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Case Series

Wide excision and reconstruction with free vascularized fibula for aggressive giant cell tumor of distal 3rd tibia

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ABSTRACT

Giant cell tumor (GCT) at distal end of tibia is relatively a rare site of occurrence. We presented our experience with extensive excision and reconstruction for GCT of distal tibia using a free vascular double strut/single strut fibula graft. The present case series was conducted on six patients of GCT at lower end of tibia who were treated with extensive excision and reconstruction either in index (n=4) or recurrence (n=2) settings. Four patients were male and 2 were female. The mean age was 26.5 years. The average length of bone defect after tumor excision was 7.4 cm. The range of movement at ankle joint up to 70% of normal opposite side achieved in 2 cases and arthrodesis of ankle joint done in rest 4 cases (2 recurrent and 2 index cases). In GCT treatment, in spite of reconstruction difficulty for bony defect of lower end tibia due to its weight bearing property, vascularized free fibula graft has advantages like allows wide excision of tumor, single stage procedure, early weight bearing capacity in young patients and no bone resorption but bone thickening.

Keywords: Distal tibia, GCT, Vascularized free fibula graft

INTRODUCTION

GCT is a benign aggressive bone tumor of unknown origin that appears in the third and fourth decades of life, with a strong female preponderance.[1] Distal femur and proximal tibia is the most common site of GCT followed by distal radius and sacrum. GCT of the distal end of the tibia is a rare site that can leads to pain, edema and a restriction in movement at ankle joint.[2]

GCT of the bones is primarily diagnosed by clinical and radiological assessment (plain X-ray, MRI and CT scan) of the lesion site.[3] GCT of the long bones exhibits more aggressive behavior, with a higher risk of recurrence and distant metastasis.[4] Although amputation appears to be curative, it is rarely indicated in tumors which rarely Curettage with bone grafting or cementing, *en block* excision and reconstruction with non-vascular/vascular free fibula autograft, osteoarticular allograft, fibular translocation, or endoprosthesis are all treatment options for GCT at this site.[5-11]

The recurrence rate following curettage or extended curettage of GCT are more than those treated en bloc excision, making en bloc excision a more appropriate and reliable option in aggressive lesions.[12] Although wide excision of the distal third tibia provides the best chance of cure from GCT, it presents a complex reconstructive problem that is required for weight bearing and walking.[13] Reconstruction of the tibial defect after *en bloc* excision of the distal tibia is a tough challenge. The majority of patients are active adults who needs an ankle

that would be both cosmetically acceptable and functionally adequate.

We presented a retrospective review of our experience on management of locally aggressive distal tibia GCT with wide local excision followed by double strut/single strut vascularized contralateral free fibular graft reconstruction.

CASE SERIES

The patient of GCT at distal end of tibia who attended to our hospital either in upfront or in recurrent settings and underwent extensive excision plus reconstruction followed by a minimum 18 months follow-up over a period from April 2016 to January 2019 were included in this retrospective analysis. A total of 6 cases of GCT at distal end of tibia encountered. The details of patient data were retrospectively reviewed from hospital record. The clinical characteristics of patient profile including age, sex, site of lesion, and image findings were recorded. All patients evaluated pre-operatively with plain X-ray and MRI of involved ankle, and plain X-ray chest. Serum calcium, phosphate and alkaline phosphatase were measured to rule out parathyroid dysfunction.

In all the cases en bloc excision was performed and reconstruction was performed by free vascularized fibular autograft.

Surgical procedure

Bilateral lower limb of the patients was prepared with prepping and draping before being operated under spinal anesthesia. A pneumatic tourniquet was used in both the thigh. Every case is approached from the anterior medial aspect. With the initial incision, a biopsy tract of incision was taken. The bone was resected at a level 2-3 cm above the MRI finding. Spillage of tumor was prevented, and the cuff of soft tissue was excised together with the tumor, with special care carried to retain the neurovascular bundle. Following excision, the defect site is thoroughly washed with hydrogen peroxide and betadine solution for 2-3 minutes. Anterior tibial artery and great saphenous vein were used as recipient vessel in 4 cases. Whereas in rest 2cases post tibial artery end to site and vena commitantes used as recipient vessel.

Contralateral free vascularized fibula harvested under tourniquet. In 3 cases single osteotomy done for double strut fibula placement for reconstruction of tibial defect. We had taken 2 cm extra length of fibula in 4 cases for fitting into socket created in talus for ankle arthrodesis. We used 6-7 holes 4 mm DCP in 4 cases for fixation of fibula to tibia. In 2 cases fixation of fibula was done by k-wire.

Above knee plaster of Paris slab was continued for 2 months. After that k-wire removed and gradual weight bearing allowed after 3 months of k-wire removal. Gentle active and assisted ankle exercise were started in 2 cases where arthrodesis was not done. Increased in intensity of weight bearing done depending on tolerance and progress. Full weight bearing was not allowed till 5months were completed. At 7-10 weeks, plain X-ray of ankle repeated to see union, recurrence of tumor, graft related complication or thickness fibula graft at its new site.

The basic clinical characteristics of the patients are depicted in table 1. In our series 4 patients were male and rest 2 were female. The mean age was 26.57 years within the range from 18 to 32 years. The right-side distal end of the tibia was involved in four cases and the left side distal end tibia was involved in two cases. There were two cases of recurrent GCT that were initially treated with curettage and recurrence was discovered 12-18 months later. Pre-operative biopsies confirmed the diagnosis in the remaining four cases.

Radiological findings showed involvement of distal articular ends of tibia by the disease in 4 cases. There was no pathological fracture or metastasis in any of the cases.

All the six cases underwent wide excision with 2-3 cm tumor free margin along the bone. The mean bone defect after tumor excision was 7.4 cm and ranges from 6 cm to 8.8 cm.

We used a double strut fibula graft in three cases and a single strut vascularized osteocutaneous fibula graft in the other three. Arthrodesis at the ankle joint was performed in four cases: two recurrent cases and two cases where the distal part of the tibia needed to be excised. We used 4 mm DCP in four cases and K-wire in two cases to secure the fibula to the tibia. The average duration of follow-up in this study is 2.3 years. Movement of ankle joint in 2 cases are of 70% of that of normal contralateral ankle and 4cases ankle arthrodesis done so no movement present. Four out of 6 cases achieved full weight bearing strength at 5 months and rest 2 achieved at 6 months. Tibialization of fibula occurred after 10 months in 4 cases.

Patient 1

Figure 1: Recurrent GCT after curettage.

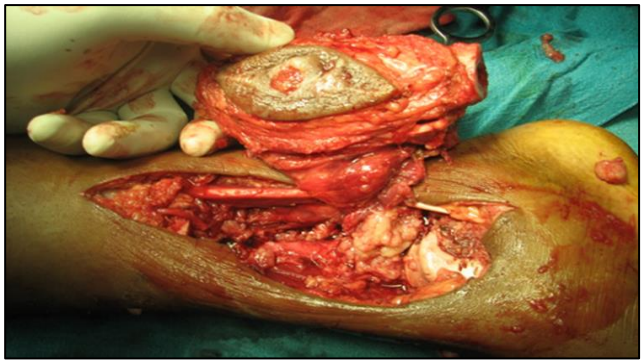

Figure 2: Defect after wide excision.

Figure 6: 10th day post-operative view.

Figure 3: Three months post operation view.

Figure 7: Pre-operative GCT right lower tibia.

Patient 2

Figure 4: 18 years male, GCT lower tibia.

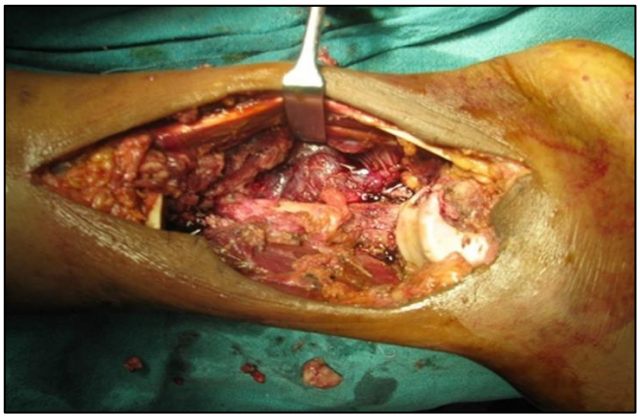

Figure 8: Tibial defect after resection.

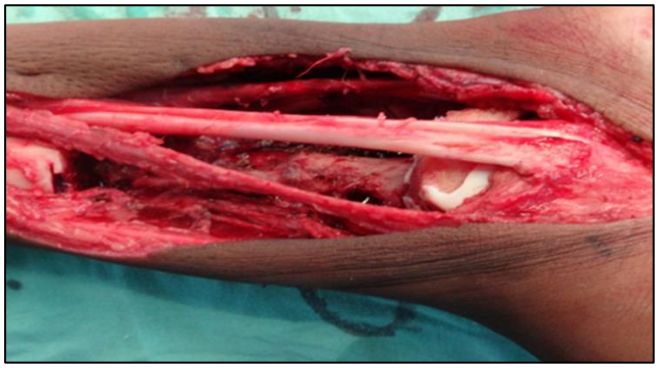

Figure 5: Defect after wide excision.

Figure 9: Two months' post-operative view.

Table 1: Clinical characteristics of patients.

Age and sex	Bone defect of length (cm)	Single/ double stud free fibula	Internal plating /k-wire fixation	External fixator/POP posterior slab	Arthrodesis done or not	Donor vessel	Skin paddle (Yes/no)	Follow up after 9 months
18/M	07	Double strut	K-wire fixation	External fixator	Yes	Anterior tibial artery	Yes	Walking
24/M	7.2	Double strut	DCP	POP posterior slab	No	Posterior tibial artery	Yes	Walking
29/F	6.8	Single strut	DCP	POP posterior slab	No	Anterior tibial artery	Yes	Walking
26/M	7.6	Double strut	DCP	POP posterior slab	No	Anterior tibial artery	Yes	
30/F	8	Single strut	K-wire fixation	External fixator	Yes	Anterior tibial artery	Yes	
32/M	7.8	Single strut	DCP	External fixator	Yes	Anterior tibial artery	Yes	Walking

DISCUSSION

Multi modalities of treatment are available for GCT. The extension of the tumor and involvement of the soft tissue, determines the type of treatment.

Bini et al treated GCT with curettage and cementation. Exothermic reaction of polymethyl methacrylate (PMMA) generates local hyperthermia which induces necrosis of neoplastic tissue. Some surgeons also have recently reported successful treatment of GCT with only monoclonal antibody denosumab.[15]

Majority authors recommended en block resection in recurrent and aggressive variety of GCT but this will result large bone defect which requires reconstruction. There was paucity of literature on GCT involving lower end of tibia. Only few case reports of were present, one treated with curettage and cementing and/bone grafting, another by curettage and tibialization of ipsilateral fibula.[16-19] Conventionally, orthopedicians managed GCT by curettage and cementing or bone grafting, but many cases followed up with recurrence up to 60% or resorption.[20]

To ensure complete cure, healthy bone margin with diseased bone was excised leading to large bone defect, which demanded vascularized bone reconstruction. This was the first case series using free vascularized contralateral fibula transfer for treatment of lower end of tibia defect following WLE with ideal outcome. There had been no recurrence after shortest follow up of 16 months and longest of 32 months.

All grafts well integrated with tibia and good functional outcome such as early weight bearing, good range of movement at ankle in index cases, so this was the ideal treatment because surgeon can be liberal during excision of lesion resulting in no recurrence. While disadvantages of other methods like increased chance of fracture through cement, difficulty in the visualizing recurrence (bone grafting), increase risk of disease transmission (allograft).[21,22]

CONCLUSION

GCT of the lower end of tibia is uncommon, with aggressive behavior in young patients. Distal 1/3rd of tibia defect after WLE of GCT reconstruction is difficult due to its weight bearing property. Vascularized free fibula graft has advantages like it allows surgeons liberty during excision, is a single stage procedure, provides early weight bearing capacity in young patients and vascularized bone with no resorption rate and tibialization of fibula. Hence, autologous free vascularised fibula graft reconstruction of lower 1/3rd tibia defect is considered as one of the best options after wide excision of GCT.

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