Surgical Options for the Treatment of Simple Bone Cyst in Children and Adolescents

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ABSTRACT: Background: There are several treatment options for simple bone cysts, with treatment depending mainly on the experience and preference of the surgeon and the extension and location of the cyst. Objectives: To assess our experience with the surgical treatment of bone cyst lesions in pediatric patients at one institution by the same group of surgeons. Methods: The study group comprised 60 patients (43 boys, 17 girls) treated surgically for monostatic lesions between January 2002 and July 2007. The mean age at surgery was 11.8 years (range 4–17 years). Mean follow-up was 4.2 years. Most of the lesions were located at the proximal humerus. Patients were divided into five groups according to treatment method: a) corticosteroids (methylprednisolone 40–80 mg) (n=26); b) curettage and bone grafting (fibula or iliac crest) (n=16); c) aspiration of the bone cavity and subsequent bone marrow transplantation (n=10); d) internal preventive fixation using an elastic stable intramedullary nail (n=5); and e) curettage and implantation of a synthetic cancellous bone substitute (pure beta-tricalcium phosphate substitute, ChronOS®, Synthes, Switzerland) (n=3). Results: Treatment success was evaluated by the Capanna criteria. Successful results were observed in 68% (18 complete healing, 23 healing with residual radiolucent areas), 30% recurrence rate, and no response to treatment in one patient (2%). We recorded recurrence in 50% of the children treated by corticosteroid injection, and one child did not respond to treatment. Conclusions: The best results were achieved in children treated by curettage and the subsequent use of an osteoconductive material, and in children treated with elastic intramedullary nail fixation. Despite our limited experience with calcium-triphosphate bone substitute, the treatment was mostly successful. Because of the short follow-up, further observation and evaluation are necessary.

KEY WORDS: simple bone cyst, surgical treatment, curettage, corticosteroids, elastic stable intramedullary nail

The unicameral bone cyst is a benign fluid-filled lesion, located mainly in the metaphyses of the long bones in skeletally immature patients [1,2]. More a developmental or reactive lesion than a real tumor, it is sometimes classified as a tumor-like lesion. The cavity of the cyst usually contains a small amount of clear yellowish sero-sanguinous fluid. In the case of a pathological fracture through the cyst, the cyst contains blood. The cyst can be in the growing skeleton, i.e., expanding and/or recurring after treatment, particularly if it is in close proximity to the growth plate. These cysts might heal spontaneously in adulthood [3]. They tend to appear in the first two decades of life, mostly in boys (2:1). On X-ray, the cyst appears as a well-localized radiolucent lytic lesion in the medullary canal, well differentiated, and without periosteal reaction. When the cyst is complicated by a pathological fracture, periosteal reaction can be seen at the fracture-healing stage. The cyst can expand concentrically but never penetrates bone cortex. The indication for treatment is pain, pathological fracture, or risk of such a fracture, for example, if a large cyst is situated in a weight-bearing area [4].

Since Virchow first described this lesion in 1876, several methods of treatment have been proposed and various outcomes described. Currently performed treatment includes observation, aspiration, and injection of corticosteroids [5]; aspiration and injection of bone marrow or demineralized bone matrix [2,6,7]; curettage combined with bone or synthetic grafting [4,8,9]; continuous decompression with intramedullary nailing or cannulated screw [3,10,11,12]; or a combinations of these approaches [13]. The choice of treatment depends on the surgeon’s experience and the location and extension of the lesion.

We assessed our experience with the surgical treatment of bone cyst lesions in pediatric patients at one institution by the same group of surgeons. Patients treated conservatively or observed for this pathology were not included in this study.

PATIENTS AND METHODS

The study included 60 patients (43 boys, 17 girls) surgically treated for monostatic simple bone cyst lesions between January 2002 and July 2007, evaluated retrospectively. The mean age at surgery was 11.8 years (range 4–17 years). The mean follow-up
was 4.2 years (range 3–5.5 years). Most of the lesions (n=28) were located in the humerus. We divided our cohort into five groups, according to mode of treatment [Table 1]:

- Injection of corticosteroids (methylprednisolone 40–80 mg) (n=26)
- Curettage of the bone cavity and bone grafting with fibula or iliac crest (n=16)
- Aspiration of the bone cavity and subsequent bone marrow transplantation (n=10)
- Internal preventive fixation using an elastic stable intramedullary nail (n=5)
- Curettage of the bone cavity with subsequent instillation of synthetic cancellous bone substitute (pure beta-tricalcium phosphate substitute, ChronOS®, Synthes, Switzerland) (n=3).

We do not perform percutaneous or open biopsies before the definitive surgical treatment. The lesions had a typical radiographic appearance, and the aspirated fluid a typical character. Anteroposterior and lateral radiographs were taken on the first postoperative day, and then 6 weeks, 3 months, 6 months, and 1 year after surgery; the patients were then followed at 1 year intervals. In cases treated by the instillation of bone marrow, the first X-ray was taken 6 months after surgery. Results were evaluated according to the radiographic criteria of Capanna:

- Complete healing: when the cyst is fully filled with new bone formation and the cortical margins were thickened
- Healing with residual radiolucency: when the cyst is well consolidated with small radiolucent areas inside
- Recurrence: when the cyst heals initially but large areas of radiolucency and cortical thinning develop
- No evident response to treatment

### RESULTS

Successful results were observed in 68% (18 total healing, 23 healing with residual radiolucent areas). There were 30% recurrences and no response to treatment in one case (2%) [Table 2]. We noted recurrence in 50% of the children treated by injection of corticosteroids, and one patient did not respond to treatment. Pathological fractures were demonstrated in 5 patients (8%), without involvement of the physis. The best results were achieved in the children treated by curettage and the subsequent use of osteoconductive material, and in children treated with elastic intramedullary nail fixations.

### DISCUSSION

Despite the fact that many authors have published studies on the treatment of simple bone cysts, the exact etiology and pathogenesis remain unclear. The most widely accepted theory is that a focal defect in metaphyseal remodeling leads to venous obstruction and rising internal pressure leading to an increase in cyst size. There are many surgical treatment options, including aspiration and injection of corticosteroids [5], aspiration and injection of bone marrow [2,6], curettage combined with bone or synthetic grafting [4,8,9], continuous decompression with intramedullary nailing [10,11], or combinations of these approaches [13]. The trend is towards surgery, to diminish the internal cyst pressure. Small asymptomatic lesions in the upper extremities should be treated conservatively and observed radiologically [3]. Larger lesions (with a risk of pathological fracture), symptomatic lesions, and cysts of the lower extremities are usually treated with curettage (with or without bone grafting or internal fixation) or aspiration and injection (often using steroids, bone marrow aspirate, demineralized bone matrix or other materials) [3,7,12]. Fractures through the cysts in the upper extremity can be treated conservatively, contrary to pathological fractures in the femur or tibia where curettage, bone grafting or internal fixation is indicated [3]. In our cohort, we treated five pathological fractures using elastic stable intramedullary nails with satisfactory results.

Because the recurrence rate after curettage and bone grafting was approximately 50%, corticosteroid injection was
Our study shows that the best results were achieved in the children treated by curettage followed by an osteoconductive material, and in children treated by elastic intramedullary nail fixation. Although our experience with calcium-triphosphate bone substitute is small, we do see a positive trend, and further evaluation is necessary.

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**References**

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**Figure 1.** Anteroposterior and lateral radiogram of a 16 year old boy with solitary bone cyst of the distal femur [A, B], anterior-posterior and lateral radiograms 6 months after curettage and filling with bone grafts, bone marrow and calcium triphosphate substitute ChronOS® [C, D].

**Figure 2.** Radiogram of 10 year old boy with simple bone cyst of the proximal femur. The fracture was treated successfully with an elastic stable intramedullary nail.


### Capsule

**Body habitat influences microbial community composition**

The human gut and skin harbor diverse microbial communities that are known to vary strikingly among individuals. Costello et al. analyzed microbial diversity among several distinct body habitats (including the gut, mouth, inside the ears and nose, and skin) of the same person at different times. They found that body habitat had more influence on microbial community composition than temporal differences and variation among people. Some skin locations, such as the index finger, back of the knee, and sole of the foot, on occasion harbored higher microbial diversity than the gut or oral cavity.

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### Capsule

**Urinary antigen tests often miss Legionella infection**

Shimada and team have presented an analysis of pooled data from 30 studies involving 40 assays and 6 different methodologies for Legionella identification. All but two studies focused on serotype 1 Legionella. The pooled specificity was 0.99, but the sensitivity was only 0.74. Therefore, a positive test indicates legionellosis, but 26% of patients with confirmed legionellosis have a negative urinary antigen test result. However, when the investigators used the Quality Assessment for Diagnostic Accuracy Studies method to evaluate the publications, the average score was only 4.4 on a scale of 1 to 14 (range 1 to 9).

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Eitan Israeli

“Losing one glove
Is certainly painful,
But nothing
Compared to the pain,
Of losing one,
Throwing away the other,
And finding
The first one again”

Piet Hein (1905-1996), Danish poet and scientist