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Research Article

Chondroblastoma Around the Knee Treated with Curettage and Bone Grafting: An Observational Study of 12 Cases from a Tertiary Care Centre in Eastern India

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Abstract

Background: Chondroblastomas are uncommon benign cartilage-forming tumors that are usually found in the epiphyses of long bones in skeletally immature patients. Though their benign nature is well appreciated, their proximity to the joint surface and growth plate creates management challenges. ***Objective***: To review the presentation, surgical intervention, and outcome of 12 cases of chondroblastoma around the knee. ***Methods***: We retrospectively reviewed 12 patients with histologically proven chondroblastoma of the distal femur, proximal tibia, or patella. Curettage and bone grafting were performed in all the patients with careful attention to exposure and articular cartilage preservation. Clinical presentation, imaging, operative findings, complications, and follow-up results were recorded. ***Results***: There were nine males and three females, aged between 14 and 38 years. Seven tumors were found in the proximal tibia, four were found in the distal femur, and one was found in the patella. MRI played a crucial role in defining the size and site of the lesions. Seven tibial cases were treated by a posterior approach, and femoral and patellar lesions by parapatellar approaches. All the patients showed complete recovery with consolidation of bone on radiographs and attained complete functional recovery without recurrence after a minimum follow-up period of 12 months. ***Conclusions***: Chondroblastomas of the knee area are challenging for diagnosis and surgery because of their location. Early diagnosis and proper surgical strategy with meticulous curettage and bone grafting can lead to excellent results. Knowledge regarding this tumor's imaging and clinical presentation enables early intervention and good prognoses.

Keywords: Bone grafting, Chondroblastoma, Curettage, Epiphyseal tumor, Knee neoplasms, Patellar tumor.

الورم الأرومي الغضروفي حول الركبة المعالج بالكشط وتطعيم العظام: دراسة قائمة على الملاحظة ل 12 حالة من مركز رعاية من الدرجة الثالثة في شرق الهند

الخلاصة

الخلفية: الأورام الأرومية الغضروفية هي أورام حميدة غير شائعة مكونة للغضاريف توجد عادة في مشاشية العظام الطويلة في المرضى غير الناضجين من الهيكل العظمي. على الرغم من أن طبيعتها الحميدة تحظى بتقدير جيد، إلا أن قربها من سطح المفصل ولوحة النمو يخلق تحديات إدارية. **الهدف**: مراجعة العرض والتدخل الجراحي ونتائج 12 حالة من الورم الأرومي الغضروفي حول الركبة. **الطرائق**: قمنا بمراجعة 12 مريضا بأثر رجعي يعانون من الورم الأرومي الغضروفي المثبت نسيجيا في عظم الفخذ البعيد أو الظنبوب القريب أو الرضفة. تم إجراء الكشط وتطعيم العظام في جميع المرضى مع الاهتمام الدقيق بالتعرض والحفاظ على الغضروف المفصلي. تم تسجيل العرض السريري والتصوير والنتائج الجراحية والمضاعفات ونتائج المتابعة. **النتائج**: كان هناك تسعة ذكور وثلاث إناث تتراوح أعمارهن بين 14 و 38 عاما. تم العثور على سبعة أورام في الظنبوب القريب، تم العثور على أربعة في عظم الفخذ البعيد، وتم العثور على واحد في الرضفة. لعب التصوير بالرنين المغناطيسي دورا مهما في تحديد حجم وموقع الآفات. تم علاج سبع حالات في الظنبوب بنهج خلفي، وآفات الفخذ والرضفة من خلال مقاربات الرضفة. أظهر جميع المرضى تعافيا تاما مع توحيد العظام في الصور الشعاعية وحققوا الشفاء الوظيفي التام دون تكرار بعد فترة متابعة لا تقل عن 12 شهرا. **الاستنتاجات**: تمثل الأورام الأرومية الغضروفية في منطقة الركبة تحديا للتشخيص والجراحة بسبب موقعها. يمكن أن يؤدي التشخيص المبكر والاستراتيجية الجراحية المناسبة مع الكشط الدقيق وتطعيم العظام إلى نتائج ممتازة. تتيح المعرفة المتعلقة بالتصوير والعرض السريري لهذا الورم التدخل المبكر والتكهن الجيد.

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INTRODUCTION

Chondroblastomas are benign cartilage-producing neoplasms that constitute < 1% of all bone tumors [1]. It was first described as a giant cell tumor with calcification by Kolodny in 1927 and next as a calcifying giant cell tumor by Ewing in 1928 [2,3]. Even Codman, after whom these tumors are also called Codman's tumor, initially thought these to be an epiphyseal chondromatous variant of giant cell tumors [4], but Jaffe and Lichtenstein confirmed these tumors to be distinct from GCTs and coined the term

chondroblastoma [5]. They are located eccentrically in the epiphysis in skeletally immature patients (10-25 years). It may cross the growth plate into the metaphysis, but penetration into the joint is extremely rare [6]. However, when found in the epiphysis of major weight-bearing bones, their wall may break with weight-bearing, leading to intra-articular deformation and arthritic features. The most common sites are the femur (distal and proximal, characteristically the greater trochanteric apophysis), tibia, and humerus [7]. Another variety of chondroblastomas is found in flat bones such as temporal bones, the ilium, or the acetabulum, and these varieties are seen in older populations in the 3rd-5th decades [6]. They usually present as solitary lesions with localized pain of long duration as the predominant symptom. The average duration before diagnosis is about 20 months. The lesions are mostly lytic , with little calcification and periosteal reaction, and typically occupy less than half of the epiphyseal width in a geographic pattern [8]. They characteristically have a thin sclerotic rim, which distinguishes them from GCTs. Occasionally secondary ABCs may develop, and lung metastases may occur—called aggressive chondroblastomas [9]. Clinically, often there is a delay in diagnosis, as we rarely do an MRI for vague joint pain in this age group, which is often dismissed as growth-related pain or a symptom of vitamin D deficiency. However, with a high index of suspicion, we can pick up this tumor, which needs a marginal excision with bone grafting as the only treatment and gives excellent functional outcomes if treated before any joint deformation happens. Due to their close proximity to vital structures such as growth plates and joint surfaces, surgical treatment of chondroblastomas is challenging. Careful complete curettage without destroying articular cartilage or physeal elements followed by reconstruction of the defect, usually with autologous cancellous bone graft, is the ideal treatment. Recurrences as high as 30% can occur due to inadequately curetted lesions, even though the histology is benign [6]. This paper is an observational study of 12 chondroblastoma patients around the knee with respect to diagnosis, surgical treatment, complications, and functional results.

METHODS

Study design and setting

In this case series study, 12 patients diagnosed with chondroblastoma of the knee region were treated in our tertiary care center between the years 2019 and 2023. The inclusion criteria included histologically proven chondroblastoma in the distal femur, proximal tibia, or patella with a minimum follow-up of 12 months. Patients with lesions that breached the articular cartilage or were centrally located in the epiphysis with joint surface deformation were excluded from this study to avoid confounding of functional outcomes. The cases were all retrospectively evaluated.

Data Collection

All patients were operated on and followed up by the authors for a minimum period of one year. Demographics of the patients, symptoms at the time of presentation with duration, radiological features, surgical method, intraoperative complications, postoperative care, and functional results were noted. Radiological assessment was done with X-rays and MRIs in all the cases. In 10 cases, CT-guided core biopsy was done prior to excision. Core biopsies of the tibial lesions were taken under CT guidance from the antero-inferior margin of the tumor, at its junction with normal bone, taking care not to perforate superiorly or posteriorly. In two cases, the excision was done without a prior biopsy, on the basis of radiological appearance alone. All the lesions were managed by intralesional curettage with autograft bone grafting.

Surgical technique

Surgical technique depended on the location of the lesion. Posterior approaches were utilized for posterior tibial lesions, whereas parapatellar approaches were employed for distal femoral and patellar lesions. All the approaches used in our series for tibial lesions were extra-articular. We avoided entering the joint space to reduce the risk of intra-articular contamination or damage to cartilage. However, the femoral lesions, as well as the patellar lesion, were dealt with by parapatellar approaches, which are intra-articular. High-speed burrs extended curettage margins. Thorough joint lavage with normal saline was performed following the curettage and prior to bone grafting to minimize joint spillage of tumor tissue. Bone grafts were taken from the ipsilateral iliac crest in 11 patients. The patellar lesion was too small to need grafting. All procedures were performed under the guidance of an image intensifier to ensure accurate localization of the lesion and confirm a thorough curettage. Arthroscopy was not utilized in this series. Postoperatively, the patients were immobilized in a knee brace and started progressive rehabilitation with range-of-motion exercises and weight-bearing as tolerated. Clinical and radiological follow-up was at 6 weeks, 3 months, 6 months, and 1 year.

Ethical considerations

All the patients gave informed consent for publication of clinical information and images in this article. No patient identification details have been used. Institutional Ethical Committee approval was obtained prior to initiation of the study vide letter number IEC/IMS.SH/SOA/2023/682.

RESULTS

The study included 12 patients (9 males, 3 females), aged between 14 and 38 years, with a mean age of 27 years. The most common symptom was localized joint pain, aggravated by activity and partially relieved by

rest. Swelling and joint stiffness were noted in five patients. Duration of symptoms ranged from 2 months to 2 years, with a mean duration of 7.9 months. The detailed clinical presentations are outlined in Table 1.

Table 1: Clinical presentation details

Patient No.	Age (year)	Sex	Site of Lesion	Symptoms	Duration of Symptoms
1	14	M	Proximal Tibia	Pain, swelling	3 months
2	16	M	Distal Femur	Pain	5 months
3	17	F	Patella	Anterior knee pain	2 months
4	19	M	Proximal Tibia	Pain, stiffness	1 year
5	22	M	Distal Femur	Pain	4 months
6	26	F	Proximal Tibia	Pain, swelling	6 months
7	30	M	Distal Femur	Pain	2 years
8	32	M	Proximal Tibia	Pain, stiffness	10 months
9	34	M	Proximal Tibia	Pain	6 months
10	35	M	Proximal Tibia	Pain, swelling	5 months
11	36	F	Distal Femur	Pain, swelling	3 months
12	38	M	Proximal Tibia	Pain, stiffness	1 year

MRI played an important role in localizing the lesions. All the tumors were lytic with sharply defined margins and no periosteal reaction. The articular cartilage was intact in 11 cases. Intralesional calcification and perilesional marrow edema within one lesion in the distal femur were suggestive of a chondroid tumor. A small lesion on the articular surface in the patellar case was best seen on MRI. Table 2 delineates the salient radiological findings of our series. Of the 10 core biopsies conducted, 4 were conclusive of chondroblastoma and 6 were non-specific in diagnosis.

Table 2: Radiologic findings

Patient No.	Imaging Modality	Lesion Appearance	Intralesional Calcification	Articular Breach	MRI Marrow Edema
1	X-ray+MRI	Lytic, well-marginated	No	No	Mild
2	X-ray + MRI	Lytic, sclerotic rim	Yes	No	Moderate
3	MRI only	Small, cortical	No	No	None
4	X-ray + MRI	Lytic	No	No	Moderate
5	X-ray + MRI	Lytic, sclerotic rim	Yes	No	Mild
6	X-ray + MRI	Lytic	No	No	Mild
7	X-ray + MRI	Lytic, with calcification	Yes	No	Marked
8	X-ray + MRI	Lytic	No	No	Moderate
9	X-ray + MRI	Lytic	No	No	Mild
10	X-ray + MRI	Lytic	No	No	Mild
11	X-ray + MRI	Lytic	Yes	No	Mild
12	X-ray + MRI	Lytic	No	No	Moderate

In seven posterior proximal tibial lesions, the direct posterior approach through the popliteal fossa was employed (Figure 1a).

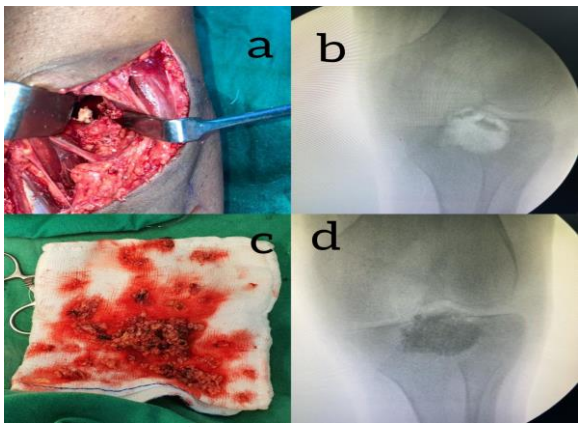

Figure 1: A case of proximal tibial chondroblastoma with large void post curettage. **a**) Posterior approach to the popliteal fossa with exposure of lesion; **b**) Image of the void after curetting of the lesion; **c**) Curetted tumour material sent for biopsy; **d**) Image after filling the void with cancellous bone grafts.

The neurovascular bundle was dissected and protected with care. Intraoperative damage to the ascending branch of the anterior tibial artery occurred in one of these cases, which was successfully ligated after consultation with vascular surgery. The four lesions in the distal femur were accessed by lateral or medial parapatellar arthrotomy along with knee hyperflexion (Figure 2c).

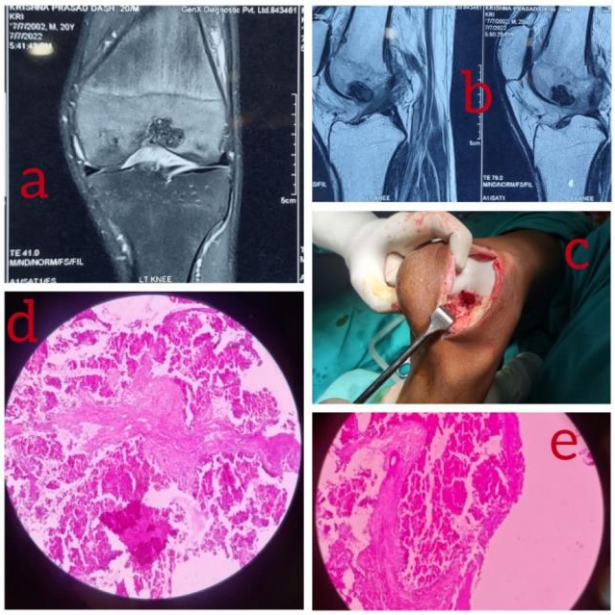

Figure 2: A case of distal femur chondroblastoma. **a**) Coronal MRI sections showing the lesion at the notch; **b**) Sagittal MRI sections showing the lesion; **c**) Lateral parapatellar approach to expose the lesion; **d**) Microscopic sections showing hemorrhagic cysts and patchy calcification; **e**) Dense eosinophilic sheets of cells with cartilage.

The lesions were curetted, and defects were filled with autologous cortico-cancellous graft. The patellar lesion was accessed by a medial parapatellar approach and not grafted because of the small size. The key intraoperative findings are outlined in Table 3.

Table 3: Intra-operative findings

Patient No.	Approach Used	Intraoperative Findings	Grafting Done	Complications
1	Posterior	Well-circumscribed lesion	Yes	None
2	Medial parapatellar	Intact cartilage, easy access	Yes	None
3	Medial parapatellar	Small lesion, not grafted	No	None
4	Posterior	Deep lesion, near neurovascular bundle	Yes	Minor bleeding controlled
5	Lateral parapatellar	Superficial lesion, good access	Yes	None
6	Posterior	Firm lesion, intact cartilage	Yes	None
7	Lateral parapatellar	Large lesion, near subchondral bone	Yes	None
8	Posterior	Close to popliteal vessels	Yes	Vascular injury managed intra-op
9	Posterior	Hard lesion with sclerotic wall	Yes	None
10	Posterior	Clean margins, good exposure	Yes	None
11	Medial parapatellar	Easy curettage	Yes	None
12	Posterior	Proximity to vessels, burring needed	Yes	None

All the lesions had characteristic histological features of chondroblastoma, such as round to polygonal chondroblasts with eosinophilic cytoplasm, chicken-wire calcification, hemosiderin-laden macrophages, and scattered osteoclastic giant cells (Figure 2d and e). Immunohistochemistry revealed variable S-100 and vimentin positivity in keeping with chondroid origin. All patients recovered smoothly. Functional rehabilitation was initiated within 2–3 weeks. Gradual weight bearing was permitted by 6–8 weeks following surgery. The radiographs at 3 months revealed graft consolidation without any articular collapse. Eleven patients achieved full knee range of motion at 12 weeks, whereas one experienced mild terminal stiffness (Figure 3).

Figure 3: A case of proximal tibial chondroblastoma with final radiologic and functional outcome. **a**) Sagittal sections on MRI showing lesion in postero-lateral tibial plateau; **b**) Coronal MRI sections of the lesion; **c**) Immediate post operative x-ray showing bone grafts in situ; **d**) Follow up Xray at 1yr shows good consolidation and healing of lesion; **e** & **f**) Clinical pictures at 1-year follow up showing full knee ROM.

At last follow-up (mean 14.8 months), all patients had normal joint and gait function and were pain-free. There was no recurrence or secondary aneurysmal bone cysts. Table 4 outlines the follow-up details of our series of patients.

DISCUSSION

Chondroblastomas, although benign on histological examination, are locally aggressive because of their epiphyseal nature. This larger series illustrates the diagnostic challenges, the surgical complexities, and the favorable outcome after accurate curettage and bone grafting. The average age in our series was marginally greater than that described in the literature, perhaps owing to delayed diagnosis or unusual sites such as the patella. MRI cannot be overemphasized in localizing tumors, planning surgical access, and avoiding articular damage. MRI also serves in differentiating chondroblastomas from osteoclastomas and intraosseous ganglion cysts [10]. The seven posterior tibial plateau cases are indicative of the difficulty represented by neurovascular proximity. We employed the posterior approach in all proximal tibial lesions due to the posterior or posterolateral location of the tumors. Anterior or parapatellar approaches do not provide safe or direct access to these regions. Posteromedial or posterolateral approaches expose the tumor from one side and often provide incomplete visualization of the entire extent of the tumor, leading to difficulty in adequate curettage. The posterior approach gives complete and excellent visualization of these areas, hence ensuring complete curettage and minimizing recurrence. We ensured meticulous dissection and neurovascular protection throughout the procedure. Only one patient experienced a minor vascular injury, which was promptly managed, and further recovery was uneventful. Thus, while posterior exposure carries risks, this risk was taken to ensure adequate visualization and curettage and minimize chances of recurrence. Central plateau locations are almost impossible to access from any approach, and an arthroscopic approach [11] with microfracture followed by osteoarticular autograft transplantation is the only procedure with reasonable results. However, this is fraught with the risk of tumor tissue contaminating the intraarticular space and increased chances of recurrence [12]. Lesions in easily accessible sites such as the distal femur and patella are more easily treated by surgery. Even so, any lesion must be entirely excised to avoid recurrence.

Table 4: Follow-up and recovery

Patient No.	Time to ROM recovery	Graft consolidation (3 months)	Final ROM status	Pain status	Recurrence	Follow-up duration (month)
1	10 weeks	Consolidated	Full	None	No	14
2	12 weeks	Consolidated	Full	None	No	15
3	8 weeks	N/A (no graft)	Full	None	No	12
4	12 weeks	Consolidated	Mild stiffness	Mild	No	13
5	10 weeks	Consolidated	Full	None	No	15
6	11 weeks	Consolidated	Full	None	No	14
7	12 weeks	Consolidated	Full	None	No	16
8	14 weeks	Consolidated	Full	None	No	18
9	10 weeks	Consolidated	Full	None	No	13
10	11 weeks	Consolidated	Full	None	No	14
11	10 weeks	Consolidated	Full	None	No	12
12	12 weeks	Consolidated	Full	None	No	15

Secondly, to avoid injuring the growth plate or articular cartilage in skeletally immature patients, often the surgeon ends up doing an incomplete excision or curettage [13].The recurrence rates are 50% in the first 2 years. Extended curettage with a high-speed burr or cryoablation helps in reducing the chance of recurrence [14]. In our series, no adjuvants were employed—phenol or cryotherapy—yet we saw no recurrence, and this would indicate that painstaking curettage could be sufficient in non-malignant lesions. Histopathological diagnosis is essential to distinguish chondroblastoma from GCTs or low-grade chondrosarcoma. Secondary aneurysmal bone cysts are not rare within the lesion [15]. S-100 positivity and chicken-wire calcification help confirm the diagnosis [16]. Although lung metastasis and recurrence are rare, they have been reported, particularly in aggressive variants [9]. Overall functional results in our patients were satisfactory, with all patients achieving almost full ROM and painless knees. Prompt diagnosis and sparing of cartilage might have allowed a better prognosis.

Study limitations

This study has a few limitations. Notably, this being a retrospective study with a small sample size, its generalizability is limited. The rarity of the tumor makes it difficult to conduct prospective studies with adequate samples. Also, the minimum follow-up duration of 12 months, while adequate for early recurrences, may not be so for late recurrences. Additionally, the use of validated scoring systems could have further strengthened the data on functional outcomes.

Conclusion

Chondroblastomas of the knee are unusual tumors requiring a high index of suspicion and meticulous radiologic examination for prompt diagnosis. In spite of difficult surgical anatomy, correct approaches as guided by lesion site can ensure successful results. Extended curettage and bone grafting are still the mainstay of treatment. Cautious follow-up care is necessary to identify recurrence in its early stage. Multicentric studies with longer follow-up and higher sample size are recommended for further establishing the efficacy of this surgical technique.

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Conflict of interests

The authors declared no conflict of interest.

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Data sharing statement

Supplementary data can be shared with the corresponding author upon reasonable request.

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