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# Study of the Different Methods of Management of Defects after Curettage of Benign Cystic Bone Lesions

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## Introduction

Currently, treatment of benign bone cysts includes: observation, injection of bone marrow or demineralized bone matrix,[1-4] curettage combined with bone or synthetic grafting,[5-7] decompression with intramedullary nailing or cannulated screw,[8-10] or a combinations of these approaches.[11]

Bone grafting can be done with either autologous bone or with allograft bone. Autologous bone grafts have osteogenic, osteoinductive, and osteoconductive properties. Autologous bone grafts have an excellent success rate, low risk of disease transmission, and histocompatibility; however, there is a limited quantity of autogenous bone graft available, especially in children.[12,13] Allografts do not contain the same growth potential as autograft and are associated with an increased risk of infection, causing some to limit its use in filling bone cysts, especially in children.[1,2]

Calcium phosphate ceramics can be used to fill bone defects. These materials act as osteoconductive bone void filler that completely resorbs as newly formed bone remodels and restores anatomic features and structural properties.[12,13]

Chemical adjuvants such as phenol, ethanol, hydrogen peroxide and alcohol have been used to extend the margin of resection in benign aggressive bone lesions. The advantages of chemical adjuvant include lowering recurrence rates and necrosis.[14-20] The goal in the use of chemical adjuvants such as hydrogen peroxide is to create a balance between exclusive mechanical methods while limiting the higher toxicity of more aggressive adjuvants. Hydrogen peroxide has a direct cytotoxic effect on active cells through denaturation of protein, controlling microscopic disease in the reactive zone after curettage has removed the gross pathologic tissues.[16-18]

Filling of the resulting cavity after removal of the pathological tissues is not always necessary and healing of the cavity can occur in a reasonable time.[21] The goal of this work was to evaluate the different methods of management of defects following curettage of benign cystic bone lesions.

## Methods

Forty-two patients were diagnosed as having benign bone lesions. There were 21 (50%) males and 21 females. Age ranged from 5 to 62 years (mean: 12.65). The proximal metaphysis of the femur was affected in 15 patients (36%), the proximal humerus in 10 patients (24%), the distal tibia in 6 (14%), the proximal tibia in 3 (7%), the pelvis in 3 (7%), the distal femur in 2 (5%), the scapula in 2 (5%) and the distal humerus in one (2%).

All procedures were performed under general anesthesia. The surgical approach was chosen according to the site of the lesion to allow for adequate exposure. The lesions were thoroughly curettaged. The tissues obtained were sent for histopathological study. Five patients had received incisional biopsy prior to definitive treatment and were diagnosed as aneurysmal bone cyst (ABC).

The diagnosis was ABC in 30 patients (71%), non-ossifying fibroma in 7 (17%), fibrous dysplasia in 4 (10%) and eosinophilic granuloma in one patient (2%). There were 33 primary and 9 recurrent lesions.

The patients were classified into three groups (Table 1) according to the method of management of the defect after the curettage and saline lavage.

**Table 1. Grouped methods of treatment.**

| Group | No | % | Method of treatment |
|---|---|---|---|
| Group 1 | 24 | 57% | Curettage + Hydrogen Peroxide (nonvascularised fibular strut grafts were used in 9/24 cases) |
| Group 2 | 13 | 34% | Curettage + Autogenous Iliac Crest Bone Graft + G-Bone Hydroxyapatite Granules |
| Group3 | 5 | 12% | Curettage + Autogenous Iliac Crest Bone Graft |
| Total | 42 | | |

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Group 1 consisted of 24 patients (57%) in whom hydrogen peroxide (20% solution) was used as an adjuvant, continuously lavaged for three to five minutes. Care was taken to protect the surrounding soft tissues from thermal and chemical injury during lavage. In this group, the resultant cavity was not filled (Figure 1a and b). In nine cases, autogenous non-vascularized fibula was used as a strut graft to stabilize the weak cystic wall after curettage. The fibular graft was rigidly impacted inside the cavity. If it was difficult to impact the strut graft, minimal fixation methods were used to stabilize it (Figure 1c and d). Cast immobilization used in 11 cases, internal fixation was used in two cases

Group 2 consisted of 13 patients (34%) in whom the resultant bone defect was filled with a combination of autogenous iliac crest bone graft (ICBG) and G-Bone (hydroxyapatite) granules (Figure 2a and b). In one patient a non-vascularized fibular graft was additionally used. Internal fixation was used in two patients; one for pathologic femoral neck fracture through fibrous dysplasia, and the other for recurrent fibrous dysplasia with coxa vara deformity (Figure 2c and d).

Group 3 consisted of five patients (12%) in whom the resultant defect was filled with autogenous ICBG. Postoperatively, physical activities were restricted until there was radiographic evidence of bone healing.

Radiological changes were evaluated according to the modified Neer classification system.[22] Neer I were determined to have a healed cyst filled with new bone with or without small radiolucent area $< 1$ cm. Neer II had a healing cyst with a defect $< 50\%$ of the bone diameter. Neer III had a persistent cyst with a radiolucent area $> 50\%$ of the bone diameter. Neer IV had a recurrent cyst.

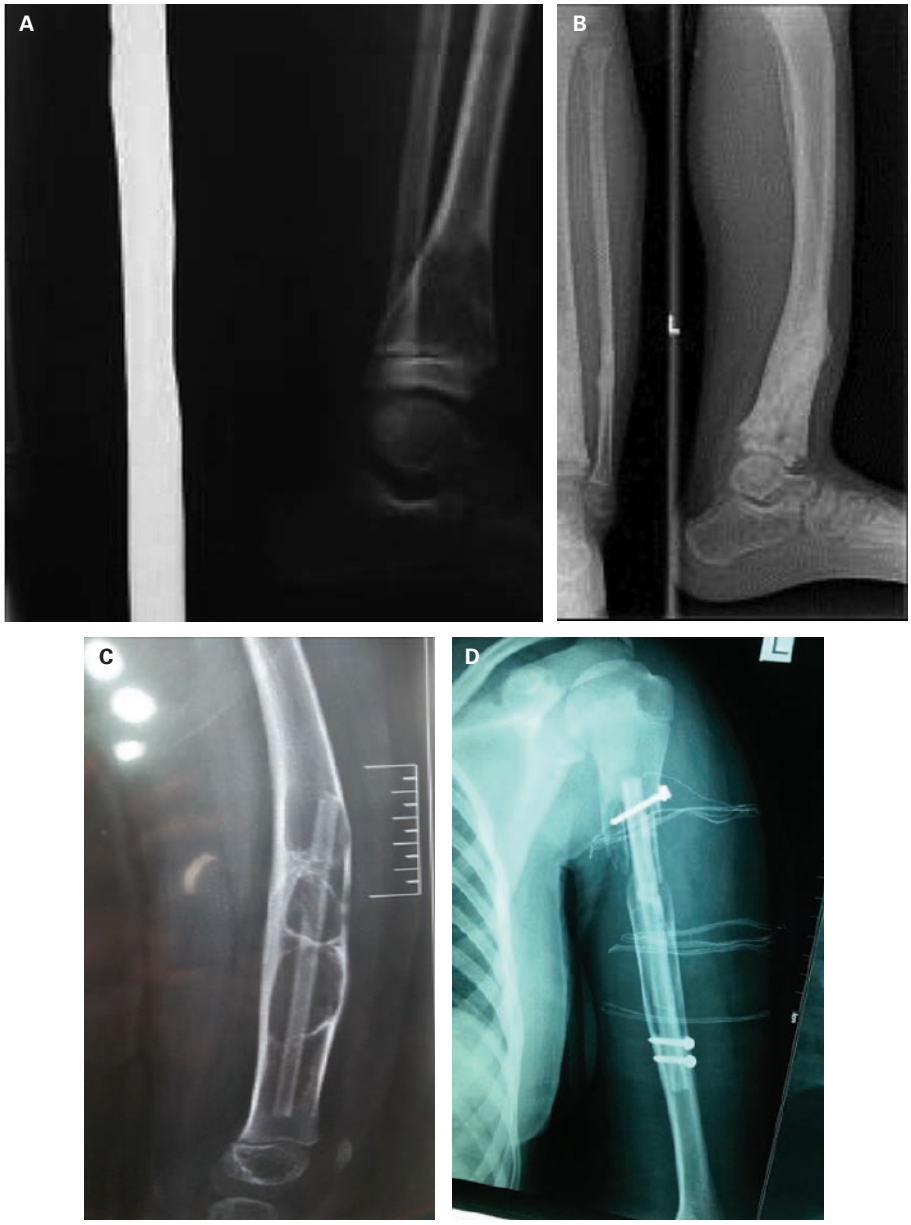


**Figure 1.** (A) Radiological presentation of a case of recurrent solid ABC of the distal tibia in a 9-year-old boy. (B) Follow-up at 18 months after curettage and hydrogen peroxide lavage; near complete healing and consolidation are observed. (C) 6-year-old boy with large ABC of the distal distal femur treated by curettage, hydrogen peroxide lavage and fibular strut autograft. (D) 15-year-old girl with pathologic fracture through a humeral shaft ABC treated by curettage, hydrogen peroxide and strut fibular autograft with internal fixation for added stability.


**Figure 2.** (A) ABC in the proximal femur. (B) Combined autogenous ICBG and hydroxyapatite granules. (C) Femoral neck fracture through fibrous dysplasia of the proximal femur treated by combined grafting and with internal fixation. (D) Corrective osteotomy, combined grafting and DHS fixation for recurrent fibrous dysplasia with severe coxa vara deformity.

The procedure was considered successful if the lesion was completely healed or healed with a small radiological defect. When evidence of consolidation of the lesion or cortical thickening was absent six months after the initial procedure or when recurrence occurred, the procedure was considered unsuccessful.[22]

An approval was given by the institutional review board (IRB) and informed consent was obtained from each patient or designated power of attorney.

## Results

Mean clinical follow up was 25.1 months for Group 1, 18.7 months for Group 2, and 14.6 months for Group 3.

In Group 1, all lesions demonstrated complete radiographic healing (Neer Class 1). Full functional recovery occurred in all cases except one; a patient with a recurrent proximal femoral lesion had a coxa vara deformity leading to a Trendelenberg gait. In lower extremity cases, full weight bearing was achieved by three months postoperatively in 9/16 cases. Autogenous fibular grafts were used in nine cases (Figure 3); in all cases the fibula was completely incorporated within six months postoperatively. No local recurrence or pathological fractures occurred in Group 1.

The overall success rates were 92% for Group 2 and 80% for Group 3 (Figure 4). Recurrence occurred in 1/13 (8%) patients in Group 2 and in 1/5 (20%) patients in Group 3. At final follow-up, 10/13 (77%) of patients in Group 2 were classified as Neer Class I. In Group 3, 4/5 (80%) of patients were considered Neer Class I (Table 2).

The patient included in Group 3 who sustained recurrence following ICBG for ABC of the proximal femur subsequently underwent a combined technique and was included in the analysis for Group 2, with no evidence of recurrence at 26-months post-op.

Recurrence occurred in one patient in Group 2; this patient presented with a fracture through fibrous dysplasia in the femoral neck and was treated by the combined technique together with internal fixation using plate and screws. The fracture and the cyst healed; however, the lesion recurred.


**Figure 3.** (A) 14-year-old girl with an aggressive distal tibia ABC. (B) Aggressive curettage + hydrogen peroxide lavage + fibular strut graft impacted in place without filling of the cavity. (C and D) X-rays at 18 months follow-up showing almost complete healing and consolidation of the lesion.

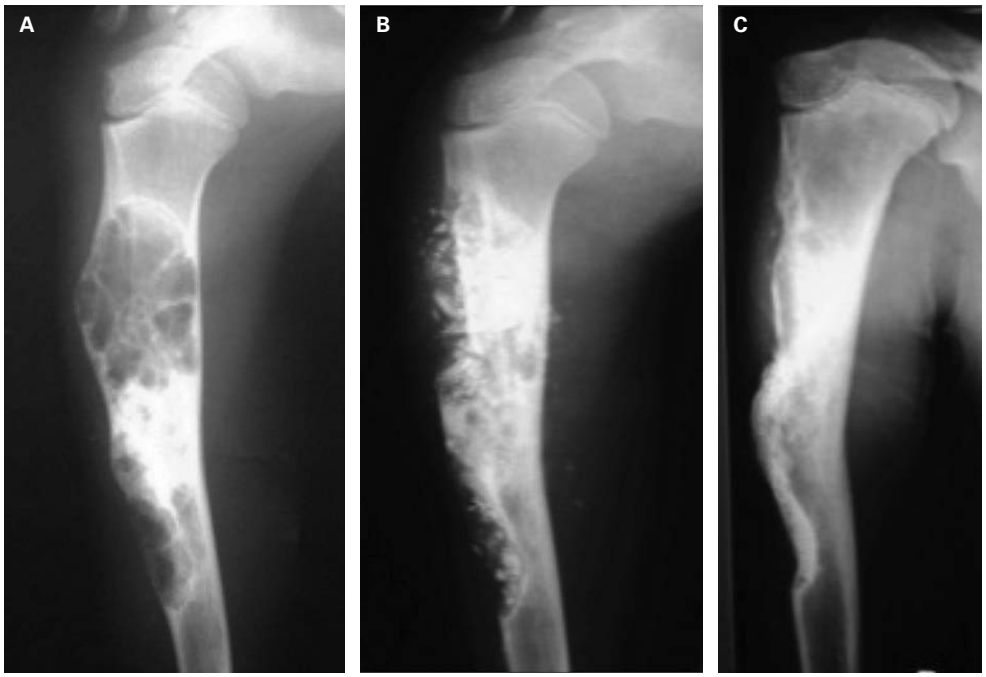


**Figure 4.** (A) Preoperative X-ray showing recurrent ABC, following two prior attempts at bone grafting. (B) Combined autogenous ICBg, fibular allograft, and hydroxyapatite granules. (C) 30 month follow-up showing healing without recurrence.

**Table 2. Results of different treatment groups.**

| | Neer I | Neer II | Neer III | Neer IV | Total |
|---|---|---|---|---|---|
| Group 1 | 24 | 0 | 0 | 0 | 24 |
| Group 2 | 10 | 2 | 0 | 1 | 13 |
| Group 3 | 4 | 0 | 0 | 1 | 5 |
| | 38 | 2 | 0 | 2 | 42 |

Another surgery was performed 14-months postoperatively removal of hardware and curettage and G-bone grafting. Unfortunately the lesion again recurred.

## Discussion

Autogenous ICBG is considered the gold standard for filling bone defects after curettage of benign cystic bone lesions; this graft type is osteoconductive, osteoinductive and osteogenic.[23,24] Autogenous ICBG has known complications such as limited graft volume (especially in children), donor site morbidity, increased pain, hematoma and wound infection.[23] To address these concerns, allografts and biologics have been processed and used. These too have limitations: cost, histo-incompatibility, infection risk, lack of growth potential compared to ICBG.[23]

Several authors used various forms of adjunctive therapy in conjunction with curettage, including phenol, hydrogen peroxide, liquid nitrogen and alcohol with variable reults.[14,18].

In our study, ICBG was used to fill smaller sized defects, while a combination of ICBG and G-bone (hydroxyapatite) was used to fill larger defects. The graft only group (Group 3) had recurrence in 1/5 cases, while the combined graft group (Group 2) had recurrence in 1/13 cases. The no graft group (Group 1) had recurrence in 1/24 cases.

We found a similar rate of recurrence among patients with ABC as found by Mankin, *et al*, who fount that 20% of their 150 cases of ABC had recurrence after treatment with curettage and allograft bone chips or Polymethylmethacrylate. Autogenous ICBG was used with large lesions or for recurrent lesions.[25]

One out of four (25%) patients with fibrous dysplasia had recurrence. The recurrence occurred in the only case of polystotic fibrous dysplasia included in this study. We were obliged to do bone grafting because she presented with a transcervical femoral neck fracture through a large lesion. Attempts to completely remove polyostotic disease with curettage and bone grafting are rarely successful.[26]

Uchida[27] used hydroxyapatite blocks and granules to fill defects in 60 cases of benign bone tumors after resection. The implants were well incorporated into the host bone in

all cases. Evaniew, *et al*[23] treated 24 benign bone tumors with intralesional curettage followed by reconstruction with a calcium sulphate/calcium phosphate composite. Recurrence occurred in two cases and deep infection in four cases.

In this study, hydrogen peroxide was routinely used as an adjuvant after curettage in Group 1 patients. It is believed that hydrogen peroxide has both local thermal and chemical effects. The use of hydrogen peroxide as an adjuvant treatment of non-malignant active and aggressive bone tumors has been rarely discussed in the literature.[18] To our knowledge, no reports exist in the literature on its use alone as an adjuvant after curettage of benign bone lesions. Hydrogen peroxide has the advantages of being cheap and is usually readily available. It has the benefit of not being harmful to skin or the local healthy tissues as has been reported with cryotherapy; additionally, our results show superior results than similar studies using other adjuvants.[28]

## Conclusion

Thorough curettage with hydrogen peroxide (20% solution) lavage could be an effective and inexpenisve method to control local recurrence after treatment of benign bone lesions. Strut fibular autografts can provide good mechanical stability especially in huge lesions. The combined use of hydroxyapatite synthetic granules with autogenous bone graft is a safe and effective option for the situations when a large amount of graft is needed, especially in children with large and/or recurrent benign bone lesions.

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