Archives & Clinical Experimental Surgery

Original Article

Arch Clin Exp Surg 2017;6:189-194

doi:10.5455/aces.20170115061337

Extended curettage and reconstruction with proximal fibula for treating giant cell tumor of lateral femoral condyle: A prospective study

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ABSTRACT

Background: The giant cell tumor (GCT) affecting lateral femoral condyle poses problems in reconstruction after the extended curettage of the lesion. This study was aimed to analyze the results of cases in which the upper end of fibula was placed upside down to reconstruct the lateral femoral condyle.

Methods: Patients with GCT affecting lateral femoral condyle, who underwent treatment at our institution from January 2008 to June 2013, were selected. Imaging and biopsy were done to confirm the diagnosis as well as to plan the surgery. After extended curettage of the lesion, the void was reconstructed with proximal fibula and allograft. The outcome was measured using Musculoskeletal Tumor Society-87 (MSTS) score and subjected to statistical analysis.

Results: In this prospective study, twelve cases (mean age 39) were selected. Among the 12 cases, 7 had sustained the pathological fracture. After a minimum of 2 years of follow-up, the mean MSTS scores in cases with or without pathological fracture were 25.85 ± 2.47 and 27.60 ± 0.54, respectively, which was found statistically non-significant (p = 0.155). The recurrence rate was 16.7%, which underwent repeated curettage, and 8.3% had the infection.

Conclusion: Treatment of GCT of lateral femoral condyle by extended curettage and reconstruction with proximal fibula seems to be a viable option with a good functional outcome, even in cases with pathological fractures. The biological form of reconstruction has the long term advantage of remodeling and can incorporate with the reconstruction as permanent.

Key words: *Giant cell tumors, femur, fibula, curettage, bone transplantation, musculoskeletal tumor society scoring system*

Introduction

Giant cell tumor (GCT) of bone was classified by World Health Organization under osteoclastic giant cell-rich tumors of intermediate nature, which is locally aggressive and is rarely metastasizing [1]. It most commonly occurs between 20 and 40 years of age with a slight female preponderance and constitutes about 20% of all benign bone tumors and 5% of total bone tumors [2]. GCT has higher incidence rates in Asian countries as compared to the western ones, comprising 20% of all bone tumors [3]. The best treatment must ensure local control and maintain the function. Curettage is the preferred treatment for most cases of GCT even in cases with pathological fracture [2].

Treatment of GCT is a challenging task to most of the orthopedic surgeons because of its inherent nature for recurrence (10%-20%) [4]. Although local recurrence of GCT is high, an extensive surgery for the pri-

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Received / Accepted : *June 20, 2016 / October 17, 2016*

mary tumor in an attempt to obtain wide margins is not the method of choice, since it leaves the patient with higher morbidity with no significant gain with respect to the cure of the disease. There is no definite guideline regarding treatment. Bone cement, bone graft, patella (d'Aubigne procedure), arthroplasty, and so forth were generally used to address the problem. Every method has its own set of benefits and adverse effects. Options of reconstruction of lateral femoral condyle after curettage of the lesion include filling the lesion with bone cement or bone graft. Although bone cement has the advantage of early weight bearing and easier detection of local recurrence, it is not a biological material and may cause degenerative changes in the cartilage in the long term. On the other hand, bone graft incorporated into the parent bone can undergo remodeling in the long term [4]. The main disadvantage of bone graft is its limited supply of autograft and donor site morbidity. In this study, we describe a simpler and easier method of reconstructing femoral condyle using the fibular head.

Materials and Methods

Patients' Selection

A prospective study was designed to include patients presented in the Department of Orthopedics, with GCT affecting the lateral condyle of distal femur over a period of 5 years (January 2008 to June 2013). All patients were evaluated with X-ray (Figure 1A), computerized tomography (CT) scan of the knee (Figure 1B) as well as chest (to rule out metastasis), and magnetic resonance imaging to assess soft tissue extension and position of neurovascular structures in relation to the tumor. CT guided biopsy was taken from all lesions preoperatively. Biopsy track was planned in order to incorporate it in the definitive surgical incision. Patients were selected for curettage and fibular strut grafting only after the fulfillment of criteria laid down by the author which was based on the CT findings [5,6]. The cases of GCT were divided into three classes. Class I tumors were intraosseous with no cortical breaks. Class II tumors were extraosseous lesions with cortical breaks confined to one surface and not exceeding one-third of the bone's circumference. Class III tumors were extraosseous lesions that had broken through the cortex at more than one surface or extended into more than one-third of the bone's circumference. Patients with class I and II tumors were selected for curettage, whereas class III underwent resection and reconstruction. Written consent was obtained from the patients or their relatives and the study design was approved by the Institutional Ethics Committee for Research.

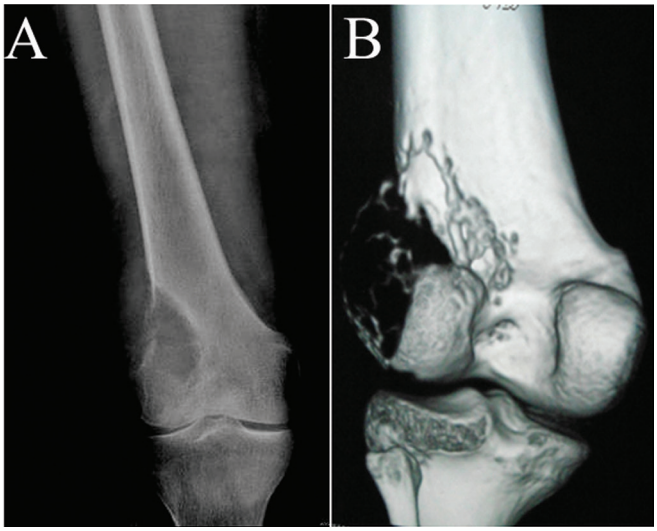

Figure 1. (A) Preoperative X-ray and **(B)** preoperative 3d CT.

Procedure

Under anesthesia using a tourniquet, the lesion was approached from the lateral side. The site of cortical break and the biopsy track will determine the exact line of incision. This incision can be extended distally along the lateral border of the fibula in order to harvest the proximal fibular autograft. This involves the identification of common peroneal nerve, which can be easily palpated near the fibular head as it passes around the inferior border of biceps femoris (Figure 2A). Attachment of biceps femoris was detached from its insertion and is retracted proximally. The fibula was exposed in a classical manner and osteotomized at a predetermined length according to the calculation from the preoperative CT. While harvesting the proximal fibula undue force was not used in stripping the periosteum at the fibular head, as this may cause crushing of the soft cancellous bone at that site. After harvesting the fibula, the tumor area was exposed, if the cortical break was posterolateral, one has to identify and protect the peroneal and tibial nerve, ligate the superior lateral genicular artery, and retracte the popliteal vessels. If the cortical break was anterolateral, dissection was rather easy. Overlying soft tissue along the softened bone cortex was removed as an operculum creating a window to curette out the tumor. An extended curettage was done using phenol. At this stage, we deflate the tourniquet

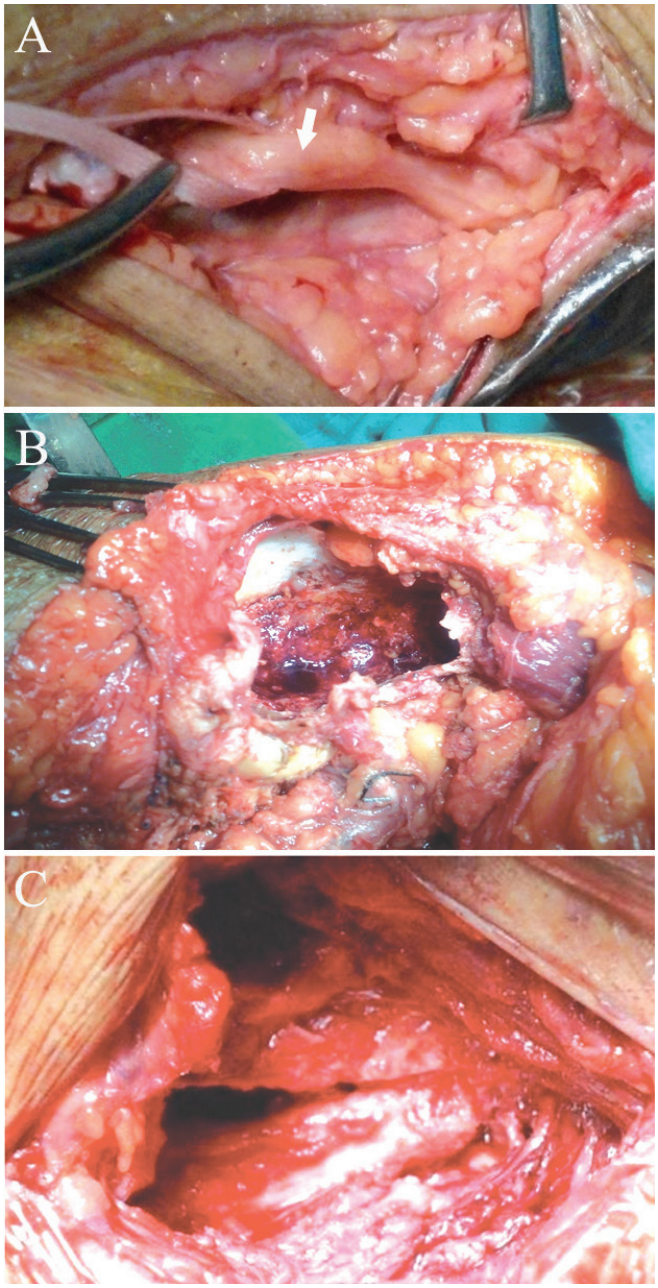

Figure 2. (A) Identification of common peroneal nerve (arrowhead) before harvesting fibula, **(B)** tumor cavity after extended curettage, and **(C)** tumor cavity with proximal fibular graft.

to attain the hemostasis (Figure 2B). The fibula was placed upside down so that the head of fibula was fixed well into the subarticular surface of the lower end of the femur. The distal end of the graft was telescoped and impacted on the healthy remaining femur (Murphy bone skid may help to place the fibular head into the lateral femoral condyle with ease) (Figure 2C). In two cases where the femoral canal was wide, a 4.5 mm cortical screw was applied just proximal to the graft under C-arm, in order to prevent the proximal migration of fibular graft. The remaining void was filled with allograft. In 3 cases, G-bone was used.

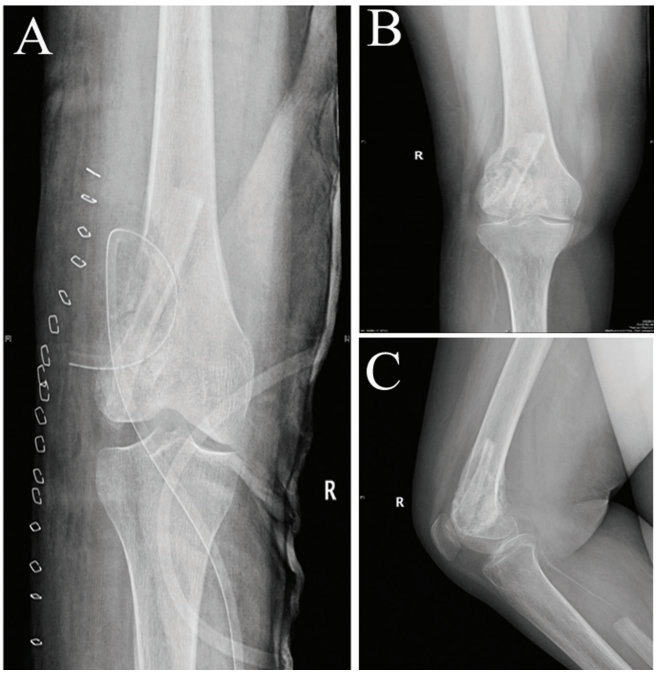

Figure 3. (A) Immediate postoperative X- ray and **(B)** X-ray after 2 years, anterior-posterior view, and **(C)** X-ray after 2 years, lateral view.

After the wound closure long leg cast was given and the window was marked on the cast. The wound was inspected on the 5th day or earlier if there was any discharge. Sutures were removed on the 10th day and patients were discharged from the hospital. All the surgeries were performed by the same surgeon and the functional outcome was measured using Musculoskeletal Tumor Society-87 (MSTS) score system [7]. Long leg cast was removed on the 6th week and the patient was put on continuous passive motion machine. Most of the cases regained 70 degrees of knee flexion after 1 week of physiotherapy. They were instructed to have partial weight bearing for 6 weeks and full weight bearing was allowed after 12 weeks. Further, follow-up was done every 3 months for 1 year and every 6 months thereafter. They were evaluated with X-rays on every visit (Figure 3A-C).

Statistical Analysis

The statistical analysis was performed using GraphPad InStat software (GraphPad InStat, CA, USA). Comparisons of the MSTS score between the pathological and nonpathological fracture were done by unpaired t-test. P less than 0.05 was considered as significant.

Results

Among the total 107 cases of GCT, 18 cases were confined to the lateral condyle (Table 1). We have reconstructed 12 of these cases with the upper end of

Table 1. Distribution of giant cell tumor.

Distribution of giant cell tumor	Frequency
Lower end of femur	41
Upper end of tibia	24
Distal end of radius	25
Pelvis	6
Ulna	3
Talus	3
Metacarpals	2
Metatarsals	1
Phalanges	1
Humerus	1
Total no. of giant cell tumor	107

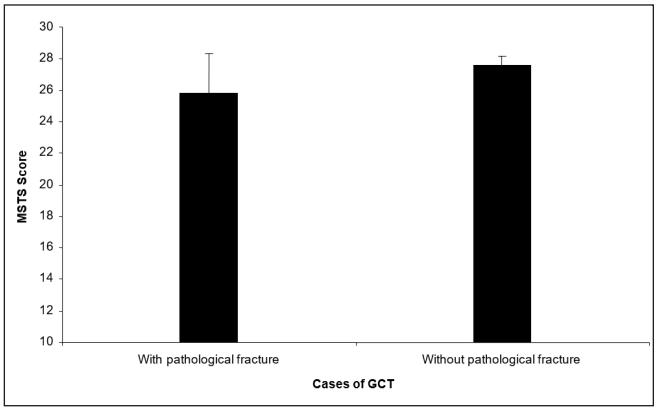

Figure 4. The mean Musculoskeletal Tumor Society-87 scores in cases with or without pathological fracture.

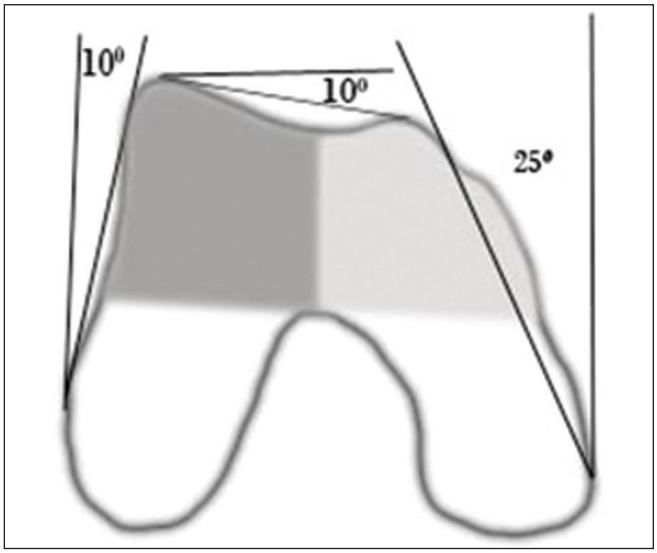

Figure 5. Difference in area of the anterior portion of medial and lateral femoral condyle.

the fibula. Seven of them presented with pathological fracture and rest of them pain on weight bearing. The lesion was present on the right side in 8 patients and on the left in 4 patients. Eight patients were females and 4 were males (Figure 4). The average age of patients was 39 yrs (ranges from 21 to 54 yrs). The mean period of follow-up was 2.9 years (2 to 4 years).

The outcome was measured using MSTS system. The mean MSTS scores, statistically non-significant ($p = 0.155$), in cases with or without pathological fracture were 25.85 and 27.60, respectively (Figure 4). Out of 12 cases, 2 had a recurrence at 2-year follow-up. This was treated by repeated curettage. Peroperatively, it was found that the fibula strut graft was partially involved by the tumor. It was still intact including the portion of the head that goes into the condyle. The involved portion was cleared of the tumor tissue and the defect was filled with bone cement. There was no evidence of recurrence three years after the second surgery. One case had an infection which was treated by debridement and antibiotic-impregnated cement beads. Except for the patient with infection, all cases had range-of-motion more than 90^0. Of the 7 cases of pathological fracture, 4 cases had valgus deformity more than 10^0 compared with the opposite side. Clinically there was no appreciable instability of knee at 6-month follow-up.

Discussion

In most of the GCT cases involving the lower end of the femur, a preponderance of tumor was found to occur in the lateral femoral condyle. Author's personal series from January 2008 to June 2013 found that most frequent locations in decreasing order are the distal femur, the proximal tibia, and the distal radius, which was consistent with the other study [2]. Rao reported 86 cases of GCT among the 200 cases of primary bone tumors in South India [8]. High incidence of GCT was reported from Andhra Pradesh and Madras, India [9,10]. Treatment of GCT of lateral femoral condyle chiefly consists of extended curettage followed by bone grafting or bone cement [11]. As only one condyle remains involved and the tumor does not involve the articular cartilage, there is no need to sacrifice the joint. d'Aubigne procedure using patella remains a standard procedure in such situations, in which articular surface of the patella was used to reconstruct the articular surface of lateral femoral condyle [12]. The disadvantages of this technically demanding procedure included weakening of quadriceps and using nonarticular part of

the patella as the articular portion of the condyle. Another simple option will be to use middle third of fibular shaft as strut graft. But, in our experience, applying fibular shaft into the condyle has led to fresh fracture of the pathological condyle or increase in the split of the existing fracture. This was not found with fibular head in the condyle which may be probably due to the large area of fibular head which produces less pressure than the shaft (GCT of medial femoral condyle is not amenable to reconstruction with reversed proximal fibular graft due to 1; fibular shaft inserted into the femoral medullary canal aligns with the anterior portion of medial condyle and 2). Due to differences in anatomy of medial and lateral condyles (Figure 5), anterior portion of medial condyle is not spacious enough to accommodate fibular head comfortably.

In our procedure, we used the fibular head to support and not to replace the articular cartilage of lateral femoral condyle. This is a simpler and easier method of reconstructing femoral condyle. Upper fibula being expendable adds no morbidity to the patients. Only a single incision is required. The cortical part of the fibular shaft gives structural support to the curetted out cavity, whereas the cancellous part of fibular head incorporates well into the articular portion. Graft fixation by the implant is often not required. Moreover, the presence of implant makes imaging and treatment of recurrence difficult. Since prosthesis was avoided, chances for infection were less and expense for the patients reduced. However, the disadvantage was a longer period of immobilization. Steyern et al. have quoted that local recurrence after curettage and cementing in long bones can successfully be treated with further curettage and cementing, with only a minor risk of increased morbidity [13]. Out of 12 cases in this study, 2 cases had the recurrence at 1-year follow-up and were treated by repeated curettage.

No correlation was found between the histological grading and behavior of tumor. The only guideline was radiological staging. Based on the CT findings, the lesion was approached through the site of cortical break [5,6]. This was to remove the involved soft tissue en mass. This calls for an approach which was not classically used for open reduction and internal fixation. Moreover, the lesion was in the epiphysis and extends up to the articular cartilage which made the fixation difficult, when there was the pathological fracture or impending pathological fracture.

Conclusion

Treatment of GCT of lateral femoral condyle by extended curettage and reconstruction with proximal fibula seems to be a viable option with a good functional outcome, even in cases with pathological fractures. Tumor recurrence can be managed by further curettage without the significant increase in the morbidity of the patient.

Acknowledgement

The authors gratefully acknowledge the valuable help of Dr. Ajith T. A., Professor at the Department of Biochemistry, Amala Institute of Medical Sciences, Thrissur, Kerala, India, during the preparation of the manuscript.

Conflict of interest statement

The authors have no conflicts of interest to declare.

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