Distraction Osteogenesis After Wide Margin Resection in Campanacci Grade III Giant Cell Tumor of Femur and Tibia

Badaruddin Sahito,[1*] Itaat Hussain Zaidi, [1] Suneel Kumar, [1] Dileep Kumar, [1] Noman Parekh, [1] Arsalan Khalil Ayoub, [1] Maratib Ali [1]

ABSTRACT

Objective — *To find the effectiveness of distraction osteogenesis with Illizarov after marginal or wide margin resection for giant cell tumor.*

Study design — *Case series.*

Place & Duration of study — *Department of Orthopaedic Surgery Dow University of Health sciences / Civil Hospital Karachi, from March 2012 to March 2019.*

Methodology — *Patients with giant cell tumor grade III who needed marginal or wide margin resection were enrolled in the study. Patients with Grade I and II giant cell tumor, secondary giant cell tumor and tumor with metastasis were excluded.*

Results — *Ten patients with biopsy proven giant cell tumor with grade III were included in this study. In five patient (50%) tumor was in distal femur, four (40%) proximal tibia and one (10%) in distal tibia. Right side was affected in six patient (60%) and four (40%) were on left side. Marginal and wide margin resection was done in all patients. In all patients bony defect was reconstructed with Illizarov apparatus by bone transport with and without nail. Two patients had retraction of transported bone after Illizarov removal. Additionally bone graft was done in four patients and in patient with distal tibia transport, fixed with T-plate. Consolidation and union were noted in all subjects. All patients had satisfactory score except one female who had problem with corticotomy.*

Conclusions — *Distraction osteogenesis for reconstruction of bone defect after wide margin resection of giant cell tumor worked well. This was found cost effective, doable, biological method of reconstruction. With arthodesis limb was saved but with no joint movement.*

Key words — *Arthodesis, Distraction osteogenesis, Giant cell tumor.*

INTRODUCTION:

The reconstruction method of bones after tumor resection is a challenging issue. No gold standard technique of reconstruction is available till date though multiple biological and non-biological methods have been tried.[1] The reconstructive options after segmental resection of a bone tumors include allografts, vascularized and non-vascularized fibula graft, single or double-barreled, combined allograft and vascularized fibula, endoprosthesis, bone transport with the principles of distraction osteogenesis, either with external fixation or an intramedullary nail. [2]

Distraction osteogenesis is the biological method of reconstruction after marginal or wide margin resection of tumor. Usually this method of reconstruction is used for defect due to trauma, infection and nonunion.[3,4] After tumor resection distraction osteogenesis can be used to achieve intercalary bone regeneration and arthodesis of knee and ankle joints.[5-7] Giant cell tumor is a benign aggressive lesion

[1] Department of Orthopaedic Surgery DUHS and Civil Hospital Karachi.

Correspondence:
Dr. Badaruddin Sahito [1*]
Department of Orthopaedic Surgery
Dow University of Health Sciences
Civil Hospital Karachi
Email: sahito.badar@hotmail.com

which accounts for 5% of total bone tumors and variable rate of recurrence of 5 -25%.[8]

After tumor resection, five types for the reconstruction with distraction osteogenesis are described depending on defect location namely diaphyseal, metaphyseal, epiphyseal, subarticular and arthrodesis. Giant cell tumor can be treated by curettage along with application of bone cement. [9] Impaction bone graft is used to prevent cartilage damage with bone cement.[10] Fibular graft strut or vascularized graft also used in reconstruction.[11,12] This study was conducted to report effectiveness of distraction osteogenesis with Illizarov after marginal or wide margin resection for giant cell tumor.

METHODOLOGY:

This was a case series conducted in the Department of Orthopaedic Surgery, Dow University of Health Sciences / Civil Hospital Karachi, From March 2012 to 2019 study. Patients with giant cell tumor grade III in femur and tibia, after all basic musculoskeletal tumor workup, were included in the study. All patients were treated with marginal or wide margin resection. Patients with grade I and II giant cell tumor, secondary giant cell tumor, tumor with metastasis were excluded from the study. Informed consent was taken.

Incision was made along the previous biopsy scar. Tumor dissected free from surrounding tissue. Popliteal vessels and common peroneal and tibial nerves were identified and spared in distal femur and proximal tibia resection. After resection, nail or navigation wire was placed to align the bone and arthodesis of the knee and ankle joint done. Illizarov apparatus was applied and osteotomy done with osteotome or Gigli saw. This was followed by bone transport to fill the defect. Patients were guided how to do distraction and care of frame. Follow up was done at two weeks interval for the first two months to assess the distraction radiologically followed at each month till consolidation achieved. Descriptive statistics were used to present data.

RESULTS:

Ten patients were included in this study. All patients had pain and swelling of the involved limb. After all investigations biopsy was done. Biopsy proven giant cell tumor Campanacci grade III tumor patients were selected. There were five male and five female patients. Five (60%) patients had tumor in distal femur, four (40%) were in proximal tibia and one (10%) in distal tibia. Right side was affected in six (60%) patients and four (40%) on left side. One patient had hepatitis C and cholelithiasis, one had hypertension and stroke that led to left sided hemiplegia.

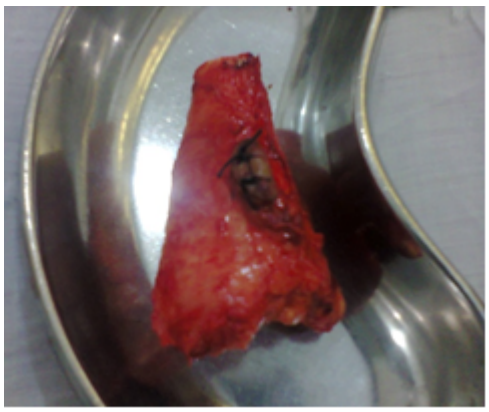
Marginal and wide margin resection was done in all patients. Eight centimeter bone resected in five patients, nine centimeter in two patients, ten centimeters in two, and eleven centimeters in one. Five patients had long interlocking nail placed from femur to tibia. Over the nail Illizarov external fixator was applied and corticotomy was done. Three patients had navigation wire with Illizarov applied. In three patients trifocal transport and distraction compression was done and in five bifocal approach was used.

Illizarov was placed for variable duration, from 6 months to 15 months. Corticotomy was performed with Gigli saw in all patients except one where osteotome was used. One patient who had corticotomy with osteotome, fracture occurred at corticotomy site. Superficial pin track infection noted in all patients. Two patients had retraction of transported bone after Illizarov removal. Additionally the bone graft was done in four patients and in a patient distal tibia transport was fixed with T-plate.

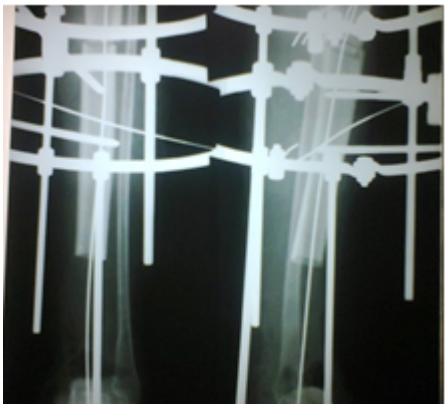
Case I: Giant cell tumor of distal tibia.

Lateral view. Distal tibia GCT

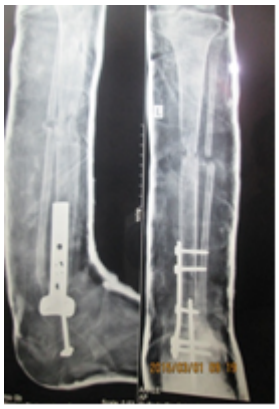
Anterio-posterior view



After tumor resection



Illizarov with Navigation wire

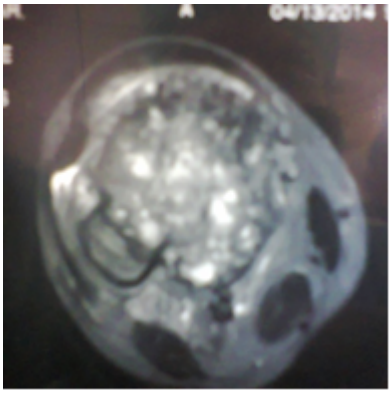


After Bone transport & Illizarov removal

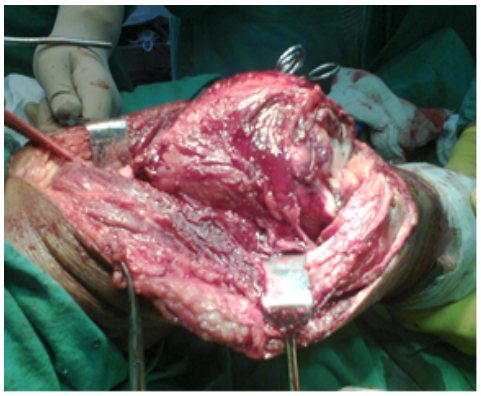
After. Consolidation

Case II: Giant cell tumor of distal femur.

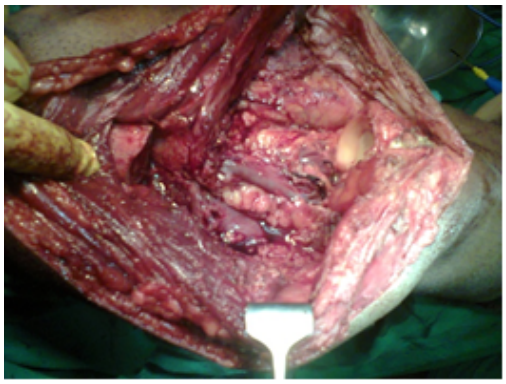
GCT distal femur



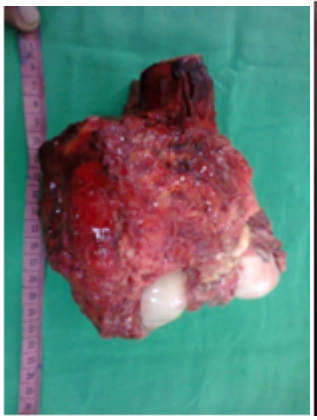
MRI – Tumor adherent to neurovascular bundle



Tumor dissection



After distal femur resection / artery spared



Resected distal femur

Transport over nail

After consolidation and knee arthodesis

Consolidation and union was noted in all patients (Case I & II). All patients had satisfactory Musculoskeletal Tumor Score except one female who had problem with corticotomy. Details are given in table I – III.

DISCUSSION:

Illizarov technique has been used in various studies for patients with giant cell tumors after surgery. In a study conducted in Korea seven patients were managed with Illizarov method and six patients had bifocal bone and one had trifocal bone transport. The mean distraction segment was 6.9 cm. Excellent results were noted in 6 and good in 1 case.[13] A retrospective study reported results of 13 patients after en bloc resection, who were reconstructed with Illizarov bone transport method where tibia was involved. In eight patients of the series, three were distal, four diaphyseal and one proximal level involvement. The external fixation device was removed when consolidation was visible on x rays. The bone defect ranged from 9 cm to 24 cm.[14]

Table I: Demographics of Study Participants

Age (Year)	Number (n %)
20 to 30	4 (40%)
31 to 40	6 (60%)
Sex	
Male	5 (50%)
Female	5 (50%)
Site	
Distal femur	5 (50%)
Proximal tibia	4 (40%)
Distal tibia	1 (10%)
Side	
Right side	6 (60%)
Left side	4 (40%)

Table II: Musculoskeletal Tumor Society Score

Patients (n)	Score (n)
03	25
02	26
03	24
03	24

McCoy et al found Illizarov method an effective limb bone tumor reconstruction technique. In their series 20 patients after resection of bone defect were treated for upper and lower limb tumors. The postoperative Musculoskeletal Tumor Society (MSTS) score was 87% for upper extremity and 93% for lower extremity.[15] Watanabe et al managed 22 bone tumor patients in 10 years where Illizarov technique was used and they concluded that this method has great future but the problems related to treatment duration, pin track infection etc were to be addressed.[16]

In another study thirty-two patients with giant cell tumor around knee were treated with resection of tumor and arthodesis. Full weight bearing and painless arthodesis was achieved in all patients within 6 to 10 months. Local recurrence and tumor fungate in one patient, that ended in amputation.[17]

A study of 17 patients who were treated with intralesional curettage with phenol injection and illizarov fixator application for giant cell tumor showed good to excellent result with no recurrence.[18] A systemic analysis of 33 studies has shown better functional outcome with limb salvage as compared to amputation. Better functional outcome and few complications were noted with biological reconstruction than prosthetics replacement.[19] Limitations of our study is of small sample size though outcome was comparable with other reported series.

CONCLUSIONS:

Distraction osteogenesis is one of the best methods of biological reconstruction after wide margin resection of giant cell tumor. This method is performed easily and cost effective. The satisfactory outcome also results in arthodesis with no joint movement thus there is a need of continuous monitoring and motivation of the patient.

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Received for publication: 12-12-2019

Accepted after revision: 30-01-2020

Author's Contributions:
Badaruddin Sahito: Conception, design of study.
Itaat Hussain Zaidi: Manuscript writing.
Suneel Kumar: Drafting of work.
Dileep Kumar: Manuscript writing.
Noman Parekh: Interpretation of data.
Arsalan Khalil Ayoub: Data interpretation.
Maratib Ali: Final approval of the version to be published.

Conflict of Interest:
The authors declare that they have no conflict of interest.

Source of Funding: None

How to cite this article:
Sahito B, Zaidi IH, Kumar S, Kumar D, Parekh N, Ayoub AK, Ali M. Distraction osteogenesis after wide margin resection in campanacci grade III giant cell tumor of femur and tibia. J Surg Pakistan. 2019;24 (4):191-6. Doi:10.21699/jsp.24.4.7.