

Functional Outcome of Extended Curettage and Reconstruction using Sandwich Technique for Giant Cell Tumor around Knee

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Learning Point of the Article:

This short case series evaluated the outcomes of three patients who had giant cell tumors surrounding their knees treated with intralesional curettage, phenol application, and sandwich technique reconstruction at our institution.

Abstract

Introduction: Giant cell tumors (GCT) are benign yet locally aggressive neoplasms. The primary objectives of treatment are to entirely eliminate the tumor, rebuild the defect, and restore limb functionality. Numerous surgical treatment options have been proposed, ranging from more drastic interventions, such as en bloc excision, to less invasive techniques such as curettage or curettage combined with bone grafting. Limited research addresses the functional outcomes following treatment for giant cell tumors, despite the abundance of publications focusing on cure rates, recurrence, and other surgical considerations of the condition.

Case Report: Individuals aged 20–40 are typically the ones affected with GCT. Patients typically exhibit pain during rest or sleep, and in certain instances, may also experience pathological fractures.

All patients were clinically evaluated, plain X-ray of the knee, chest X-ray, computed tomography, and magnetic resonance imaging were taken before the procedure. In all patients a pre-operative, biopsy was performed to determine the tumor's histological grade and to confirm the diagnosis.

Conclusion: The sandwich technique is an appropriate reconstructive procedure for GCT around the knee joint, involving the use of polymethylmethacrylate to occupy the residual cavity post-curettage, the placement of a structural allograft in the subchondral region, and the application of a gel form in the intervening space.

It also has less complications, favorable survival rates, and positive functional outcomes. This approach preserves the advantages of cementing, mitigates potential complications, and restores the subchondral bone stock.

None of our patients experienced any collapse of the joint, recurrences, immunological complications. All of them also had good functional status of the limb after 1 year. Thus, based on our good findings, we advocate this technique for joint salvage in GCTs around the knee.

Keywords: Sandwich technique, giant cell tumor, functional outcome.

Introduction

Giant cell tumors (GCTs) constitute 5% of primary bone tumors and are classified as benign although they are locally aggressive neoplasms [1]. The proximal tibia and distal femur are the most

often affected areas, followed by the distal radius [2]. The closeness of these epi-metaphyseal lesions to articular surfaces poses therapeutic problems. Individuals between 20 and 40 years are often affected [3,4]. Patients typically first present with pain

Author's Photo Gallery



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Figure 1: Pre operative x rays of a patient with proximal tibia giant cell tumor (a)Anteroposterior view (b) Lateral view.

during rest or sleep, and in some instances, experience pathologic fractures, especially in weight-bearing bones [5].

The GCT treatment primarily focuses on complete tumor eradication, defect reconstruction, and restoration of limb function [6]. A variety of surgical modalities have been suggested, from radical procedures such as en bloc excision to less invasive techniques, including curettage and curettage supplemented with bone grafting or bone cementing [3, 7]. Intralesional curettage is often employed alongside adjuncts such as liquid nitrogen, phenol, and hydrogen peroxide, referred to as extended curettage, to enhance the kill zone and mitigate recurrence rates [3].

This short case series evaluated the outcomes of three patients

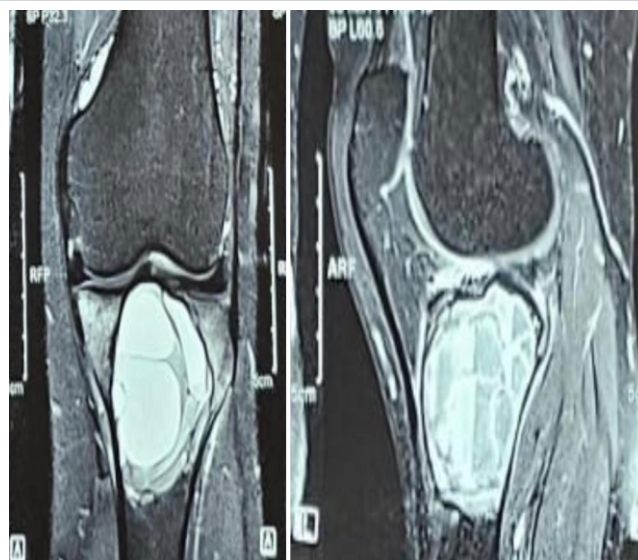


Figure 2: Pre-operative magnetic resonance imaging T2- weighted images of the knee showing a hyperintense lesion in the proximal tibia with fluid-fluid levels.

who had GCTs surrounding their knees treated with intralesional curettage, phenol application, and sandwich technique reconstruction at our institution.

Case Report

This is a short case series of 3 patients aged 27–30 (mean, 28) years underwent intralesional curettage, use of phenol, and reconstruction using the sandwich technique for GCT in our institute. Institutional ethical clearance was obtained.

The objective of our case series was to evaluate prospectively the functional outcome, recurrence rates, complications, and metastasis of patients treated with the sandwich technique for GCT around the knee.

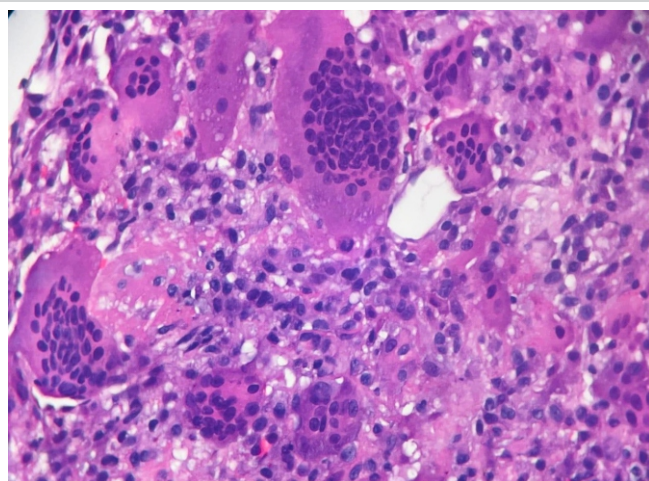


Figure 3: Histopathology slide showing stromal cells and multinucleated giant cells suggestive of giant cell tumour.

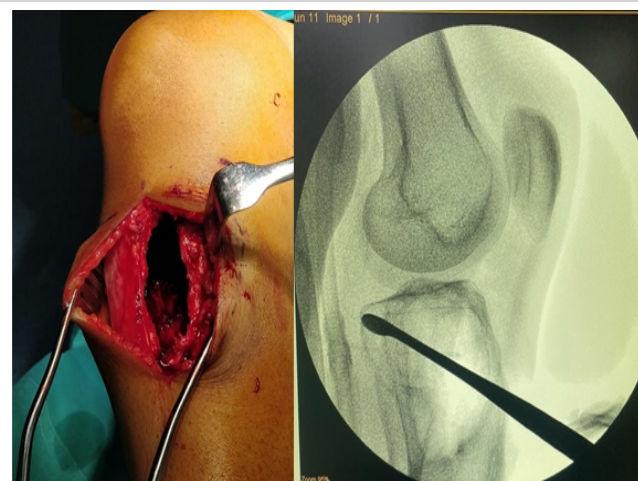


Figure 4: (a) Showing cortical window made on the lateral side of the tibia, (b) fluoroscopic image showing curettage of the bone lesion.



Figure 5: Anteroposterior and lateral radiographs post-surgery showing the defect filled with bone graft in the subchondral area, followed by bone cement and internal fixation using locking plates.

Before surgery, patients were clinically evaluated; plain X-ray of the knee [Fig. 1], chest X-ray, computed tomography, and magnetic resonance imaging were taken. [Fig. 2] In every instance, a biopsy was performed to validate the diagnosis.

Subjects with degenerative joint changes, pathological fractures, and roentgenograms demonstrating the loss of more than two-thirds of the cortex in a single view substantial subchondral bone stock (>5 mm) following extensive curettage were excluded from this case series.

The radiographic characteristics were taken into consideration and were classified based on the classification given by Campanacci et al. [10].

Grade 1	Well-defined margin with no cortical breach
Grade 2	Relative well-defined margin with no radio-opaque rim and thinned and moderately expanded cortex
Grade-3	With an indistinct border with cortical destruction

In all 3 cases, pre-operative biopsy was utilized to establish the diagnosis for each patient, and intraoperatively acquired samples were dispatched for histological examination, which verified the diagnosis of GCT. [Fig. 3]

Technique

The patient was positioned supine under spinal anesthesia. The surgical site was painted and draped. The Incision was made in such a way that included the biopsy scar. A substantial cortical window was made, facilitating sufficient exposure, and curettage was performed until normal bone was visualized. [Fig. 4]

The cavity formed was further enlarged using a high-speed burr, ensuring the surrounding tissue remained uncontaminated. Sufficient samples were collected for histopathological analysis. Pulsatile lavage was given, facilitating the exposure of raw cancellous bone. Subsequently, phenol was instilled; as an adjunct, the remaining cavity was filled with bone cement, pieces of iliac crest graft were then placed in the subchondral region, followed by the application of a gel foam (a biodegradable, non-toxic gel made from human fibrinogen and thrombin) layer beneath them; the bone was then stabilized by internal fixation [Fig. 5] with a proximal tibia locking plate. A drain was inserted and the wound was sutured.

Post-operative protocol

All patients were immobilized using above-knee plaster of Paris slabs.

From post-operative day 1, patients were initiated on non-weight-bearing ambulation. Quadriceps strengthening and knee range of motion exercises were commenced 2 weeks later. One-month post-surgery, partial weight-bearing was initiated. Patients were advised to full weight-bearing walking after 3 months.

Patients underwent clinical and radiological follow-up for a minimum of 6 months to assess functional outcomes, identify any local surgical complications, and lung metastases.

The musculoskeletal tumor society (MSTS) score was used to assess the functional outcome (MSTS) (Table 1), which includes a subjective clinical evaluation in addition to six parameters: Function, pain, emotional acceptance, walking capacity, usage of walking aids, and gait.

Results

Out of three patients, two patients had lesions in the proximal tibia and one patient had a lesion in the distal femur. Table 2,3]. None of the patients experienced malignant changes.

The mean MSTS score was 29.6. [Table 2]

Discussion

The mean age of our patients was 28, which is consistent with previous studies [1].

The patients' ultimate functional results were not significantly impacted by factors such as age, gender, or tumor grade.

Increased lysis measuring more than 5 mm at the bone-cement contact or the lack of a sclerotic rim at the interface were considered indicators of tumor recurrence [10].

Score	Pain	Function	Emotional	Support	Walking	Gait
5	No pain	No restriction	Enthused	None	Unlimited	Normal
	severe disabling					
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
	Moderate/disabling	Partial restriction	Accepts	One cane or crutch	Inside only	Major cosmetic
0	Severe disabling	Total restriction	Dislikes	Two canes or crutches	Not independently	Major handicap

Table 1: Musculoskeletal tumour society score.

None of the patients exhibited any recurrence within 6 months; however, an extended follow-up will be essential to accurately assess the recurrence rate.

A series of studies by Banerjee et al. on 12 patients with GCT of the distal femur treated with the sandwich technique showed outstanding results, with a mean MSTS score of 26, which is similar to our case series [8-11]

We performed intralesional curettage on all our patients and utilized phenol as an adjunct, which acts by protein coagulation, necrosis, and DNA damage. Studies suggest that recurrences are most probable within the initial 2 years following curettage and can be mitigated with the use of adjuncts (extended curettage) [6].

The biological barrier of periosteum on the posterior aspect keeps bone cement and bone grafts from escaping the hollow. Furthermore, it also inhibits the leakage of phenol, which could result in neurovascular damage [9]. Therefore, during curettage, pre-cautions were implemented to prevent the rupture of the cortex and periosteum in the posterior region [6].

The cavity was filled with poly methyl methacrylate (PMMA) to diminish the recurrence rate, as evidenced by a meta-analysis of six studies including over a thousand patients treated with thorough curettage and filling the formed cavity using

allogeneic graft or PMMA [1]. Studies indicate that the recurrence rate of cavities filled with cement is <25%, whereas the recurrence rate of cavities filled with other materials is >50% [8]. The reason being heat generated during the formation of PMMA causes thermal necrosis of the tumor, and the monomer that is formed induces hypoxic

tumor necrosis. It also has an ability to show lysis in the bone cement interface in radiographs, facilitating the early detection of recurrence [3].

In sandwich technique we added iliac crest bone graft below the subchondral layer to increase bone stock and an additional layer of gel foam beneath it, following the study of Radev et al. [1] which recommended a minimum of 2-4 mm subchondral bone to protect articular cartilage from degenerative changes due to PMMA's cytotoxic and exothermic effects [1,3,8].

Since we have used iliac crest autograft, which has got good osteogenic, osteoinductive, and osteoconductive properties, good acceptability of the autograft was observed with a minimal risk of immunological complications.

We also employed fixation in every instance, using locking plates and cortico-cancellous screws to stabilize the bone graft and bone cement and lessen the likelihood of collapse. This also promoted early mobilization and improved range of motion [4].

Our own set of constraints included the tiny population cohort of only 3 patients, as well as the absence of a control group. Furthermore, there were differences in the tumor mass's position and volume. The treatment plan was the same for each

Patient	Pain	Function	Emotional	Support	Walking	Gait	Total/30
Patient 1	5	5	5	5	5	5	30
Patient 2	5	5	5	5	5	5	30
Patient 3	5	5	4	5	5	5	29
Mean	5	5	4.6	5	5	5	29.6
MThe mean MTSC score was found to be 29.6 at 12- months follow -up							

Table 2: MTSC-Our findings at 12 months.

SL. no.	Age/sex	Site	MSTS score	Knee flexion at 12 months (°)
Patient 1	27/F	Left proximal tibia	30	100
Patient 2	30/M	Left femur lateral condyle	30	100
Patient 3	27/F	Left proximal tibia	29	100
MSTS: Musculoskeletal Tumours Tumor Society				

Table 3: Patient details.



patient, though. Finally, our follow-up period was 1 year, which is rather short. Despite the fact that studies have demonstrated that the majority of local recurrences happen before 2 years, certain instances of GCT recurrences have been documented after this time [8]. Degenerative changes in the joints could also take longer to manifest [8] to definitively identify tumor recurrence and evaluate joint failure, we want to monitor these patients for an extended period of time. Even though the outcomes after intermediate follow-up has shown promise. Long-term follow-up is necessary.

Conclusion

Even though there exist many studies that describe the cure rate, recurrence, and other surgical factors, there are a few that

address the functional results following GCT treatment using various techniques.

This short case series suggests that the sandwich technique following an extended curettage results in satisfactory knee function with few complications and may withstand without articular collapse or fractures, thus can be safely used in selected cases.

Clinical Message

In the Sandwich technique, the benefits of cementing are utilized, possible complications are minimized, and subchondral bone is restored. We advocate the sandwich method for joint salvage in GCTs around the knee based on our good findings.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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