



Treatment of a Calcaneal Chondroblastoma with Curettage and Bone Substitute Grafting Mixed with Autologous Bone Marrow

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Chondroblastoma is a relatively rare benign bone tumor. This is a case of a chondroblastoma in the calcaneus which was removed successfully by curettage and replaced with a bony substitute of calcium sulfate pellets impregnated with autologous bone marrow. After two years, the patient remained symptom-free, and the radiographs demonstrated complete filling of the defect with good bony union without recurrence.

Key words: chondroblastoma, calcaneus, treatment, bone graft

INTRODUCTION

Chondroblastoma is an uncommon lesion, accounting for approximately 1% of benign primary bone tumors.¹ Derived from chondroblasts or their precursors, chondroblastomas have a predilection for the epiphyses of long bones in adolescents. Only 7% of chondroblastomas occur in the calcaneus.² Most treatment approaches involve tumor removal by curettage and repair of the bony defect with autologous bone grafting.^{3,4} To the best of our knowledge, this is the first reported case of chondroblastoma treated with total curettage followed by replacement with a bony substitute of calcium sulfate pellets impregnated with autologous bone marrow. This technique not only enhances bone healing but also avoids the complications of harvesting autologous bone graft.

CASE REPORT

A 23-year-old man presented with right heel pain for five months. His past medical history was unremarkable. He denied any systemic disease, history of alcohol or drug abuse, or history of trauma. He was treated with

non-weight-bearing with crutches and some nonsteroid anti-inflammatory agents for one month; however, the pain persisted.

Physical examination revealed localized tenderness of the right heel, and no skin lesions or palpable masses were identified. Ankle range of motion was normal; however an antalgic gait was observed. The patient described the pain quality as moderate and indicated it limited his recreational activities. The ankle-hindfoot scale rating system developed by the American Orthopaedic Foot and Ankle Society provided a standard method for examining and reporting the clinical findings of the patient's ankle and foot. The preoperative ankle-hindfoot score was 70 points (pain 20; function 40; alignment 10).⁵ Laboratory data, including the white blood cell count (WBC), erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), and uric acid were unremarkable.

Radiographs demonstrated a well-defined, osteolytic lesion located in the posterior portion of the right calcaneus (Figure 1). The computerized tomography (CT) of the right heel identified a lobulated, osteolytic lesion approximately 1.8 cm × 2.4 cm × 2.8 cm with a sclerotic border. (Figure 2). The patient was admitted to our hospital for treatment which included curettage and bone grafting with a bony substitute mixed with autologous bone marrow. Intraoperative frozen section confirmed the benign nature of this lesion.

During surgery, a cortical window (10 × 10 mm²) was created at the posterolateral aspect of the calcaneus to expose the lesion: a soft, friable, moderately vascular tissue which filled the cavity. The specimen was submitted for frozen section examination. The histological findings demonstrated the typical features of chondroblastoma.

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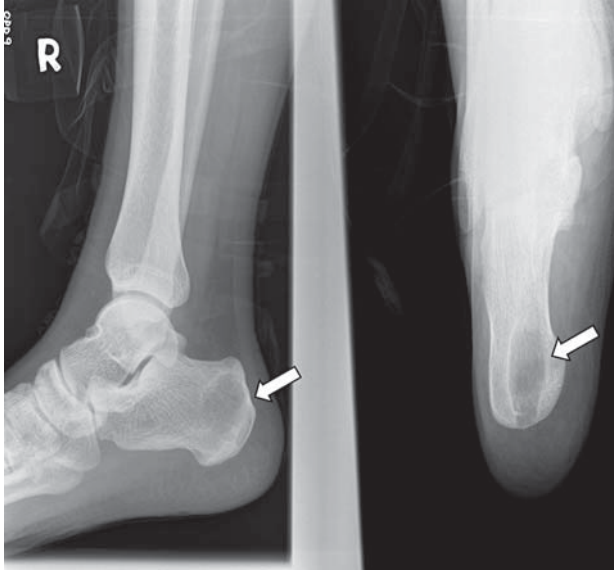


Fig. 1 A plain radiograph revealed a well-defined, osteolytic lesion (see arrow) located in posterior region of calcaneus.

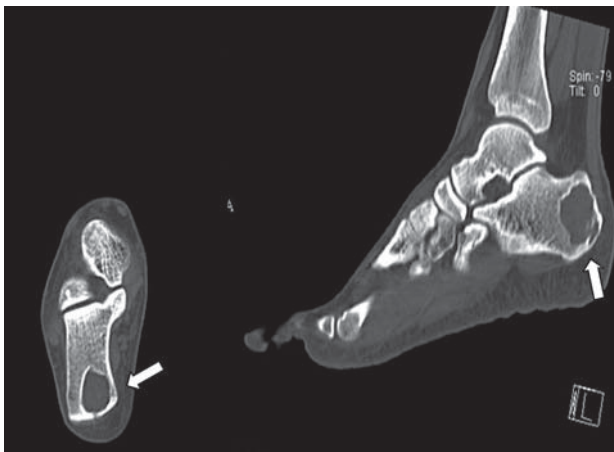


Fig. 2 The computerized tomography (CT) of the right heel demonstrated a lobulated osteolytic lesion (size: about 1.8×2.4×2.8 cm) with sclerotic border in the calcaneus (see arrow). Eroded bone trabeculae of the lesion were also noted.

Cellular areas were composed predominantly of large mononuclear cells with oval nuclei in immature chondroid material (Figure 3).

Curettage of the bone lesion was performed. Approximately 10 ml of bone marrow was aspirated from the patient's anterosuperior iliac spine (ASIS) with an 18-gauge bone marrow needle and mixed with 2 ml of Osteoset bone graft substitute (Osteoset: calcium sulfate pellets; Wright Medical Technology, Arlington, Tennessee,

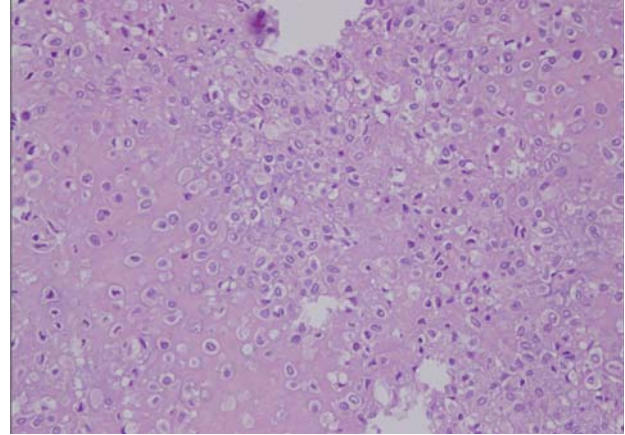


Fig. 3 Histopathological examination revealing large mononuclear cells with oval nuclei in immature chondroid material.



Fig. 4 At two years follow up, our patient was symptom-free and the radiographs showed total filling of the cavity with good bony union (see arrow).

see, United States). The mixture was used to completely fill the cystic cavity after phenol washing. The cortical bone initially removed was placed back in its original location. The wound was closed with nylon, and a short leg splint was applied for immobilization.

The patient remained on non-weight-bearing status for six weeks, partial weight-bearing for an additional two weeks, and low impact, full weight-bearing for an additional two months. The postoperative ankle-hindfoot score recorded at three months and at two years were

both 100 points (pain 40; function 50; alignment 10).⁵ Radiographs taken at the two-year follow-up showed new bone formation and sclerotic change within the lesion (Figure 4).

DISCUSSION

Chondroblastomas are relatively uncommon, accounting for only 1 to 2% of all primary bone tumors. A review of the literature suggests they account for 0.9% of all bone tumors, 1.4% of all primary bone tumors, and 3.6% of all primary benign bone tumors. There is a male predominance with the peak incidence during the adolescent years.^{6,7} These tumors originate most often in a secondary ossification center. Murari et al. reviewed 255 cases of primary bone tumors of the foot and reported that the metatarsals, followed by the calcaneus, are the most common locations.⁸ Fink et al. noted that chondroblastoma of the foot is most common in the posterior subchondral areas of the talus and calcaneus, as well as in the calcaneal apophysis.⁹

Typical radiographic findings of chondroblastoma are sharply margined, predominantly lytic lesions rimmed by sclerotic bone. In long bones, these tumors generally involve the epiphysis but may also cross the physis and extend into the metaphysis. Periosteal reaction is uncommon.

In this case, both the plain film and CT of the calcaneus identified a lobulated and osteolytic lesion with a sclerotic margin. The differential diagnosis preoperatively included chondromyxoid fibroma, giant cell tumor, aneurysmal bone cyst, and enchondroma. Chondromyxoid fibroma is a rare cartilage tumor, consisting of fibromyxoid tissue and cartilage tissue. This tumor is usually located in the subarticular region or adjacent to the inferior surface of the calcaneus. Giant cell tumor, with very few exceptions, is a lesion of the mature skeleton. When it is identified in younger patients, it is generally metaphyseal in location. Additionally, giant cell tumors do not have calcifications, and sclerotic margins are rarely seen. Simple bone cysts are usually located at the base of the calcaneus neck on the lateral side within an area referred to as Ward's triangle.¹⁰ Aneurysmal bone cyst of the calcaneus is more expansive than a simple bone cyst. The margin may be either poorly defined, or sharp and thinly sclerotic, and is usually located toward the plantar and posterior aspect of the bone. Aneurysmal bone cysts are seen predominately in childhood, and 76% of cases occur in patients younger than 20 years of age. Aneurysmal bone cysts cause multicystic, eccentric, expansile le-

sions with a thin periosteal reaction, and create fluid-fluid levels on contrast-enhanced CT and magnetic resonance imaging (MRI) scan.

According to the orthopedic literature, curettage and autologous bone grafting is still the standard surgical treatment for chondroblastomas.¹¹ Springfield et al. reviewed 70 cases of chondroblastoma and recommended curettage with or without phenol washing, and bone grafting was described for improved bone healing.¹² Masui et al. considered simple curettage effective in only local control, and the use of alcohol or cement was recommended in cases with local recurrence or aggressive behavior.¹³ According to Garin and Wang, chondroblastoma treated with curettage and bone grating can achieve a good outcome with a low recurrent rate.⁴ However, the risk of complication for ASIS autologous bone graft harvesting ranges from 9% to 25%.¹⁴ The most common complications are protracted pain and hematoma at the donor site. Injury to the lateral femoral cutaneous nerve can be avoided by limiting the extent of subcutaneous dissection and providing layered, tension-free incision closure.

In our case, bone marrow aspiration from the ASIS was performed with an 18-gauge bone marrow needle. We mixed the bone marrow with bone graft substitute and filled in the cystic cavity. This procedure promotes bone healing by providing osteogenic cells and osteoconductive material. Bone marrow contains osteoprogenitor cells that not only promote the healing ability of bone but also play an important role in the process of bone regeneration.¹⁵ Bone marrow aspirated from iliac crest is harvested easier than by open methods. This method also avoids complications such as pain, hematoma, and injury to the lateral femoral cutaneous nerve, observed from harvesting autologous bone graft. The radiographs taken two years postoperatively showed bony union with consolidation and no collapse of the cystic cavity.

However, there are some limitations of this technique. Lack of a cortical component may prevent its use when structural support is needed. In cases of tumors with high local recurrence or aggressive behavior, there can be difficulty distinguishing the post-operative radiolucent lesion from local tumor recurrence and bony resorption.

CONCLUSION

Rare cases of chondroblastoma of the calcaneus have been reported, but this is the first reported case of successful treatment with curettage of the tumor followed by filling of the cavity with a mixture of Osteoset bone graft

substitute and autologous bone marrow. This combination may enhance the cascade of bone healing.¹⁶ The patient was symptom-free at the 2-year follow-up, and the radiographs showed total filling of the cyst cavity with good bony union. Bony substitute grafting mixed with bone marrow is a simple, safe, and effective technique, and avoiding the complications of harvesting autologous bone graft.

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