Proximal Tibia Chondroblastoma Treated With Curettage and Bone Graft and Cement Use

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Abstract

Chondroblastoma has a predilection for the epiphyses or apophyses of long tubular bones. Management of lesions in the proximal tibia is challenging because it is difficult to gain access to intraepiphyseal lesions for completion of curettage. From October 2007 to December 2011, 9 patients with de novo chondroblastoma of the proximal tibia underwent surgery at the authors’ institution. All patients initially presented with pain, and 5 patients had limitation of range of motion of the ipsilateral knee. Four lesions abutted the tibial attachment sites of the cruciate ligaments. Surgical procedures included intrasional tumor curettage, additional burring, and packing of the defect with bone graft and/or bone cement. The extra-articular approach was used according to tumor location. The medial or lateral parapatellar approach was used when the tumor was located in the anterior two-thirds of the horizontal plane. When a lesion was located in the posterior third, the posteromedial or posterolateral approach was used as the lesion was cornered. Mean duration of follow-up was 47.2 months (range, 27-80 months). No local recurrence or pulmonary metastasis was noted at latest follow-up. Mean functional score was 29.3 points (range, 28-30 points). All patients fully recovered range of motion in the affected knee. No avulsion fracture or anteroposterior instability of the knee joint was detected. Results of the current study suggest that intrasional curettage followed by additional burring with an extra-articular approach is a successful treatment option for chondroblastoma of the proximal tibia. [Orthopedics. 2016; 39(1):e80-e85.]

Chondroblastoma has a predilection for the epiphyses or apophyses of long tubular bones. In the second decade of life, the femur is the most common site, followed by the humerus and the tibia. Lesions in the proximal tibia are far more likely to occur in the proximal epiphysis than in the distal epiphysis. Although large series have reported the surgical outcomes of chondroblastoma, the specific management and results in patients with chondroblastoma of the proximal tibial epiphysis were not specified.

Curettage of the tumoral lesion is the treatment of choice for uncomplicated chondroblastomas. However, the local recurrence rate for chondroblastomas is relatively high, ranging from 8% to 35%, because of its proximity to the articular cartilage and the physis, which remains open in patients in the prevalent age bracket. Few cases of proximal tibial lesions have been reported, despite their high prevalence. Determining the surgical approach to this anatomic site for...
intralesional curettage is challenging. The intraepiphyseal location of most chondroblastomas leads to difficulty in gaining access for completion of curettage, especially for the posterior portion of the proximal tibia. In addition, the tumor often invades the tibial attachment site of the cruciate ligament. Therefore, some authors introduced alternative procedures to surgical curettage that ranged from radiofrequency thermoablation with arthroscopic or computed tomography (CT) guidance to wide resection. However, it is difficult to determine the extent of thermoablation. Because chondroblastoma is locally aggressive, extended curettage under direct visualization should be considered the primary treatment.

To the authors’ knowledge, no single study has focused on the surgical approach, technique, and oncologic and functional outcomes of chondroblastoma in the proximal tibial epiphysis, even though the proximal tibia is the third most common site of chondroblastoma. The goal of this study was to review treatment results in patients treated with intralesional curettage of chondroblastoma of the proximal tibial epiphysis with an extra-articular approach.

**Materials and Methods**

The authors obtained a list of patients who had chondroblastoma of the proximal tibia from the orthopedic surgical database at their hospital. They reviewed the patients’ medical records, including radiologic data, pathologic results, and surgical records. From October 2007 to December 2011, 9 patients with de novo chondroblastoma of the proximal tibia underwent surgery at the authors’ institution. The presenting data of the 9 patients are summarized in the Table. The study group included 7 men and 2 women, with mean age of 21.2 years (range, 14-42 years) at surgery. Mean duration of follow-up was 47.2 months (range, 27-80 months). All patients initially presented with pain, and 5 patients had limitation of range of motion of the ipsilateral knee. Mean tumor size on initial presentation was 2.8 cm (range, 1.0-3.8 cm) at the greatest diameter, and 3 of the 9 lesions extended to the metaphysis. Four lesions abutted the tibial attachment sites of the cruciate ligaments, and all of them had limitation of range of motion of the knee before surgery. The diagnosis of chondroblastoma was made based on radiologic findings in all patients. No separate biopsy was performed before surgery when the presumptive diagnosis was chondroblastoma, based on imaging studies. Moreover, a small lesion in the posterior aspect of the proximal tibia is hard to access for the biopsy. Instead, frozen section was performed at the time of curettage.

Surgical procedures included intralesional tumor curettage, additional burring, and packing of the defect with bone graft and/or bone cement. The extra-articular approach was used according to the tumor location (Figure 1). The medial or lateral parapatellar approach was used when the tumor was located in the anterior two thirds of the horizontal plane. A skin incision was made on the medial or lateral side of the patellar tendon. After the infrapatellar fat pad was elevated from the anterior cortex, a cortical window was made under fluoroscopic guidance (Figure 2). When a chondroblastoma was located in the posterior third of the horizontal plane, the posteromedial or posterolateral approach was used as the lesion was coronal. The postero medial approach was used in 3 patients, with the patient in the supine position with 60° flexion. A longitudinal skin incision of approximately 5 cm was made on the posteromedial edge of the proximal tibia.

### Table

**Patient Characteristics**

<table>
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<th>Patient No./Sex/Age, y</th>
<th>Size, cm&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Cruciate Ligament&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Range of Motion</th>
<th>Approach</th>
<th>Filler</th>
<th>Follow-up, mo</th>
<th>Functional Score</th>
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<td>Cement</td>
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<td>30</td>
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<td>20°-125°&lt;sup&gt;d&lt;/sup&gt;</td>
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<td>Cement</td>
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<td>Anterior</td>
<td>20°-120°&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Anteromedial</td>
<td>Bone graft</td>
<td>31</td>
<td>30</td>
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<td>Bone graft</td>
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<td>Posteromedial</td>
<td>Bone graft</td>
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<td>28</td>
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*Abbreviations: F, female; M, male.
<sup>a</sup>Longest diameter of lesion.
<sup>b</sup>Abutting the anterior or posterior cruciate ligament.
tibial epimetaphysis. The interval between the pes anserinus tendon and the medial head of the gastrocnemius was developed, and the popliteus muscle was retracted inferiorly. For better visualization, the proximal half of the popliteus muscle was cut off of the posteromedial surface. This approach allowed exposure of the medial two thirds of the posterior surface, even over the tibial attachment site of the posterior cruciate ligament. The posterolateral approach was used when the lesion was located in the posterolateral area of the proximal tibial epiphysis. With the patient in the prone position, a skin incision that was approximately 5 cm long was made along the common peroneal nerve. The lateral head of the gastrocnemius was retracted medially, and then the popliteus with the underlying periosteum was elevated and retracted superiorly (Figure 3). For curettage, a cortical window was made over the lesion under fluoroscopic guidance, with care taken not to injure the physe when it remained open. Then intraoperative frozen section was performed. After curettage, high-speed burring was adopted as an adjuvant treatment in all patients. To fill the defect after curettage and burring, allogeneic or autogenous bone graft (6 cases) or methylmethacrylate bone cement (3 cases) was used. The choice of packing material was determined by careful consideration of a variety of factors, including patient age, defect size, lesion location, and bone quality. All procedures were performed without penetration of the knee joint. No metal implants were placed.

Postoperatively, patients used crutches with partial weight bearing for 3 weeks. When the tumor abutted the tibial attachment sites of the cruciate ligaments, the knee joint was immobilized for 4 weeks to prevent an avulsion fracture. All patients had follow-up with plain radiographs of
the knee every 3 months and posteroanterior chest radiographs every 6 months for first 2 years and then once annually to monitor for local recurrence and pulmonary metastasis. In addition, growth disturbance of the proximal tibial physis was monitored by radiographic comparison of the angular profile and leg length with the contralateral leg. At every regular visit, anteroposterior stability of the knee joint was evaluated, especially in patients with tumor involvement of the area of tibial attachment of the cruciate ligaments. Functional evaluation was performed with the classification system of the International Society of Limb Salvage. This classification has 6 functional parameters, including pain, function, emotional acceptance, use of walking supports, walking ability, and gait. Each parameter is scored on a scale of 0 to 5, for a maximum score of 30.

RESULTS
No immediate postoperative complications occurred, including wound infection, nerve palsy, and vascular compromise. No local recurrence or pulmonary metastasis was noted at latest follow-up. Mean duration of follow-up was 47.2 months (range, 27-80 months). Mean functional score for the 9 patients was 29.3 points (range, 28-30 points). Because of the small number of patients available, no significant difference was found between the cement packing and bone graft groups in recurrence rate, functional score, or growth disturbance. All patients fully recovered range of motion in the affected knee. No avulsion fracture or anteroposterior instability of the knee was noted. No patient had pain at latest follow-up. Because most patients were affected near the end of their growth spurt, growth disturbance did not occur.

DISCUSSION
Chondroblastomas can be locally aggressive and rarely cause distant metastasis, despite histologically benign features. Intralesional curettage is the treatment of choice. However, surgical procedures range from radiofrequency thermoablation with arthroscopic or CT guidance to wide resection and arthrodesis. The intraepiphyseal location of most chondroblastomas leads to difficulty in gaining access to the lesion for curettage. Even though the proximal tibia is a prevalent site of chondroblomastoma, only a few case reports specified this anatomic site. This article retrospectively reviewed surgical techniques and treatment outcomes for chondroblastomas of the proximal tibial epiphysis. In the current study, all chondroblastomas of the proximal tibia were successfully treated with extra-articular approaches, and all patients had satisfactory functional outcomes.

Chondroblastomas and giant cell tumors are representative epiphyseal tumors. The surgical approach is intricate because most chondroblastomas occur in adolescents in whom the physis is open. Moreover, the small size of the lesion makes it difficult to gain access. Many large series of chondroblastomas have been reported, but only a few case reports described surgical approaches and techniques. De Boeck et al reported a case of chondroblastoma invading the attachment of the posterior cruciate ligament. They used a posterior S-shaped incision described by Trickey that was originally used for ligament reconstruction. This approach allows access to the posterior structures of the knee, including the posterior capsule, the posterior part of the menisci, the posterior aspect of the femoral and tibial condyles, and the origin of the posterior cruciate ligament. However, this approach has some disadvantages for tumor curettage. It requires exposure of major neurovascular bundles and leads to a risk of potentially malignant contamination by the tumor that may occur even though the tumor appears benign on radiologic studies. In addition, it can produce permanent serious disability, such as vascular complications, nerve injury, and linear scar contracture across the popliteal crease.

This study used extra-articular approaches in all patients, including medial/lateral parapatellar, and posteromedial/posterolateral approaches. These approaches allowed access to the lesion without exposure of major neurovascular bundles and the knee joint, with the exception of the posterolateral approach that required isolation of the peroneal nerve. A parapatellar approach was used for lesions located in the anterior two thirds of the axial plane. Advantages of this approach include easy creation of a window, with no need for arthotomy after elevation of the infrapatellar fat pad. In addition, a healthy cancellous bone on the way to the lesion can be reused as bone graft material when the lesion is far from the window. Posteromedial and posterolateral approaches were used in 4 patients whose lesion was located in the posterior third of the axial plane. Compared with the conventional posterior approach, this technique requires a shorter skin incision. On the other hand, with the conventional posterior approach, the area from the skin to the posterior cortex is so deep that relatively wide dissection is needed. Moreover, this approach requires manipulation of the major neurovascular bundles, and potential complications include vascular compromise, nerve palsy, and tumor contamination if malignancy is present. This approach has been used for all benign and low-grade lesions of the proximal tibia and modified according to tumor location and characteristics. This approach also allows the surgeon to access and manage the lesion under direct vision. Otherwise, the lesion can be difficult to access.

As alternatives to open surgical curettage, arthroscopic resection and percutaneous radiofrequency thermoablation were introduced in several reports. Cohen et al reported intra-articular resection of chondroblastoma with arthroscopic assistance, and Zoccali et al described arthroscopy-guided biopsy and radiofrequency thermoablation for a chondroblastoma of the tibial spines area.
This technique allows the use of a minimal skin incision and direct monitoring of the articular cartilage during the procedure, but there is a risk of intra-articular tumor contamination. In addition, in the case presented by Zoccali et al,13 the high pressure from the arthroscopic water pump broke the tibial joint surface. Radiofrequency thermoablation with CT guidance was also introduced as an alternative primary treatment for chondroblastoma and has proven to be an effective treatment for osteoid osteoma.14 This technique can be performed with a percutaneous single approach for a small lesion, but several overlapping or contiguous heat treatments are needed for a large tumor. In addition, if malignancy is suspected, this procedure may be inappropriate.

Previous studies reported recurrence rates of 8% to 35%. Ramappa et al15 suggested that bone cement packing would be beneficial in preventing local recurrences. However, some authors emphasized that local recurrences depend primarily on the thoroughness of tumor eradication. Springfield et al2 noted that “thorough curettage” is the key to local control. Several studies included patients with chondroblastoma of the proximal tibia, but no study focused on this anatomic site. A study by Mashhour et al16 included 3 patients with chondroblastoma of the proximal tibia in a total of 14 cases in which liquid nitrogen was used as an adjuvant. The overall rate of local recurrence was 7.1%, but there was no local recurrence in the proximal tibia. Atalar et al17 reviewed 28 patients with chondroblastoma, including 7 patients with chondroblastoma of the proximal tibia. They reported no local recurrence in this anatomic location after curettage and additional burring and/or electrocautery. The current study used high-speed burring after curettage in all patients because many authors recommend this technique in the management of benign aggressive bone tumors, including chondroblastomas. No local recurrence was reported at latest follow-up.

A major concern in chondroblastoma is determination of the type of packing material for the defect after curettage. Bone graft has the theoretical advantage of restoring normal biomechanics to the joint surface to prevent future degenerative joint disease. It also restores bone stock, which may be helpful if future procedures are necessary. However, the use of bone graft requires joint protection for an extended time to prevent a pathologic fracture. In addition, tumor recurrence can be difficult to distinguish from graft resorption. On the other hand, bone cement provides immediate stability, allows easier detection of recurrence, and may kill residual tumor cells through the heat of polymerization. In addition, there is no limitation of the amount of cement available. However, bone cement may lead to arthritis when it is used in a subchondral bone defect. When choosing a packing material, the authors consider various factors, including patient age, defect size, lesion location, and bone quality, rather than just 1 criterion.

The effect of cement use on the physes is controversial. Wallace and Henshaw20 investigated the results of cement and bone graft after curettage of bone tumors in skeletally immature patients. They suggested that the use of cement does not increase the risk of postoperative growth disturbance or deformity. However, some authors reported concerns about premature physeal closure after cement use. In an animal study, the physes treated with radiofrequency at 60°C was seen to fuse.21 Gaston et al22 reported a case in which the physis was supposed to be damaged by the heat of polymerization. As is well known, the heat of cement polymerization ranges from 60°C to 80°C and extends a few millimeters into the surrounding bone.2324 Further investigation is needed to determine whether the use of bone cement may cause physeal arrest or prevent the formation of osseous physeal bar. Some authors have suggested that growth complications in patients with chondroblastoma may be related not to the surgical procedure but to the aggressiveness of the tumor. Lin et al25 and Springfield et al2 noted that violation of the epiaphysial plate was observed before surgical resection in a few patients, and they suggested that growth complications after operative procedures are not entirely iatrogenic. In the current series, no patient had growth arrest or growth-related deformity because most patients were affected near the end of their growth spurt.

Limitations

Limitations of the current study include the retrospective design and small sample size. The authors were not able to conduct sound analyses to determine the factors affecting oncologic and functional outcomes. Nevertheless, the results suggest that intralesion curettage followed by additional burring with an extra-articular approach would be a successful treatment option for chondroblastoma of the proximal tibia.

CONCLUSION

Nine patients with de novo chondroblastoma of the proximal tibia underwent surgery with extra-articular approaches. These approaches allowed access to the lesion without exposure of major neurovascular bundles and the knee joint and enabled the surgeon to manage the lesion under direct vision.11

REFERENCES

5. Ramappa AJ, Lee FY, Tang P, Carlson JR, Gebhardt MC, Mankin HJ. Chondroblas-


