

A SERIES OF FOUR CHONDROBLASTOMA CASES
TREATED WITH TWO DIFFERENT BONE GRAFTS

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Introduction

Chondroblastoma is a rare benign bone tumor that comprises approximately 1% of all benign bone tumors.^{1,6} It characteristically affects individuals in the second decade of life^{5,6,9} and involves the epiphysis of long bones.^{5,3,4} The pathological characterization of this tumor is somewhat varied, thus, initial misdiagnosis has been reported as high as 34% in certain studies.² Curettage, alone, with bone graft, polymethylmethacrylate, phenol, alcohol, cryosurgery, or a combination of these modalities are the most frequently described techniques for primary treatment of this tumor.^{3,5-7,9} Although this tumor is not typically prone to metastasis, there have been reports of metastases with some resulting in death.^{5,7,9} It is, however, considered an aggressive tumor that is prone to local recurrence. Recurrence rates have been reported between 8.3-38%.³⁻⁵ The high recurrence rates for this tumor have been attributed to the involvement of the open physis in many cases and an inability to remove all of the neoplastic cells without damaging the growth plate.⁷ Specific factors leading to recurrence have not been consistently identified in previous studies of chondroblastoma. Age at onset, time period of symptoms, open physal plates, and the presence of an aneurysmal bone cyst (ABC) component are factors linked to recurrence in individual studies, but these indicators were not universally verified^{2,3,6}. The purpose of this case report is to describe four cases of chondroblastoma of the distal femur treated with two different injectable bone grafts and determine how these treated lesions differed over time.

Case 1: Injectable CaPO₄ Bone Graft

A 16 year old male presented with right knee pain. After radiographs of the knee, appropriate staging and incisional biopsy, it was determined that the patient had a chondroblastoma of the right distal femoral epiphysis | FIGURE 1. The chondroblastoma was treated with extended curettage and filled with an injectable calcium phosphate (CaPO₄) bone graft (Hydroset® Bone Graft, Stryker, Mahwah, NJ). Post-operatively, the patient was evaluated clinically and radiographically at 6 weeks, 3 months, and 6 months. Functionally, this patient continues to do well with all desired post-operative activities without event. Radiographically, the CaPO₄ bone graft material remains unchanged based on defect margins and appears to be largely inert.



FIGURE 1 | A 16 year old male with chondroblastoma of the right distal femoral epiphysis pre-operatively (A), after treatment with an injectable CaPO₄ bone graft (B), and post-operatively at 6 weeks (C) and 6 months (D). The 6 week and 6 month images show the entire graft unchanged from the immediate post-op, with no decrease in the defect margins.

Case 2: Injectable CaPO_4 Bone Graft

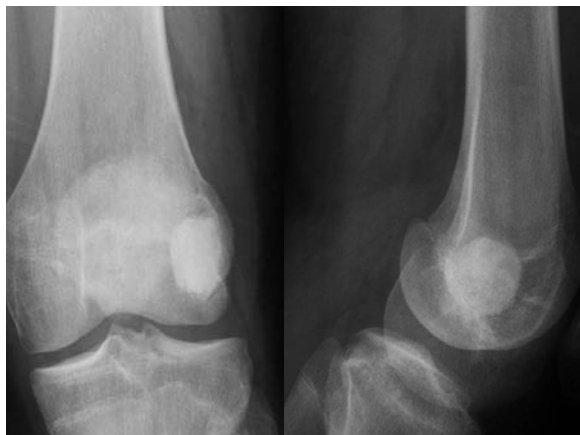
A 15 year old male presented with pain and swelling of the left knee. Radiographs revealed a radiolucent lesion in the distal femur epiphysis confirmed to be chondroblastoma after incisional biopsy | FIGURE 2. The chondroblastoma was treated with extended curettage and filled with an injectable CaPO_4 bone graft (Hydroset® Bone Graft, Stryker, Mahwah, NJ). The patient was evaluated clinically and radiographically at 6 weeks, 3 months, 6 months, and 9 months. The patient has done well and has returned to all desired post-operative activities without event. There have been no significant radiographic changes or evidence of resorption in the calcium phosphate bone graft over time.



A



B



C



D

FIGURE 2 | A 15 year old male with chondroblastoma of the left distal femoral epiphysis pre-operatively (A), after treatment with an injectable CaPO_4 bone graft (B), and post-operatively at 6 weeks (C) and 9 months (D). Demonstrates no significant radiographic evidence of resorption or new bone.

Case 3: Injectable Composite CaSO₄ /CaPO₄ Bone Graft

A 16 year old male presented with pain and swelling of the left knee. Radiographs and an incisional biopsy indicated a chondroblastoma of the distal femoral epiphysis | FIGURE 3. The patient was treated with extended curettage and packing with an injectable composite calcium sulfate (CaSO₄) and CaPO₄ bone graft (PRO-DENSE® Bone Graft, Wright Medical Technology, Inc, Arlington, TN). The patient was evaluated for functional and radiographic changes at 6 weeks, 3 months, 6 months, and 9 months. The patient is doing well and has returned to his desired level of activity post-operatively without event. Radiographically, the composite bone graft material exhibited resorption over time and replacement with trabecular bone.

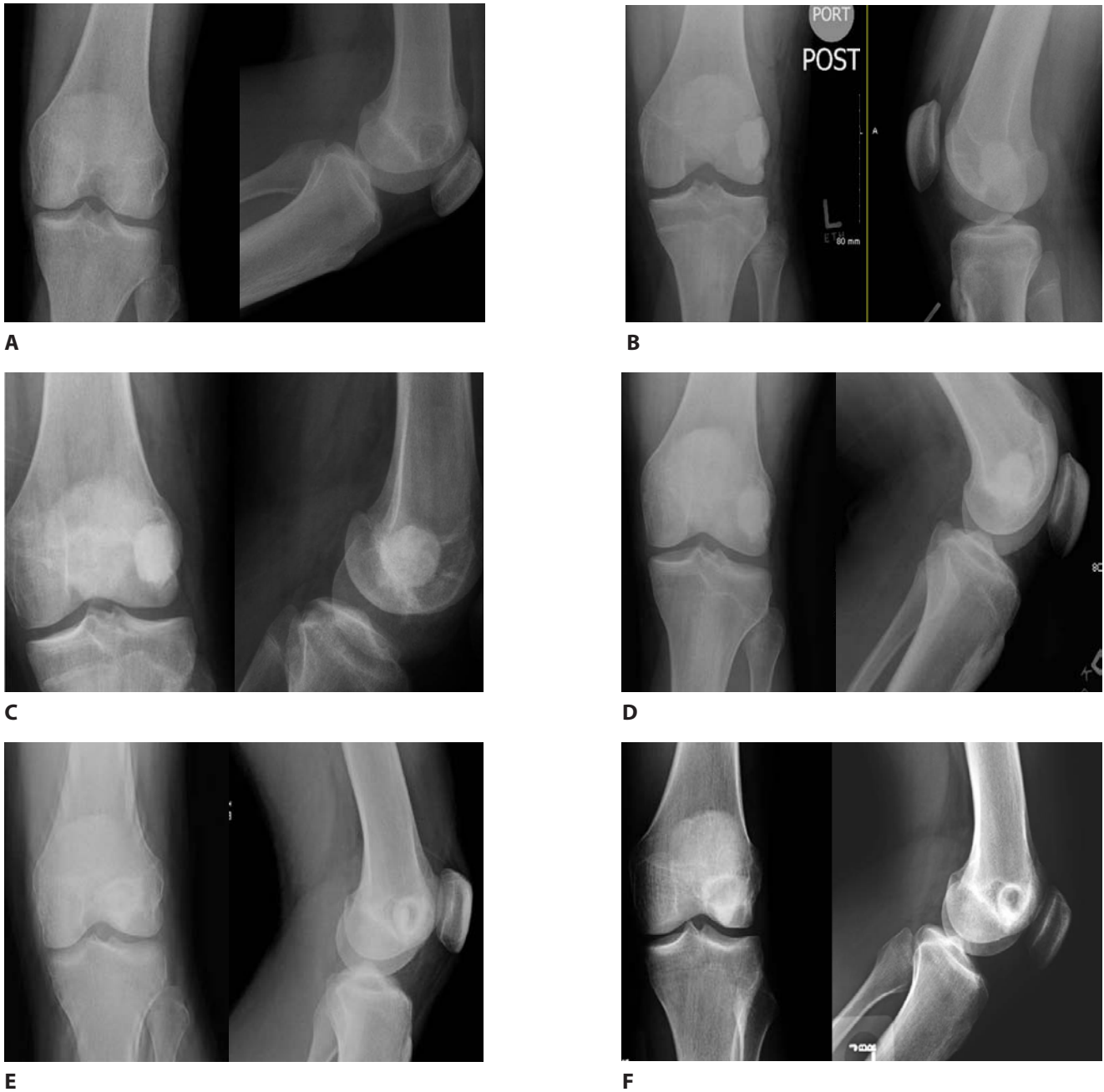


FIGURE 3 | A 16 year old male with chondroblastoma of the left distal femoral epiphysis pre-operatively (A), after treatment with an injectable CaSO₄/CaPO₄ composite bone graft (B), and post-operatively at 6 weeks (C), 3 months (D), and 6 months (E), and 9 months (F). New bone is visible where graft was placed.

Case 4: Injectable Composite $\text{CaSO}_4/\text{CaPO}_4$ Bone Graft

A 10 year old male presented with pain and swelling of the right knee. Radiographs showed a radiolucent lesion along the distal femur epiphysis that was determined to be a chondroblastoma after incisional biopsy | FIGURE 4. The lesion was removed with extended curettage and filled with an injectable $\text{CaSO}_4/\text{CaPO}_4$ composite bone graft substitute (PRO-DENSE® Bone Graft, Wright Medical Technology, Inc, Arlington, TN). The patient was evaluated for functional and radiographic changes at 4, 10, and 16 weeks. The patient is functioning well and has returned to his desired level of activity without event. The composite bone graft material has progressively consolidated and been replaced by trabecular bone. Radiographs at 16 weeks show that the lesional area appears to be filled with solid trabecular bone.



FIGURE 4 | A 10 year old male with chondroblastoma of the right distal femoral epiphysis pre-operatively (A), after treatment with an injectable $\text{CaSO}_4/\text{CaPO}_4$ composite bone graft (B), and post-operatively at 4 weeks (C), 10 weeks (D), and 16 weeks (E). Sixteen week radiographs show solid trabecular bone where graft was placed.

Discussion

These four cases of chondroblastoma in the distal femur are classic examples of this rare bone tumor. This group of patients is typical for this type of tumor, being adolescent males and involving the epiphysis of a long bone. Although these patients have all experienced excellent functional outcomes, radiographic evidence shows distinct differences in the interaction of the two bone grafts with the surrounding bone. The injectable CaPO_4 material remained relatively inert in the defect site as evidenced by the lack of change in the defect margins and radiopacity over a 9 month period. In contrast, the radiographic progression of the injectable $\text{CaSO}_4/\text{CaPO}_4$ composite bone graft substitute demonstrated steady resorption and regeneration of trabecular bone within the defect margins.

The clinical distinction between these two mechanisms of interaction with the surrounding bone may not be discernable in the short term or in cases where further surgical intervention is unnecessary. Unfortunately, chondroblastoma are tumors marked by high rates of local recurrence due to their involvement with the epiphysis. For this reason, the long term effects of the bone graft used should be considered. In pre-clinical studies, the differences between inert injectable CaPO_4 bone grafts and regenerative injectable $\text{CaSO}_4/\text{CaPO}_4$ specimens in a canine proximal humerus model have been significant. (Data on file) Gross observation of specimens excised after 13 weeks in the canine proximal humerus has shown trabecular bone with the $\text{CaSO}_4/\text{CaPO}_4$ composite bone graft while injectable CaPO_4 grafts have not changed | FIGURE 5. In mechanical testing using the test methods described previously by Urban et al,⁸ the CaPO_4 bolus could not withstand the specimen preparation and therefore could not be tested. (Data on file) In contrast, $\text{CaSO}_4/\text{CaPO}_4$ treated specimens with dense bone ingrowth could be tested and offered ultimate compressive strength results exceeding normal cancellous bone.⁸ In the clinical setting, radiographic evidence of local recurrence would

lead to treatment with curettage. In situations where an inert CaPO_4 bone graft was used, it is quite possible that the original defect space as well as the recurrent chondroblastoma defect would require curettage and bone grafting. In situations where the bone graft has been replaced with regenerate bone, such as with those treated by the injectable $\text{CaSO}_4/\text{CaPO}_4$ composite graft in this study's radiographs, the area requiring curettage and bone grafting should be limited to the recurrent defect. Morbidity associated with extensive pre-debridement is therefore limited.

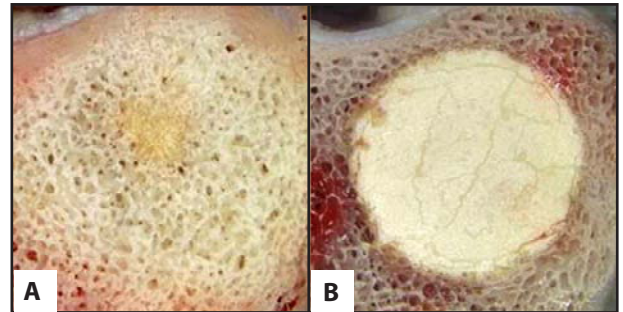


FIGURE 5 | Gross specimen from 13 week proximal humerus canine defects show dense bone regeneration within the defect filled with an injectable $\text{CaSO}_4/\text{CaPO}_4$ composite (A) and edge incorporation with an overall lack of resorption in defects filled with an injectable CaPO_4 bone graft (B).

Conclusion

In this series, extended curettage and either an injectable $\text{CaSO}_4/\text{CaPO}_4$ composite bone graft or an injectable CaPO_4 bone graft were used to treat four chondroblastomas of the distal femur. Functionally, all four patients are performing well after 4 to 9 months. No clinical differences with regards to function or tumor control were noted. Radiographically, the two defects treated with the composite $\text{CaSO}_4/\text{CaPO}_4$ bone graft exhibited progressive replacement with trabecular bone while the two defects treated with the CaPO_4 bone graft displayed no remodeling over time.

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Additional patents pending. Donated human tissue processed by LifeCell Corporation for
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