

A Case Report on the Treatment of Pediatric Aneurysmal Bone Cyst of the Calcaneus by Curettage and Allogeneic Bone Impaction Grafting: Long-Term Results

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Case Report

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Abstract

Background

Calcaneal aneurysmal bone cyst (CABC) is a rare, benign, locally aggressive vascular lesion, accounting for 1.6% of all aneurysmal bone cyst cases. It may be primary (65%) or secondary to other bone tumors.

Case presentation:

This report describes a female patient presenting with chronic heel pain (duration of 2 years, with worsening swelling and walking impairment over the past 6 months). Imaging revealed a solitary expansile osteolytic lesion in the posterolateral calcaneus, with cystic enhancing foci within the medullary cavity, thinning of the bone cortex, and soft tissue extension. The patient underwent an extensive curettage procedure, which involved multiple drillings using a 1.0 mm K-wire, followed by reconstruction utilizing allogeneic bone compact grafts. Histopathological examination confirmed a primary CABC. Postoperative 9 years follow-up showed complete ossification of the lesion with no complications.

Conclusions

Calcaneus is an uncommon site for an aneurysmal bone cyst; it should be considered in the differential diagnosis. Accurate diagnosis necessitates the integration of clinical presentation, anatomical localization, radiological findings, and histological assessment.

Introduction

The World Health Organization (WHO) defines an aneurysmal bone cyst as a benign, cystic lesion of the bone composed of blood-filled spaces separated by connective tissue septa containing fibroblasts, osteoclast-type giant cells, and reactive woven bone [1]. First described by Lichtenstein and Jaffe in 1942 [2], while most common in the metaphysis of long bones, only 3% of cases occur in the foot, with the calcaneus involved in just 1.6% of all aneurysmal bone cyst cases [3, 4].

CABC present with a slightly older mean age of 24 years [3] and a female-to-male ratio of 1.04:1 [5]. Approximately 85% of cases occur in patients under 20 years, and the condition is exceedingly rare in those under 5 or over 50 [6]. Clinically, CABCs are often more symptomatic and less prone to pathological fracture compared to aneurysmal bone cysts at other skeletal sites [7]. These lesions are classified as non-malignant vascular lesions [5] and may be primary (65%) or secondary (35%) to pre-existing conditions, including giant cell tumor, osteoblastoma, chondroblastoma of the calcaneus, fibrous dysplasia, angioma, chondromyxoid fibroma, simple bone cyst, fibrous histiocytoma, eosinophilic granuloma, radiation osteitis, osteosarcoma, trauma, and fibrosarcoma [1–3, 6, 8].

Given their rarity and atypical presentation, we describe our experience managing one case of CABC at a tertiary referral center. All patients provided informed consent for publication. We also present a case diagnosed as CABC, with findings from radiography, computed tomography (CT), and magnetic resonance imaging (MRI).

Case Report

A 13-year-old female presented with a two-year history of left heel pain, which had progressively worsened over the preceding six months. She developed edema and had trouble walking.

There was no history of trauma, fever or any other constitutional symptoms.

Tenderness was noted over the posteromedial aspect of the left heel. Although ankle range of motion was normal, inversion and eversion movements of the foot were painful.

A lateral foot radiograph revealed an expanding radiolucent mass on the posterolateral aspect of calcaneus (Fig. 1A). CT demonstrated a lytic lesion with soft tissue density, causing erosion and expansion of the bone cortex (Fig. 2A). MRI revealed a cystic mass lesion on the posterolateral calcaneus, resulting in significant cortical thinning and destruction. The lesion was located within the medullary cavity; T2-weighted (T2W) sequences showed a marked hypointense sclerotic rim encircling the medullary component, while T1-weighted (T1W) sequences exhibited heterogeneous hyperintense septal formations. Additionally, T2W MRI indicated heterogeneous hyperintense septal formations and blood-fluid levels, accompanied by contrast enhancement of the surrounding tissue and septage. There was no evidence of any abnormal enhancing soft tissue solid component within the lesion. Based upon the clinico-radiological findings, diagnosis of a benign cystic lesion of the calcaneum, most probably CABC, was made (Fig. 4).

After receiving consent, patient was planned for open biopsy. As the lesion was located laterally, the extended lateral approach was used to expose the calcaneum. The cortical window was raised and cyst was exposed. The cavity was filled with blood, and no suspicious soft tissue was identified. The curetted material was sent for histopathological analysis. An extensive curettage procedure, which involved multiple drillings using a 1.0 mm K-wire, followed by reconstruction utilizing allogeneic bone compact grafts (Fig. 5).

Post-operatively, the patient was kept non-weight bearing for 6 weeks and then gradually allowed partial weight bearing. Full weight bearing started at 3 months.

Microscopic analysis revealed the presence of cavernous cavities of varying sizes filled with blood, devoid of endothelial lining, and separated by collagenous tissue containing fibroblasts, macrophages, and osteoclastic giant cells. The diagnosis of primary CABC was thus confirmed (Fig. 6).

At the most recent follow-up, conducted 9 years post-diagnosis, the patient achieved full functional recovery and remained asymptomatic, with postoperative imaging showing complete ossification of the

lesion and no evidence of recurrence or complications. (Fig. 1, 2, 3).

Patient Perspective

As a young girl, I endured two years of heel pain that worsened over the last six months, making walking difficult due to swelling. Diagnosed with a calcaneal aneurysmal bone cyst, I underwent surgery and a smooth recovery. I'm thankful for the successful treatment that restored my pain-free, active life, and long-term follow-ups have confirmed the cyst hasn't returned.

Discussion

Aneurysmal bone cysts are locally aggressive, blood-filled cystic lesions. While some consider them reactive, the identification of USP 6 gene translocations in primary CABCs suggests a neoplastic origin [4, 9]. CABCs can be primary (de novo) or secondary to other bone tumors [4, 10]. Aneurysmal bone cysts predominantly affect the metaphysis of long bones [4] and account for about 1% of primary bone tumors [5, 6, 11]. Approximately 85% of cases occur in individuals under 20 years old [12], with a slight female predominance (1.04:1) [5]. CABCs are rare, representing only 1.6% of all aneurysmal bone cysts cases [3, 7, 8].

CABCs are typically symptomatic, with chronic heel pain being the most common presentation [3, 7]. Pathological fractures are rare due to an intact cortical shell [7]. Diagnosis primarily relies on radiological assessment [8]. Simple bone cysts are common benign tumor-like lesions in the calcaneus, often asymptomatic [8]. Chondroblastoma is rarely found in calcaneus and can recur if associated with CABC [12]. Telangiectatic osteosarcoma can mimic CABC on X-ray and requires biopsy for definitive diagnosis due to its aggressive nature [8]. CABCs are lytic, expansile lesions with well-defined margins [4, 13, 14]. Fluid-fluid levels on MRI are a key feature but not specific [4, 13]. CABCs appear as expansile osteolytic lesions causing cortical thinning or destruction, typically eccentric and foam-like, preserving a thin cortical rim [5, 8]. CT is useful for assessing density, while MRI reveals a non-homogeneous cystic lesion with multiple FFLs [5, 8]. Ultrasound can also identify Fluid-fluid levels [5].

Given diagnostic challenges, treatment may be guided by the lesion's biological nature [10]. For classic benign cystic lesions, open biopsy followed by surgery in the same setting is appropriate. The treatment of choice is extended curettage with bone graft or substitute [15, 16]. Adjuvants like cryotherapy or chemical agents (phenol) are used to reduce recurrence rates, which are around 10–20% [4, 7, 14]. CABCs generally have a favorable outcome with a 90–95% cure rate [17]. The most common complication is recurrence, typically within 2 years of surgery [18].

This case report from a single center may have selection bias due to involving only one case. The positive outcome could be influenced by the treatment protocol, surgical skill, and patient characteristics, so generalization should be cautious. Despite favorable 9-year follow-up results, long-term monitoring for calcaneal CABC recurrence is necessary. Success largely depends on the surgeon's

expertise, and potential complications from allogeneic bone grafting, though not observed here, should be considered.

Conclusion

Calcaneus is an uncommon site for an aneurysmal bone cyst; it should be considered in the differential diagnosis. Accurate diagnosis necessitates the integration of clinical presentation, anatomical localization, radiological findings, and histological assessment.

Abbreviations

CABC: Calcaneal Aneurysmal Bone Cyst

CT: Computed Tomography

Fig.: Figure

K-wire: Kirschner wire

MRI: Magnetic Resonance Imaging

T1W: T1-weighted

T2W: T2-weighted

WHO: World Health Organization

USP6: Ubiquitin-Specific Peptidase 6

Declarations

Ethics and consent to participate

The need for ethical approval was waived by Yanbian University Affiliated Hospital (Yanbian Hospital) Approval Form of Research/Cell Clinical Research Ethics Committee for this retrospective case report.

Consent to publish

The patient's parent or legal guardian provided written informed consent for the publication of this case report and accompanying images. A copy of the signed consent form will be made available for review by the Editor-in-Chief of this journal on request.

Availability of data and materials

This article includes all study data, while original medical records and images are accessible from the corresponding author upon reasonable request to protect patient privacy.

Competing interests

The authors declare no competing interests.

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Authors' contributions

XTD, GQT, and MDL conducted the patient's physical assessment and outcome measurement. FLY and XHX handled the critical appraisal and final revision. SHW, XZQ, and YSS were responsible for primary writing, final revision, and manuscript submission.

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Figures



Figure 1

Lateral X-rays are labeled as follows: **A** for preoperative, **B** for 1-day post-surgery, **C** for 1-year follow-up, and **D** for 9 years follow-up.



Figure 2

MRI/CT horizontal images are labeled as follows: **A** for preoperative, **B** for 1-day post-surgery, **C** for 1-year follow-up, and **D** for 9 years follow-up.

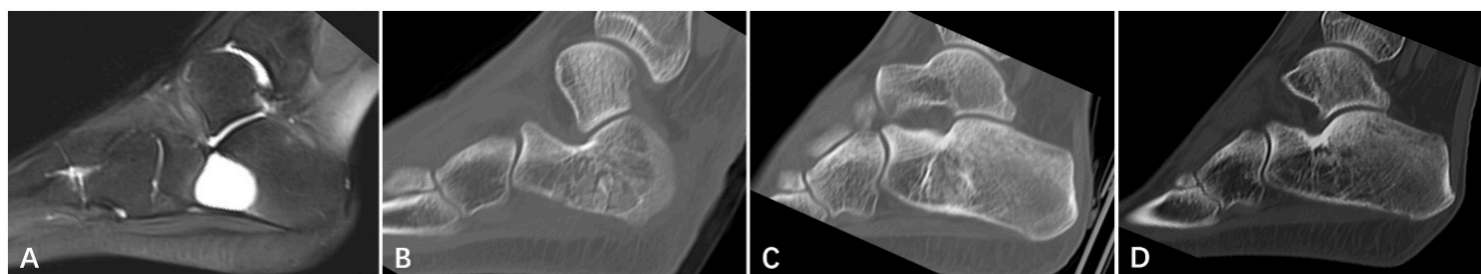


Figure 3

MRI/CT sagittal images are labeled as follows: **A** for preoperative, **B** for 1-day post-surgery, **C** for 1-year follow-up, and **D** for 9 years follow-up.

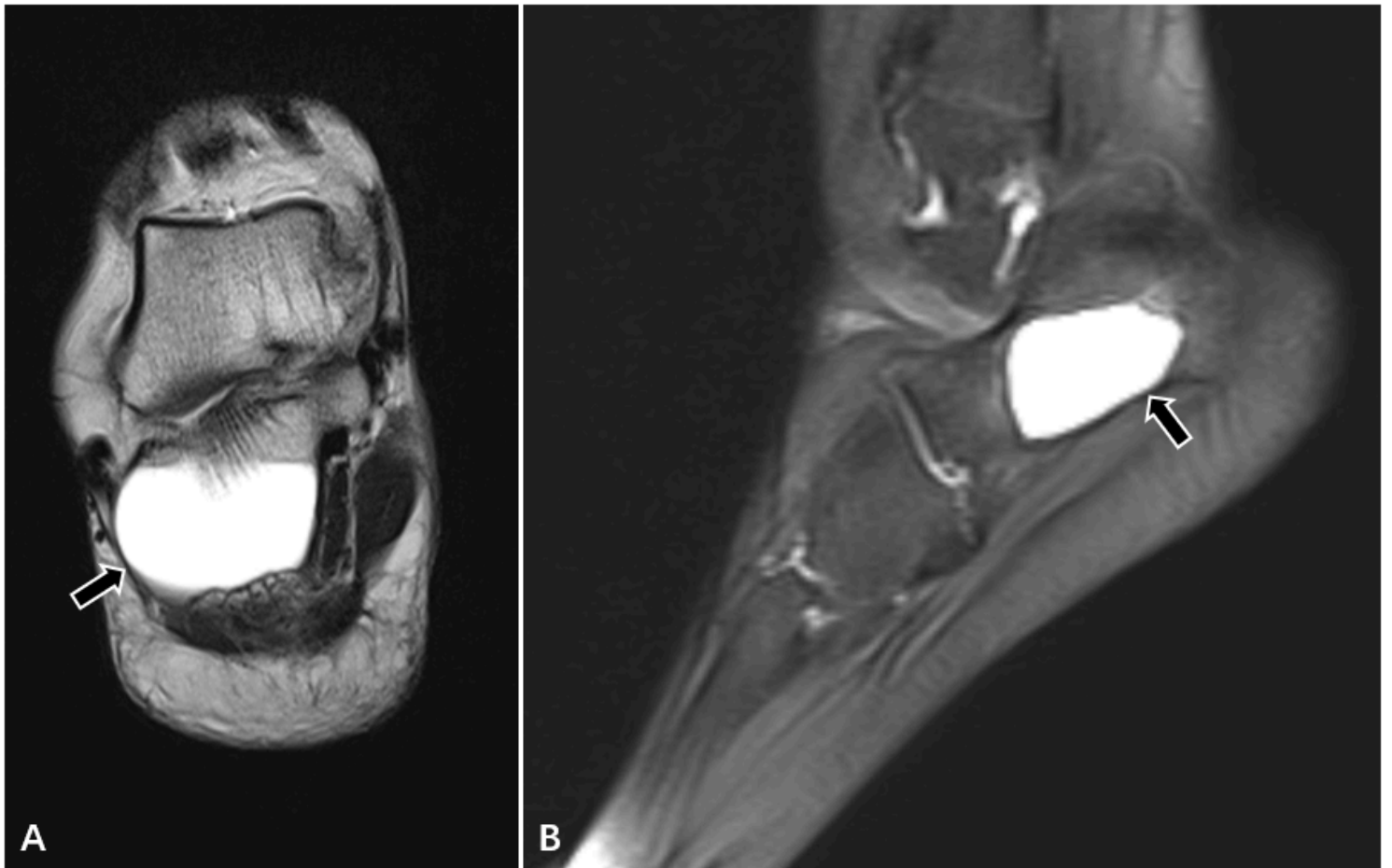


Figure 4

MRI on the middle part of the calcaneus shows a cystic mass lesion in the medullary cavity. **A** T1W and **B** T2W sequences show heterogeneous hyperintense sclerotic rim (arrow) surrounding the medullar component. **B** T2W sequence shows blood level components (arrow).

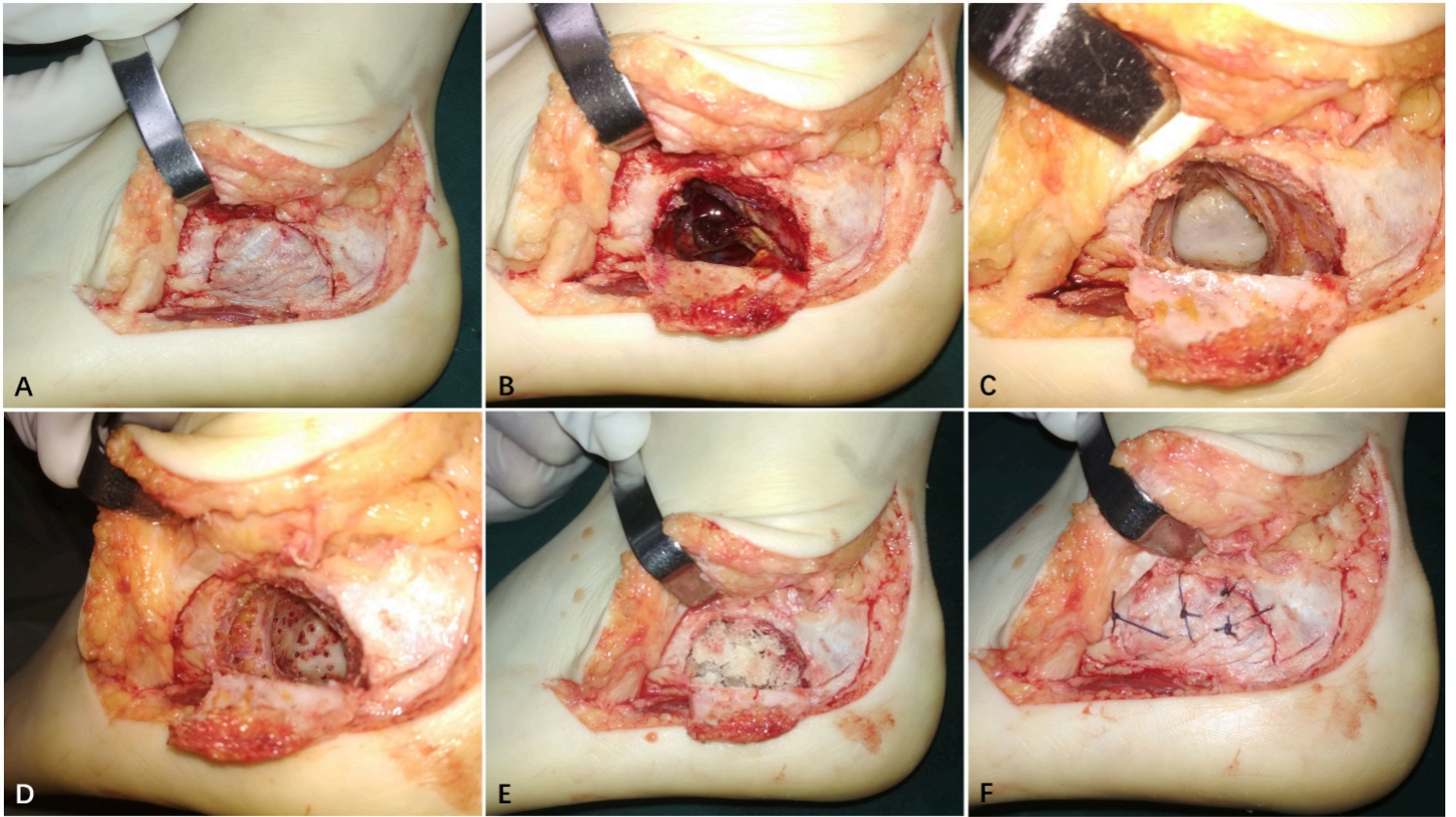


Figure 5

A show the exposure of the lateral wall of the calcaneus achieved via an extended lateral incision and a reverse U-shaped fenestration.

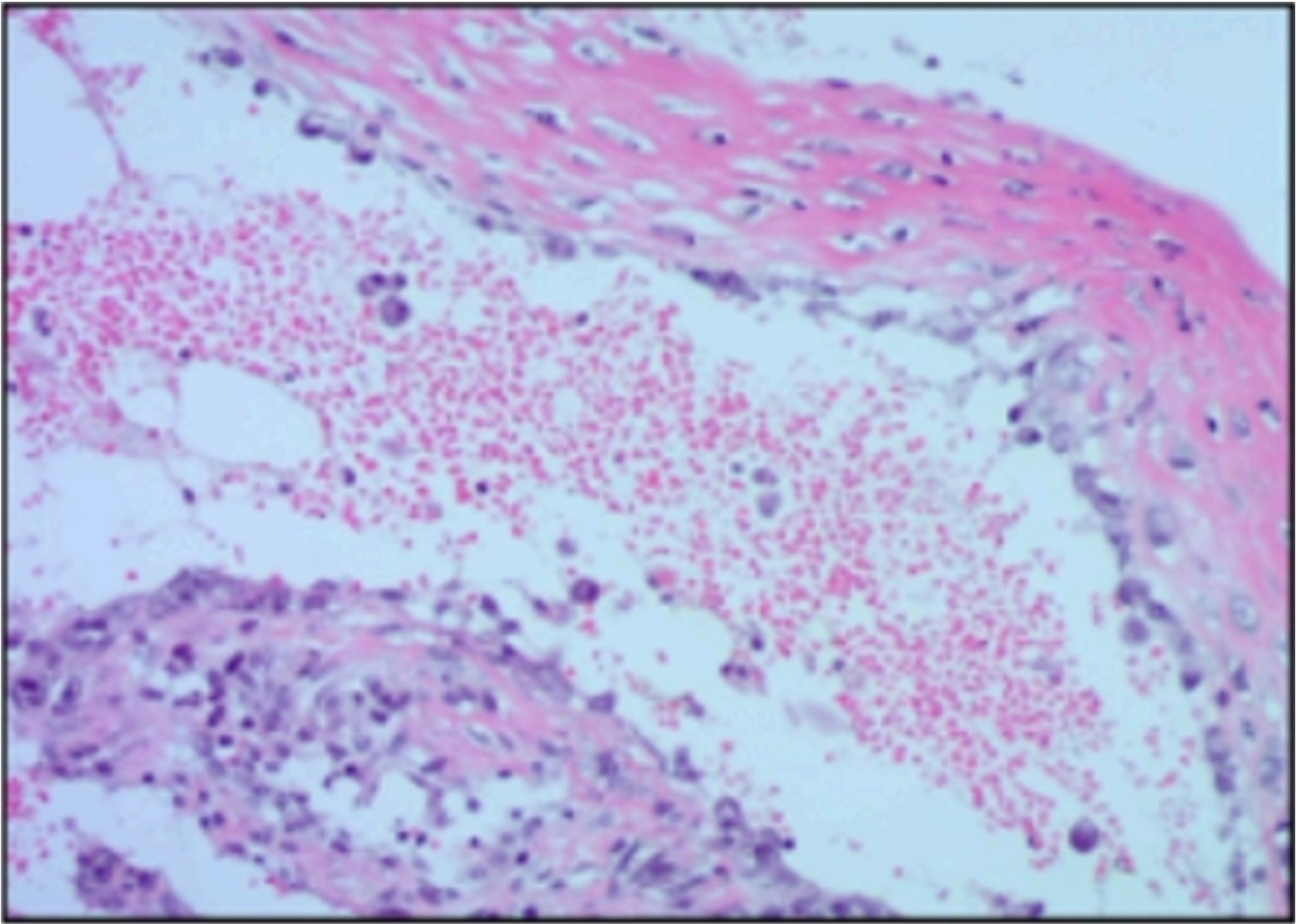
B shows the presence of hemorrhagic soft tissue, observable through a U-shaped fenestration in the lateral wall of the calcaneus.

C shows the complete excision of the tumor.

D shows the multiple drilling procedure utilizing a 1.0 mm K-wire.

E shows the impact of grafting with allogenic bone.

F shows the closure of the U-shaped fenestration on the lateral wall of the calcaneus, which is subsequently secured using absorbable sutures.



HE 10x10

Figure 6

The image shows deposits of Hematoxylin and Eosin. Pathologically, the tissue appears as fragmented gray-brown material, exhibiting a morphology consistent with that of an calcaneal arterial bone cyst.