Use of an autologous nonvascularized fibular strut graft in the treatment of benign cystic lesions of the proximal femur

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Introduction
The proximal end of the femur is a common site of benign aggressive lesions that might cause destruction and lead to pathological fracture. Treatment of these lesions usually entails curettage, and bone grafting with or without plate osteosynthesis.

Patients and methods
This study included 18 patients; 11 were males, mean age 12 years (range 4–34 years). The diagnosis was as follows: aneurysmal bone cyst (*n*=10), simple bone cyst (*n*=4), and one case of a giant cell tumor, eosinophilic granuloma, fibrous dysplasia, and enchondroma. Treatment involved curettage, hydrogen peroxide lavage, and an autologous nonvascularized fibular graft without internal fixation, except in one case presenting with a pathological fracture. The fibula was impacted as a strut, and a Kirschner wire was used to fix it in four cases. Patients were placed in hip spica for 6–8 weeks. Follow-up ranged from 20 to 40 months, with a mean of 26 weeks.

Results
All patients had an excellent functional outcome at the last visit, except one patient, who showed good function according to the musculoskeletal tumor society score. Fibular incorporation took 8–12 months. Time to weight bearing ranged from 3 to 6 months. Fibula was reformed at the donor site in most cases with minimal complications.

Conclusion
We believe that thorough curettage without refilling of the cavity is a satisfactory method of treatment of benign aggressive lesions of the proximal femur; the use of a nonvascularized autologous fibular graft is helpful as an early biological support and aids healing of the cyst. Internal fixation is not necessary, especially in younger patients.

Keywords:
fibrous dysplasia, fibular graft, bone cyst and aneurysmal bone cyst

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Introduction

The proximal femur is a common site of benign cystic lesions in either tumor or tumor-like conditions. Common benign lesions include giant cell tumor, chondroblastoma, enchondroma, aneurysmal bone cyst (ABC), and simple bone cyst. Some of those lesions are discovered accidentally during radiological investigation for other purposes [1–5]. However many of these lesions may present with pain, limb and pathological fracture [1,3]. There is a high risk of pathological fracture of this region. Treatment of these lesions usually entails curettage, with or without the use of adjuvants to control local recurrence of some lesions. The resultant defect could be left to heal without refilling or it is backed with autogenous, allogenic, or synthetic bone graft with or without osteosynthesis. The use of a plate or nail osteosynthesis after curettage might be challenging because of the lack of bone for proper purchase, and the risk of injuring the proximal femoral epiphysis in immature bone. Also, there exist the risks of infection, cut out, and the need for second surgery for removal of implants, especially in children [2,3].

Patients and methods

This study included 18 patients. Eleven were males (61%) and seven were females. The age of the patients ranged from 4 to 34 years at presentation, with a mean age of 12 years. The pathological diagnosis was aneurysmal bone cyst (10 cases), simple bone cyst (four cases), and the following: giant cell tumor, eosinophilic granuloma, fibrous dysplasia, and solid aneurysmal bone cyst (Table 1). Cases presented with painful lesions, recurrent lesion after previous treatment or impending fracture, or pathological fracture of the proximal femur (Table 2). The size of the lesion was assessed roughly in comparison with the girth of the affected bone. If the lesion affecting the whole bone it is 100% affected bone, if the lesion affected part of the bone it is (<100%) affected or if the lesion expanded outside the bone it is >100% affected bone. All patients were assessed preoperatively by

plain radiography, computed tomographic scan, and MRI study. Suspicious lesions were biopsied before the final surgery by incisional biopsy in three cases and core needle in two patients. The indication for surgery is listed in Table 3.

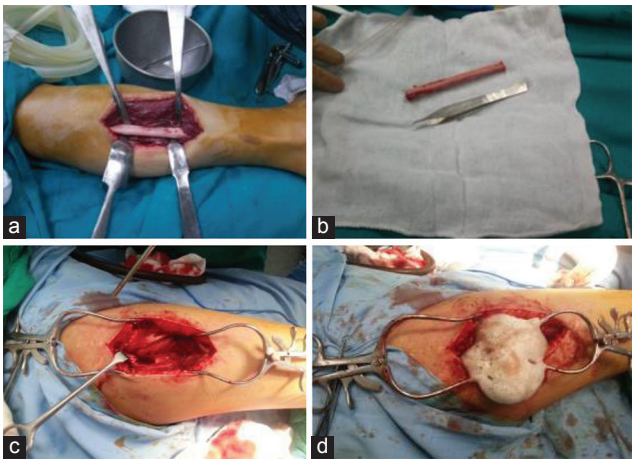
Operative technique

Surgery was performed in three steps: step 1, harvesting of the fibula from the ipsilateral leg was performed through lateral incision and middle segment of the fibula was dissected subperiosteally and kept in a wet sterile towel. Care was taken not to injure the sural nerve or leaving short distal segment less than 6 cm to prevent an adverse effect on ankle joint stability. The leg wound was closed and covered by sterile dressing before opening the site of the lesion to avoid donor site contamination by tissues of the tumor (Fig. 1a and b).

Step 2: Thorough curettage was performed to the proximal femoral lesion through a lateral femoral approach. This was followed by hydrogen peroxide lavage in cases where local recurrence was a risk (Fig. 1c and d).

Step 3: Impaction of the fibular graft inside the cyst, either one segment or more, without internal fixation (Fig. 2). If the graft was not rigidly fixed spontaneously, minimal fixation by Kirschner wire was done. Plate osteosynthesis was performed in one patient aged 16 years at presentation and presenting with a pathological fracture (Fig. 3). All patients were placed in a hip spica cast for external support, except the one with plate osteosynthesis (Table 4). Removal of the spica cast was performed after 8–12 weeks and weight bearing was started thereafter according to cyst healing and graft incorporation. Follow-up was performed by plain radiography.

Figure 1



Harvesting of the fibular strut graft subperiosteally (a), the graft (b), exposure of the proximal femur and opening adequate window for curettage (c), use of hydrogen peroxide as an adjuvant for local biological control (d).

Results

Follow-up period ranged from 20 to 40 months, with a mean follow-up of 26 months. Time to weight bearing ranged from 3 to 5 months, with a mean of 3.8 months. All patients regained full functional recovery with excellent results according to the musculoskeletal tumor society scoring system for limb salvage for the lower limb [4], except one case with a simple bone cyst, who had postoperative pathological fracture after starting weight bearing

Table 1 List of pathological diagnosis of the cases studied

Pathological diagnosis	*n* (%)
ABCii bone cyst	10 (55.6)
Eosinophilic granuloma neck femur	1 (5.6)
Fibrous dysplasia	1 (5.6)
Giant cell tumor	1 (5.6)
Simple bone cyst	4 (22.2)
Solid aneurysmal bone cyst	1 (5.6)
Total	18 (100.0)

Table 2 Clinical presentations of the cases studied

Presentations	*n* (%)
Pain at hip	12 (66.7)
Pain at hip, recurrent lesion	1 (5.6)
Pathological fracture	2 (11.1)
Pathological fracture, recurrent lesion after curettage and mixed cortical and synthetic graft	1 (5.6)
Recurrent lesion for the second time after curettage and bone graft	1 (5.6)
Recurrent lesion for the third time after curettage and bone graft	1 (5.6)
Total	18 (100.0)

Table 3 Indications for surgery

Indication for surgery	*n* (%)
Huge cyst with a history of fracture	1 (5.6)
Impending fracture	4 (22.2)
Pain	2 (11.1)
Pain, impending fracture	9 (50.0)
Pain, pathological fracture	2 (11.1)
Total	18 (100.0)

Table 4 Methods of fixation used in this study

Methods of fixation	*n* (%)
Kirschner wire	4 (22.2)
Locked proximal femoral plate	1 (5.6)
No fixaion	13 (72.2)
Total	18 (100.0)

that was treated with a longer period of spica cast and finally achieved union with residual pain in the hip region (Table 5).

Factors such as age, sex, and size of the cyst had no statistically significant effect on the final functional outcome. Most of the fibular grafts were fully incorporated into the recipient site within 8–14 months, with a mean incorporation time of 10.5 months. The graft donor site showed some minor problems such as leg discomfort and heel pain (Table 6).

Other complications of the main operative site were encountered such as pathological fracture in one case and limb-length discrepancy because of coxa vara deformity after healing of the cyst without an impact on the overall functional result (Table 7).

The pattern of cyst healing ranged from complete cyst consolidation, which means 100% radio-opacity of the cystin, in 50% of patients within a mean time of 11 months. Some lesions remained incompletely consolidated with residual cavities until the last follow-up without affecting the functional outcome.

Discussion

The proximal femur is one of the common anatomical sites of benign bony lesions [1]. In planning for the management of such lesions, three important points should be considered: first, to prevent deformity and pathological fracture; second, control the biological behavior of the disease to prevent local recurrence in the long term; and third, postmanagement protection of the proximal femur either externally by a spica cast or internally by osteosynthesis, which protects against pathological fracture [3].

The ideal graft material should be osteoconductive, osteoinductive, osteogenic, and easily available [2]. An autologous cancellous bone graft easily incorporates, revascularizes, and has no immunogenicity, but it does

Table 5 Summary of the final functional outcome

Final functional outcome	*n* (%)
Good	1 (5.6)
Excellent	17 (94.4)
Total	18 (100.0)

Table 6 Donor site morbidity

Donor site morbidity	*n* (%)
Heel pain	1 (5.6)
Leg discomfort on walking	2 (11.1)
Non	13 (72.2)
Pain	2 (11.1)
Total	18 (100.0)

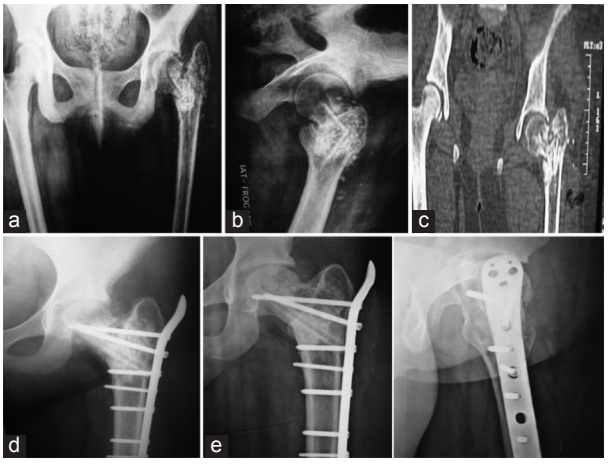
Table 7 Complications

Complications	*n* (%)
Coxa vara	1 (5.6)
Hip pain	1 (5.6)
Limb shortening coxa vara	1 (5.6)
Non	12 (66.7)
Pathological fracture treated by cast	1 (5.6)
Superficial wound infection, coxa vara	1 (5.6)
Trendelenburg gait	1 (5.6)
Total	18 (100.0)

Figure 2

MRI of the proximal femur with a solid aneurysmal bone cyst (a), curettage with a strut autologous bone graft (b), follow-up after 6 months (c), radiograph after 14 months with almost complete healing of the lesion (d).

Figure 3



Radiographs and computed tomographic scan show pathological fracture on top of the recurrent aneurysmal bone cyst after curettage and mixed grafting (a–c), follow-up radiograph after 6 months from treatment by curettage, fibular strut graft, and plate osteosynthesis (d), and radiograph after 2 years (e).

not provide early structural support [2,6]. Also, it has a failure rate up to 48% if it is used alone and it is an insufficient source for large defects [2,7].

Allografts offer the advantage of no donor site morbidity, but require a tissue bank. Also, there is a risk of infection, and transfer of serious diseases [2].

Bone graft substitutes such as bone cement and biocompatible materials provide an alternative for filling bone defects, but these materials do not provide structural support, with difficult incorporation, and thus, they have not gained complete acceptance [1,2,8,9].

Autogenic nonvascularized cortical grafts provide good structural support at the recipient site [2,3,10]. The proximal femur has a rich blood supply that aids vascularization of the grafts. During the first few weeks after grafting revascularization weakens the biomechanical strength of the graft because of increased osteoclastic activity and decreased ostoeblastic activity. Thus, it is better to protect the limb either by restriction of the activity, internal fixation, or external support [2,3,6,11].

In this study, 61% of the patients were males, similar to the findings of Shih *et al*. [1] and Jaffe and Dunham [3], but the number of females was higher in another similar study [2].

The mean age of the studied group of patients was 12 years, which was significantly lower than that in three similar studies [1–3]. This might explain the use of hip spica cast as a mean of external support instead of internal fixation that would be difficult in older age group. In this study, two patients presented with a pathological fracture neck femur: the first patient was a 16-year-old female, for whom we used internal fixation with a locked plate without hip spica, and the other patient was a 4-year-old boy in whom the impacted fibular strut was enough to stabilize the neck with external support by hip spica.

Complications were minimal in this study group, without a significant effect on the final functional outcome, except in one case, where a pathological fracture of the neck femur occurred during follow-up that finally achieved union with good function according to the musculoskeletal tumor society score [4].

Donor site at the leg showed minimal affordable complications such as leg discomfort during walking and heel pain, similar to the findings of some other studies [2].

The overall functional outcome was excellent, which is almost similar to the results of other studies [1–3,7].

For control of the biology of the underlying pathology, we used hydrogen peroxide lavage as cytotoxic to control local recurrence, which we believe worked, as no local recurrence occurred until the last follow-up [12].

Some studies have reported that there is no need to refill the resultant cavity as we have done in this study [2,13]. This did not agree with the work of Shih *et al*. [1], in which they used a combined allogenic fibular strut graft and backed the cyst with an autologous cancellous graft.

Conclusion

In benign cystic lesions of the proximal femur in relatively young patients, curettage and an autogenous fibular strut graft were enough to control disease and prevent pathological fracture, and it is better to externally protect the limb with plaster of Paris; also, we routinely use hydrogen peroxide lavage to control local recurrence. Osteosynthesis is mandatory if pathological fracture is the presenting factor, especially in older age groups.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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