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Use of a PHILOS Plate for Fixation of a Pathological Subtrochanteric Fracture Secondary to an Aneurysmal Bone Cyst in a Child: A Case Report

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أستخدام شريحة فيلوس لتثبيت كسر مرضي ثانوي نتيجة كيس دموي حميدي تحت المدورين لعظمة الفخذ لدى طفل : تقرير حاله

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ABSTRACT

Aneurysmal bone cyst (ABC) is a benign but locally aggressive bone lesion that predominantly affects children and adolescents. Pathological fracture through a proximal femoral ABC requires simultaneous management of the cyst and stable fracture fixation. A 9-year-old boy presented to Tobruk Medical Center, Libya, following minor trauma, with pain and functional impairment of the right lower limb. Radiographs revealed a pathological subtrochanteric fracture through an osteolytic proximal femoral lesion. Histopathological examination of an intraoperative biopsy confirmed ABC. Following intralesional management, the fracture was fixed with a Proximal Humeral Internal Locking System (PHILOS) plate, used off label for proximal femoral fixation. Early postoperative wound dehiscence with culture positive *Staphylococcus aureus* resolved after culture-directed antibiotic therapy. At most recent follow-up, the patient was clinically well with satisfactory alignment. The PHILOS plate may serve as a viable alternative fixation for selected pediatric proximal femoral pathological fractures secondary to ABC, although longer follow-up is required to monitor healing, recurrence, and physeal integrity.

الملخص:

يُعدّ الكيس العظمي الدموي آفة عظمية نادرة، حميدة، لكنها قد تكون موضعياً عدوانية، وتصيب غالباً الأطفال والمراهقين. ويتطلب حدوث كسر مرضي في منطقة أعلى عظم الفخذ نتيجة هذه الآفة معالجة الكيس وتحقيق تثبيت مستقر للكسر في الوقت نفسه. حضر طفل يبلغ من العمر 9 سنوات إلى مركز

طبرق الطبي في ليبيا بعد تعرضه لإصابة بسيطة، وكان يعاني من ألم وضعف في وظيفة الطرف السفلي الأيمن. أظهرت الصور الشعاعية وجود كسر مرضي تحت المدور عبر آفة حالّة للعظم في الجزء القريب من عظم الفخذ. وأكد الفحص النسيجي لعينة مأخوذة أثناء العملية تشخيص الكيس العظمي الدموي. وبعد معالجة الآفة، ثُبّت الكسر باستخدام صفيحة نظام التثبيت الداخلي خاصه للطرف القريب من عظم العضد ولكنها استخدمت للفخذ ، وذلك يعتبر خارج الاستطباب الأصلي للصفيحة .حدث في الفترة المبكرة بعد العملية تباعد في حواف الجرح، وأظهرت المزرعة نمو بكتيريا المكورات العنقودية الذهبية ، وقد تحسنت الحالة بعد إعطاء مضاد حيوي وفق نتائج المزرعة واختبار الحساسية. وفي آخر متابعة موثقة، كانت الحالة السريرية للطفل جيدة مع محاذاة مرضية للكسر. ويمكن أن تمثل صفيحة خياراً بديلاً للتثبيت في حالات مختارة من الكسور المرضية في الجزء القريب من عظم الفخذ لدى الأطفال، مع ضرورة المتابعة لمدة أطول لتقييم الالتئام، واحتمال عودة الكيس، وسلامة صفيحة النمو.

الكلمات المفتاحية: الكيس العظمي أمّ الدم؛ الكسر تحت المدور؛ الكسر المرضي؛ صفيحة نظام التثبيت الداخلي

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1. INTRODUCTION

Aneurysmal bone cyst (ABC) is a benign, expansile, non-neoplastic lesion of the bone, characterized by channels of blood and spaces that are separated by fibrous septae. ABC is a benign lesion, but malignant transformation has been reported in some cases **(1)**. Most studies estimate the incidence of ABCs to be 0.14/100,000 people accounting for 1–6% of all primary bone tumors with 80% presenting within the first two decades of life and a median age of 13–15 years. It is most commonly located in the metaphyseal end of long bone with the highest incidence in the proximal end of femur **(2)**. The etiology and pathogenesis of this bony lesion are poorly understood, with some theories suggesting it to arise from vascular malformations, trauma, and genetics **(3)**. Primary ABCs have been shown to be true neoplasms linked with chromosomal fusion that may affect osteoblastic maturation **(4)**. Secondary ABC can also arise from other lesions such as chondroblastomas, osteosarcoma, osteoblastoma, non-ossifying fibroma, and giant cell tumors **(5)**. Several treatment modalities are described for ABC, such as curettage, curettage with cementation or bone grafting, fibrosing agents or bone marrow injections, arterial embolization, adjuvant cryotherapy or radiotherapy, demineralized bone matrix applications, and segmental or en bloc resections. En bloc resection has the advantage of the lowest recurrence rate, which is as low as 0% **(6)**. The use of a Proximal Humeral Internal Locking System (PHILOS) plate for proximal femoral fixation is unusual because the implant was originally designed for proximal humeral fractures. Nevertheless, its locking screw configuration and angular stability have led to its use as an alternative fixation construct in selected pediatric proximal femoral fractures. In this report, we present the case of a 9-year-old boy with a right pathological subtrochanteric fracture secondary to a histopathologically confirmed aneurysmal bone cyst, treated with surgical management and fixation using a PHILOS plate.

2. CASE PRESENTATION

A 9-year-old boy presented to Tobruk Medical Center, Libya, following minor trauma to the right lower limb, associated with pain and functional impairment. Plain radiographic examination of the right proximal femur revealed a pathological subtrochanteric fracture through an osteolytic lesion involving the proximal femur. The radiological appearance was suggestive of an aneurysmal bone cyst (ABC) **(Fig. 1)**.

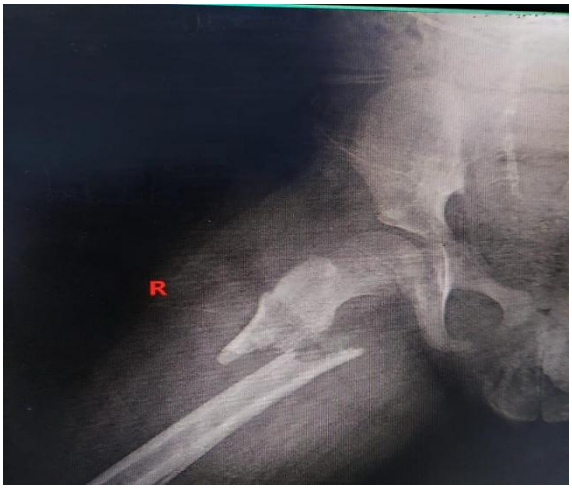


Fig. 1 Preoperative anteroposterior radiograph of the right proximal femur showing a pathological subtrochanteric fracture through an osteolytic lesion involving the proximal femur.

The patient was scheduled for operative management. Intraoperatively, a lytic lesion was identified in the proximal femur, and a biopsy specimen was obtained for histopathological examination. Histopathological analysis confirmed the diagnosis of an aneurysmal bone cyst.

Following management of the lesion and fracture, internal fixation was performed using a proximal humeral internal locking system (PHILOS) plate. Although the PHILOS plate is designed primarily for proximal humeral fractures rather than proximal femoral fixation, it was utilized in this case to achieve stable fixation of the proximal femur. The postoperative radiograph demonstrated satisfactory alignment and fixation of the fracture with the PHILOS plate **(Fig. 2)**.



Fig. 2 Postoperative anteroposterior radiograph demonstrating fixation of the right proximal femoral pathological fracture using a PHILOS plate, with satisfactory alignment of the proximal femur.

The patient was subsequently followed clinically and radiologically. During the early postoperative period, wound dehiscence developed at the operative site. A wound sample was obtained for microbiological examination, which revealed *Staphylococcus aureus*. Antibiotic therapy was initiated according to the culture and sensitivity results. The wound subsequently improved with appropriate management.

At the most recent follow-up, the patient was clinically doing well, with satisfactory recovery. Continued clinical and radiological follow-up was planned to assess fracture healing, implant stability, and the underlying aneurysmal bone cyst.

3. DISCUSSION

Aneurysmal bone cyst (ABC) is a rare, benign but locally aggressive bone lesion that mainly affects children and adolescents. Progressive bone destruction may weaken the affected bone and predispose to pathological fractures, particularly in the proximal femur. Management requires treatment of the lesion together with stable fracture fixation, and the PHILOS plate has recently been reported as an alternative fixation option for pediatric proximal femoral pathological fractures **(5,7)**.

In this case, a 9-year-old boy presented following minor trauma to the right lower limb, with pain and functional impairment. Radiographs revealed a pathological subtrochanteric fracture through an osteolytic proximal femoral lesion suggestive of ABC. Similarly, **Sonkusale et al.** reported a 13-year-old boy with proximal femoral ABC presenting with a pathological subtrochanteric fracture following trivial trauma **(5)**. A systematic review also emphasized that pathological fractures may complicate ABC and require management of both the lesion and associated fracture **(8)**.

Treatment of ABC aims to eradicate the lesion while preserving bone integrity and function. Curettage remains a common treatment, although recurrence remains a concern, particularly in young patients. **Strohm et al.** reported healing rates of approximately 91% following curettage, increasing to 96% when combined with autologous cancellous bone grafting **(9)**. Another review similarly emphasized curettage and local adjuvants as important strategies for reducing recurrence **(10)**. The published literature indicates that intralesional curettage is the most frequently used technique, with healing rates of approximately 91% after curettage alone and up to 96% when combined with autologous cancellous bone grafting **(9,10)**. En bloc resection offers the lowest reported recurrence rate, approaching 0% in selected series **(6)**, but is rarely feasible in the proximal femur without significant functional cost. Selective arterial embolization and percutaneous sclerotherapy with polidocanol or doxycycline have also been described as effective primary or adjunctive options, particularly for lesions in surgically inaccessible sites **(10)**. In pediatric patients the choice of adjuvant must also weigh the risk of growth disturbance and physeal injury.

Stable fixation is particularly important in proximal femoral pathological fractures because of the mechanical demands of this weight-bearing region. **Sonkusale et al.** treated a pediatric proximal femoral ABC with pathological subtrochanteric fracture using curettage and a pediatric dynamic hip screw with a four-hole plate, with favorable healing **(5)**. In the present case, a PHILOS plate was used as an alternative fixation strategy.

Although originally designed for proximal humeral fractures, PHILOS plates have been used in selected pediatric proximal femoral and subtrochanteric fractures. **Morales et al.** reported four children aged 8–14 years with subtrochanteric fractures treated with PHILOS plates, with excellent outcomes at six months **(11)**. Similarly, **Primaputra and Jatmiko** reported two pediatric pathological proximal femoral fractures treated with PHILOS plating, with satisfactory healing, alignment, and functional recovery **(7)**.

Of particular relevance, **Pai et al.** reported a recurrent proximal femoral ABC with pathological fracture in a 5-year-old child treated with a PHILOS plate, with good hip function and no recurrence after three years **(12)**. Unlike that case, the present patient had a primary ABC with a pathological subtrochanteric fracture treated with PHILOS fixation at initial presentation, further supporting its potential use in selected pediatric proximal femoral pathological fractures.

Fixation of a pathological subtrochanteric fracture in a 9-year-old is mechanically demanding. Conventional pediatric options include pediatric dynamic hip screw (DHS) constructs, blade plates, elastic stable intramedullary nailing (ESIN), and external fixation each with limitations in this setting. ESIN provides relative stability and is widely used for diaphyseal fractures but offers limited rotational control and poor resistance to varus collapse in comminuted subtrochanteric lesions **(11)**. Pediatric DHS constructs, such as those used by **Sonkusale et al. (5)**, provide angular stability but require a substantial lateral bony bridge and may be difficult to seat in a small proximal femur with significant cortical destruction. External fixation is generally reserved for open or contaminated injuries.

The PHILOS plate was originally designed for proximal humeral fractures but offers features that have made it attractive for selected pediatric proximal femoral fractures: (i) multiple locking screws directed into the femoral head and neck provide angular-stable fixation in osteopenic or lytic bone; (ii) divergent and convergent screw trajectories distribute load over a wider volume of the proximal fragment, which is particularly useful when bone quality is compromised by cystic destruction; and (iii) the low-profile plate minimizes soft-tissue irritation **(7,11)**.

Pediatric-specific considerations. The use of a locking plate in a skeletally immature patient raises specific concerns. First, screws placed near the proximal femoral physis may contribute to growth disturbance; in the present case, screw trajectories were confined to the metaphyseal region to avoid the capital femoral physis, but longer-term radiographic follow-up is required to confirm the absence of physeal injury. Second, the relatively bulky implant may predispose to symptomatic hardware, which in children frequently requires a second operation for removal. Third, the rigid construct may produce stress-shielding across the fracture site after union, with theoretical implications for remodelling of the residual cystic cavity.

In the present case, early postoperative wound dehiscence occurred, with microbiological examination identifying *Staphylococcus aureus*. Appropriate antibiotic therapy was initiated according to culture and sensitivity results, followed by clinical improvement. *S. aureus* is a recognized pathogen in postoperative orthopedic wound infections, including those following fracture fixation **(13)**. Despite this complication, the patient achieved satisfactory clinical recovery, with continued clinical and radiological follow-up planned.

4. CONCLUSION

In conclusion, pathological subtrochanteric fracture secondary to ABC is an uncommon and challenging condition in children. Appropriate management should address both the underlying lesion and fracture stability. This case highlights the PHILOS plate as a potential alternative fixation option for selected pediatric proximal femoral pathological fractures. Despite an early wound complication, the patient achieved satisfactory clinical recovery with continued follow-up.

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