, the anterior tibial and peroneal vessels were visualized. These vascular structures were found to be encased by the tumour mass.[4]

Following this, the proximal fibular tumour was excised using a type I marginal in-bloc technique, incorporating intralesional elements during removal. This involved removing the affected bone along with approximately 2 cm of healthy diaphyseal bone, and a surrounding muscle cuff was resected, ensuring preservation of the peroneal nerve and its branches. All muscles attached to or surrounding the fibula were excised en masse. **(Figure 6)** An extended curettage of the tumour site was done using multiple angled curettes, followed by thorough irrigation to eliminate residual tumour cells.[3] **(Figure 5)**

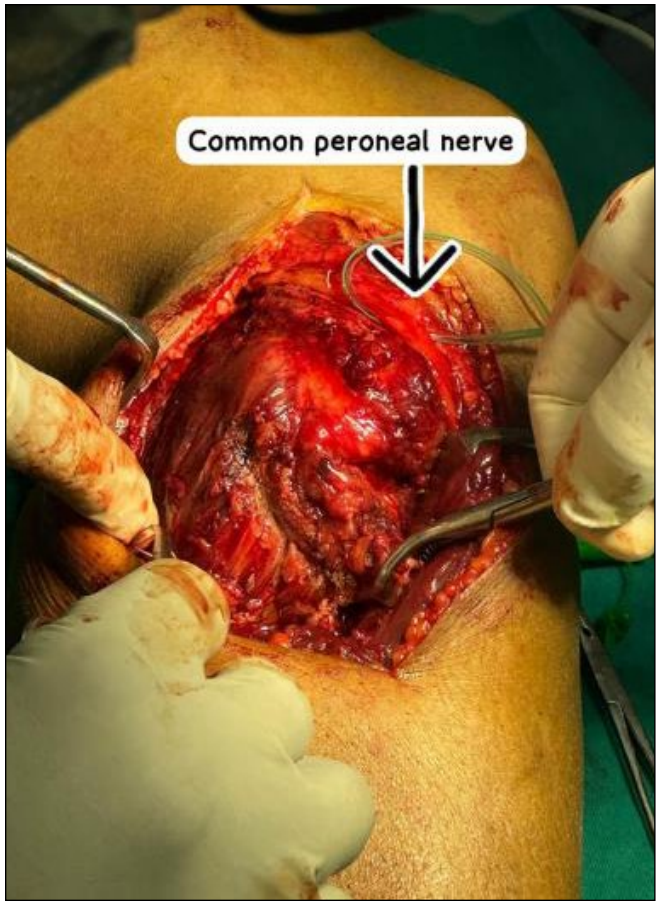

Figure 4: Intra-op CPN Nerve identification

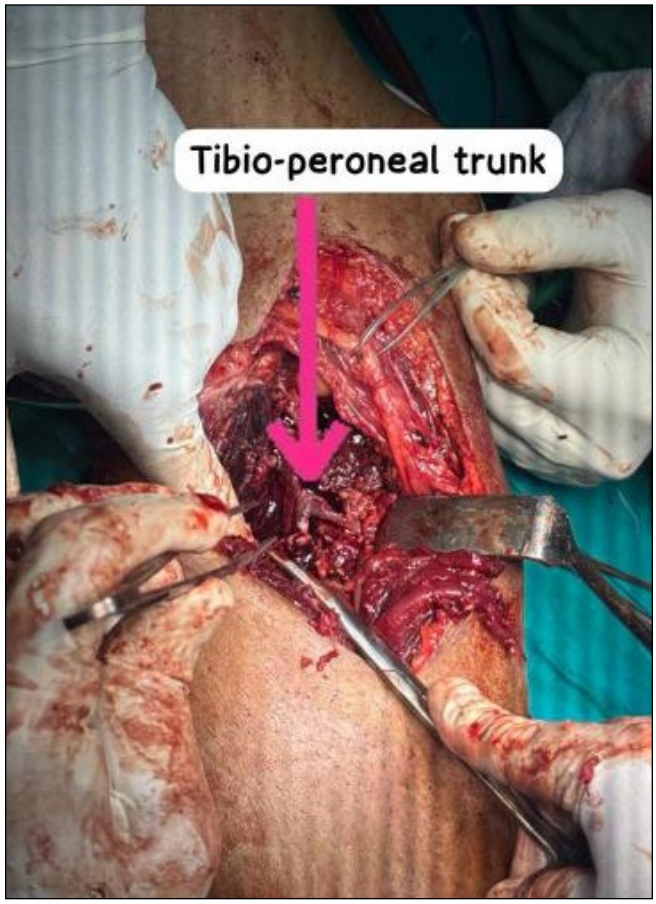

Figure 5: Inta-op Tibi peroneal trunk identification

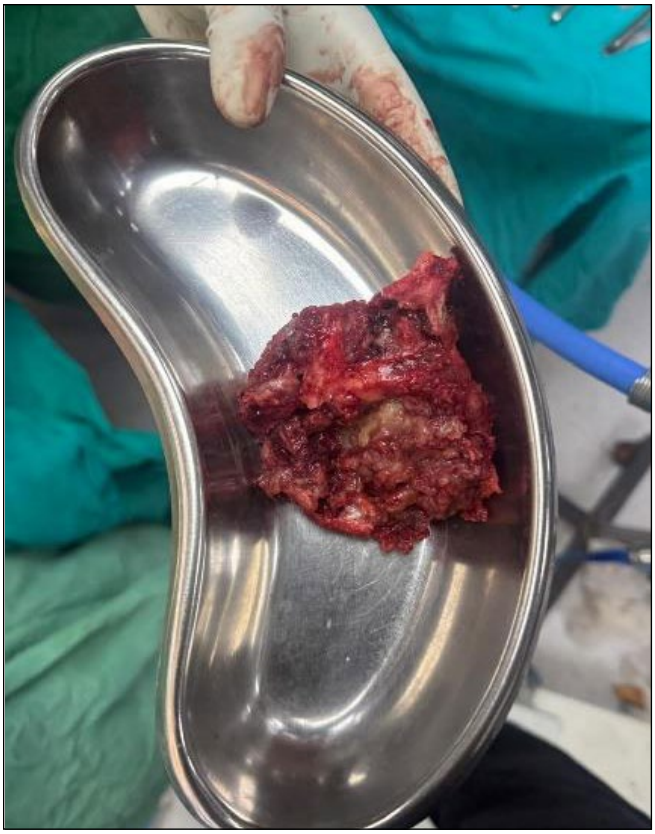

Figure 6: Resected tumour mass

After resection, the surrounding lateral soft tissue structures were meticulously aligned and secured Figure 6 through layered suturing. During the procedure, knee stability was assessed, and no varus instability was observed. Immediately post-operation, the common peroneal nerve function remained intact. **(Figure 7)**

Figure 7: Immediate post op normal ankle dorsiflexion

6. Follow Up

After surgery, the affected limb was stabilized with a knee brace for a duration of four weeks, maintaining it in a fixed and supported posture to aid soft tissue recovery. Gentle range-of-motion exercises were introduced during the following two-week period, and patients were gradually transitioned to full weight-bearing status after six weeks. **(Figure 8)**

Five months and one year post-surgery, clinical assessment confirmed stable knee function under varus stress, complete range of motion in the ankle and foot, and no signs of tumour recurrence.[5] **(Figure 9)**

Figure 8: 1 year follow up cross leg sitting

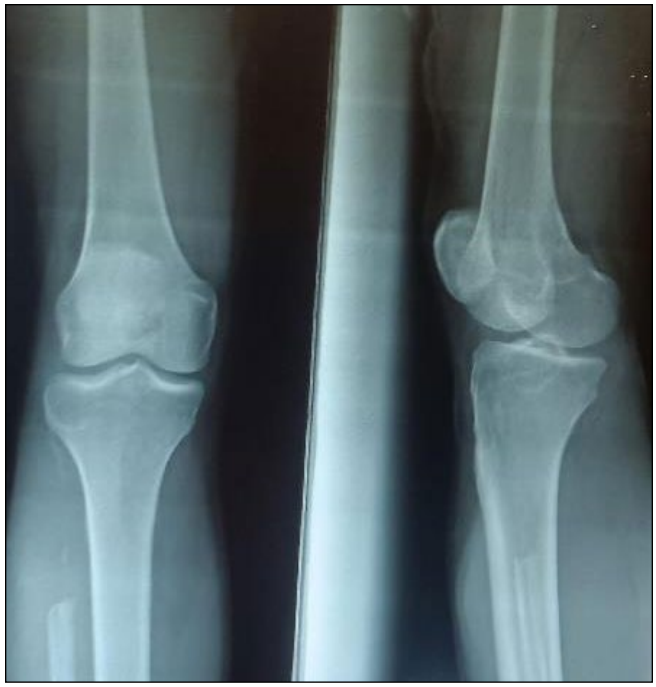

Figure 9: 1 year follow up Xray showing no recurrence

7. Discussion

Giant Cell Tumour of bone is a relatively common benign neoplasm, typically affecting individuals between 25 and 40 years of age. It tends to occur more frequently in females and is most often found in the epiphyseal regions of long bones such as the distal femur, proximal tibia, and distal radius. However, its occurrence in the **proximal fibula** is notably rare, making such cases clinically significant due to diagnostic and therapeutic challenges.

GCTs generally arise after the closure of growth plates and are characterized by their solitary nature and locally aggressive behaviour. Although histologically benign, they can occasionally metastasize to the lungs, where the metastatic lesions may behave unpredictably and sometimes require no intervention. Importantly, there are no definitive histological markers that reliably predict the tumour aggressiveness or prognosis.

Patients commonly present with gradually worsening pain, which may or may not be accompanied by a palpable mass. The pain typically intensifies as the tumour compromises the cortical bone or irritates the periosteum. In some cases, the structural weakening of the bone leads to a **pathologic fracture**, which may be the initial clinical manifestation.

When GCT involves the proximal fibula, surgical management becomes more complex due to the anatomical proximity of critical structures such as the **common peroneal nerve** and the **lateral collateral ligament (LCL)** of the knee. En bloc resection is often considered the preferred approach to minimize recurrence, but it must be balanced against the risk of postoperative complications like nerve palsy or knee instability. Some studies suggest that reconstruction of the LCL may not be mandatory, as many patients maintain functional stability even after resection.

Overall, early diagnosis, careful surgical planning, and long-term follow-up are essential to ensure favourable outcomes in patients with GCT of the proximal fibula.

Malawer classification outlines two principal methods for surgically managing tumours located in the proximal fibula.[1] One approach involves a more conservative excision that preserves key neurovascular structures, while the other entails a wider resection designed for more aggressive or malignant lesions. The first, known as Type I resection, entails excising the upper portion of the fibula along with a narrow cuff of adjacent muscle and the lateral collateral ligament attachment, while Care is taken during surgery to protect the peroneal nerve and its associated motor branches from injury. The tibiofibular joint is removed using an approach that enters the joint space directly. In contrast, Type II resection is more extensive; this surgical approach entails the comprehensive excision of the proximal fibula along with the tibiofibular joint, surrounding anterior and lateral muscle groups, the anterior tibial artery, and the peroneal nerve as part of a wide resection strategy.[6]

Postoperative complications such as flap ischemia, wound breakdown, or thromboembolic events were not observed.

Management of giant cell tumour in the proximal fibula requires a nuanced approach due to its rare location and proximity to vital structures such as the peroneal nerve and lateral knee stabilizers. While en bloc resection remains a widely accepted method for achieving oncologic control, especially in cases with cortical breach or soft tissue extension, alternative strategies may offer comparable outcomes with reduced morbidity.

Extended Curettage. This technique involves thorough intralesional removal of the tumour, often supplemented with high-speed burring and cavity filling using bone grafts or cement. Although less invasive than resection, curettage carries a higher risk of local recurrence, particularly in anatomically complex regions like the proximal fibula.[4,7]

En Bloc Resection Preferred in cases with aggressive radiologic features or compromised cortical integrity, en bloc resection allows for complete tumour removal and reduces recurrence risk.[8] However, it demands careful intraoperative planning to preserve the peroneal nerve and maintain knee stability. In this case, resection was chosen due to cortical disruption and proximity to joint structures. Adjuvant Therapies like Denosumab, a RANKL inhibitor, have shown promise in reducing tumour size preoperatively and may facilitate less extensive surgery. It is particularly useful in cases where resection poses significant functional risks. Phenol and other chemical cauterizing agents are often used post-curettage to eliminate residual tumour cells, though their efficacy in preventing recurrence remains variable.[9,10]

Ultimately, the choice of treatment must balance oncologic safety with functional preservation. In rare sites like the proximal fibula, individualized planning considering tumour extent, patient activity level, and anatomical constraints is essential to optimize outcomes.

8. Conclusion

Giant cell tumour of the proximal fibula, though rare, presents distinct diagnostic and surgical complexities due to its anatomical proximity to critical neurovascular structures. This case highlights the critical role of prompt diagnosis and customized surgical management in maintaining limb function and minimizing the risk of tumour recurrence. The successful outcome marked by preserved knee stability and full distal limb mobility demonstrates that even in atypical locations, meticulous operative technique and structured rehabilitation can lead to excellent functional and oncologic results. Ultimately, this case reinforces the value of individualized treatment planning and vigilant follow-up in managing uncommon presentations of GCT.

9. Source of Funding

None.

10. Conflict of Interest

None.

11. Patient Consent

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12. Acknowledgement

None.

13. Contributors Role

1. **Amol Khairnar** (Supervision)
2. **Akshay Deshmukh** (Methodology, Conceptualization)
3. **Sayaji Bhamre** (Validation)
4. **Atul Patil** (Validation)
5. **Harshal Patil** (Methodology)
6. **Rakesh Sanivada** (Software)
7. **Rohit Dipwal** (Software)

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