Treatment of benign cystic lesions of bone with a composite of bone substitute and bone marrow

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Background
There are many methods for the treatment of unicameral bone cysts, which are benign cystic lesions seen in the metaphseal–diaphyseal region of long bones in growing children.
Patients and methods
Totally 20 patients, eight boys and four girls with a mean age of 10 years (range: 8–14 years), who had unicameral bone cysts were treated by curettage and a $CaSO_4$–$CaPO_4$ bone substitute mixed with bone marrow aspiration. The lesion size ranged from 2×4 to 3×7 cm.
Results
New bone formation was noted in all cases with residual defects in five cases ranging from 15 to 25%. No pathological fracture occurred in this study. Recurrence of the lesion occurred in one case and was treated by reoperation with another dose of $CaSO_4$–$CaPO_4$. Complications within this series included superficial infection with serous drainage 3 weeks postoperatively in two cases treated conservatively.
Conclusion
Early results of this study using the $CaSO_4$–$CaPO_4$ incorporated with bone marrow aspirate are promising in treating benign bone cysts with bone formation, which can stand for normal bone strength and low rate of complications.

Keywords:
benign, bone cyst, bone marrow, substitute

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Introduction

Unicameral bone cysts or simple bone cysts are benign cystic lesions seen in the metaphseal–diaphyseal region of long bones in growing children. Virchow R. described the lesion for the first time in 1876. Pathological fracture usually is the first presentation of patients [1,2].

A number of treatment methods have been suggested for addressing these lesions like intralesional injections of steroids and autologous bone marrow. The most frequent technique used for treatment of bone cysts and benign tumors is curettage with bone grafting [3,4]. The large resultant defects from curettage are often filled with autologous bone graft, allograft material, or synthetic bone substitutes. Although autologous bone graft has traditionally been considered the gold standard, bone graft substitutes are often attractive options because of the size of the defect, location of the defect, autograft harvesting morbidity, and overall patient health [5]. A minimally invasive (the bone substitute acts as a scaffold so if normal bone did not form fracture can occur if it is united in x-ray) surgical technique described here preserves the periosteum, muscles, and blood supply and provides access to cyst curettage, decompression, and use of filling material – in this case autologous bone grafts – which gives easy and effective approach and successful outcome [6]. Several reports recommended the use calcium sulfate ($CaSO_4$)-based bone graft substitutes both with and without demineralized bone matrix in benign bone tumors [7–9].

Patients and methods

Between June 2008 and January 2011, 12 patients with benign bone cysts were treated by curettage and with a $CaSO_4$–$CaPO_4$ bone substitute mixed with bone marrow aspiration. This prospective study was conducted at Zagazig University Hospitals, after approval of our ethical committee for research in accordance with the ethical standards laid down in the 1964 declaration of Helsinki and its later amendments. There were eight boys and four girls, and the mean age of the patients was 10 years (range: 8–14 years). The pathologic diagnoses of patients were simple bone cyst in six patients, nonossifying fibromas

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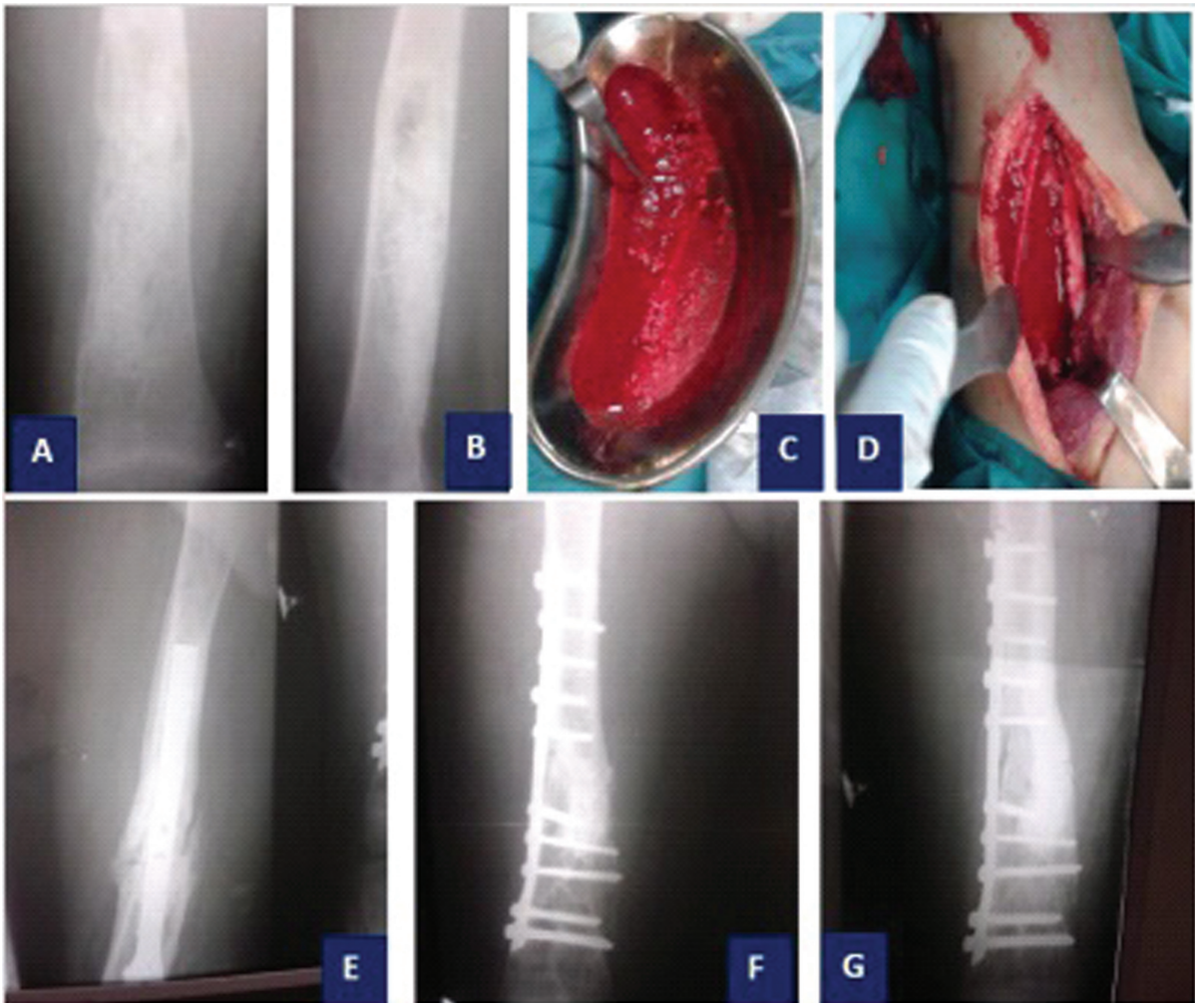
Figure 1



Male patient, 16 years old, with osteolytic lesion of the lower femur. (a and b) Preoperative radiography; (c and d) mixing of bone substitute with bone marrow aspiration from iliac crest; (e and f) 1 month postoperative radiography with plate and screw fixation; (g) 1 year postoperative radiography

in four, and intraosseous lipomas in two patients. The lesion size ranged from 2×4 to 3×7 cm. Lesion size was determined through preoperative radiographic or MRI measurements. The amount of $CaSO_4$–$CaPO_4$ graft used ranged from two to four packages of 5 ml granules. The site of the lesion in the bone was distal femur in four cases (Fig. 1), distal tibia in five cases (Fig. 2), and talus in three cases (Fig. 3).

Surgical technique in all cases was curettage and filling of the defect by $CaSO_4$–$CaPO_4$. A cortical window was made over the lesion using a drill bit followed by curetting the lesion and taking the contents as biopsy. In all cases the resultant cavity was filled with the $CaSO_4$–$CaPO_4$ injectable composite. Complete filling of the cavity was confirmed using fluoroscopy. The method of fixation in the case of pathological fracture was internal fixation with plate and screws used in distal femur, and plaster cast was used in the remaining cases.

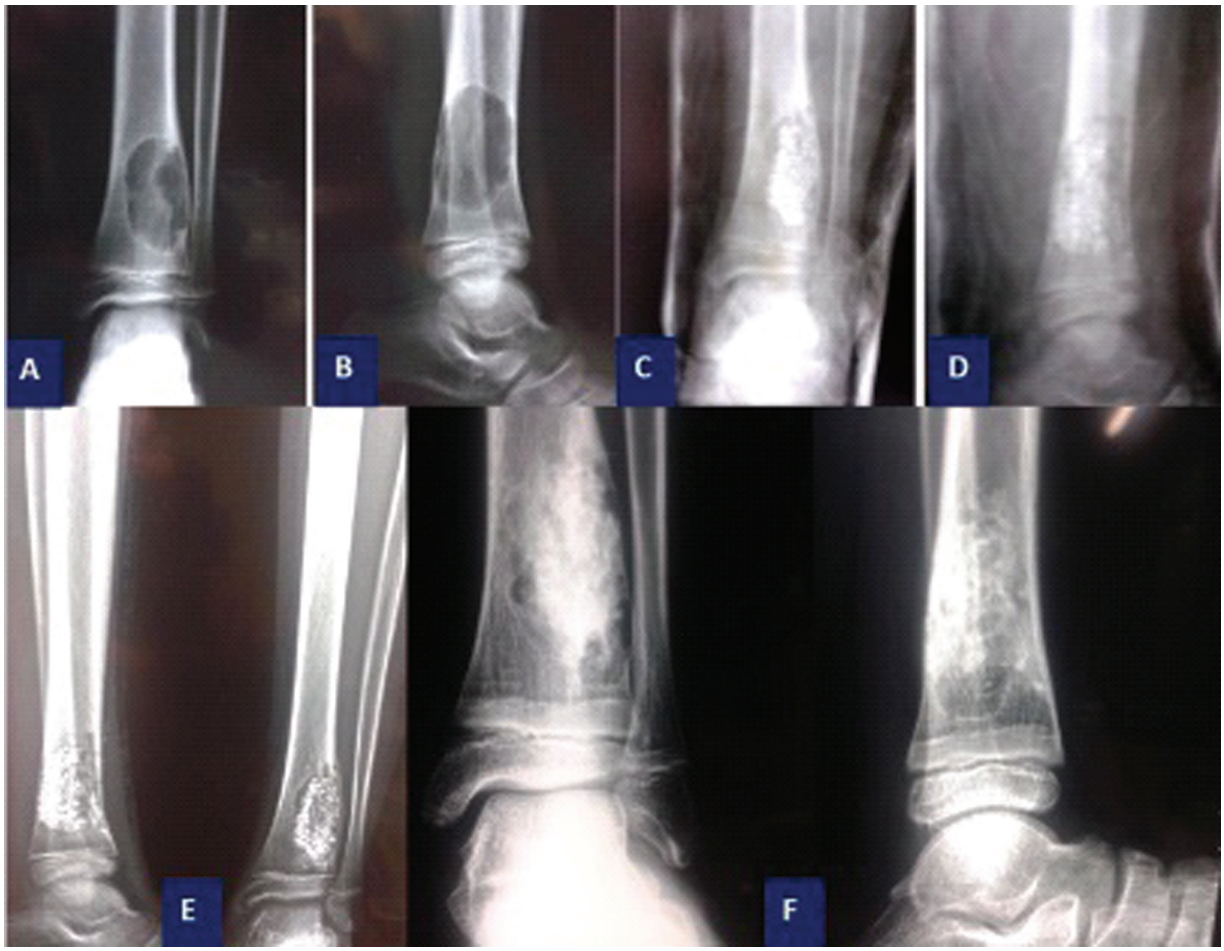
Results

The average time of follow-up was 15 months (range: 12–19 months). Clinically, all patients have returned to normal activity without restrictions. Pain was resolved in 10 of 12 patients. Two patients had pain at the site of internal fixation in the distal femur. Radiographically, seven patients had complete bone incorporation, and new bone formation was first noted at an average of 8 weeks (range: 4–10 weeks).

Residual defects in five cases ranged from 15 to 25%. No pathological fracture occurred in this study. Recurrence of the lesion occurred in one case and was treated by reoperation with another amount of $CaSO_4$–$CaPO_4$.

Complications within this series included superficial infection with serous drainage 3 weeks postoperatively in two cases treated by parenteral cephalosporin antibiotics and repeated dressings.

Figure 2



Female patient, 11 years old, with osteolytic lesion in lower tibial metaphysis. (a and b) Preoperative radiography; (c and d) postoperative radiography with leg in cast; (e) 3 months postoperative radiography; (f) radiography 1.5 years postoperatively

Discussion

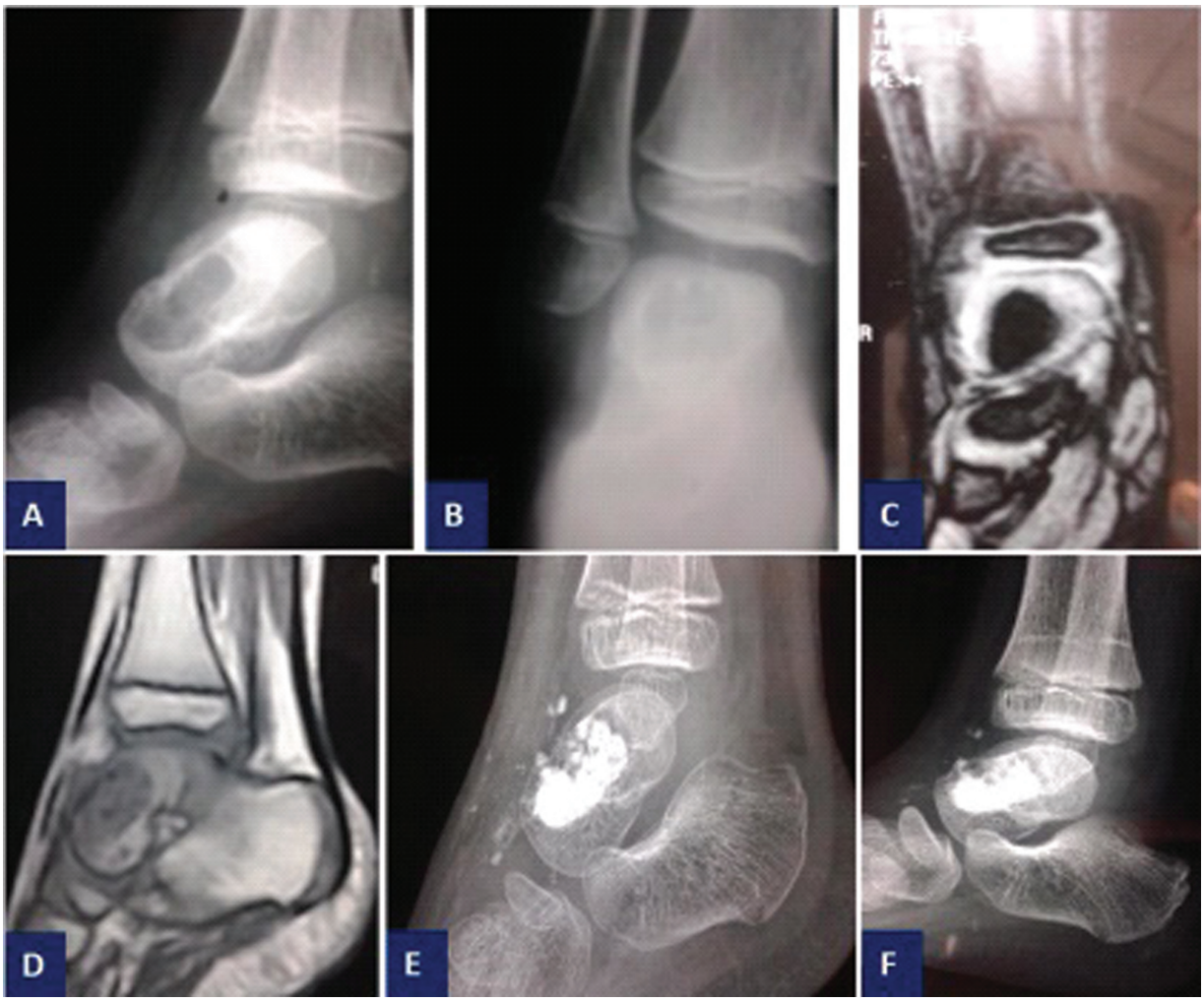
Traditional bone graft substitutes can offer osteoconductive and/or osteoinductive properties. These materials have been shown to be replaced by bone through creeping substitution. As the material resorbs, bone subsequently forms in place of the material. The resultant histological pattern is typically marked by concentric lamellar rings corresponding to the original shape of the material [10,11]. If faster resorbing $CaSO_4$ materials are placed in conditions subjected to soft tissue interaction or increased aqueous flow like those found in uncontained defects, the speed of dissolution could occur at a rate higher than bone formation [12]. The resulting mismatch in the rate of graft removal and rate of bone growth can produce an inadequately filled defect [13–15].

The early clinical data for the use of this $CaSO_4$–$CaPO_4$ composite has been encouraging. In this series, all patients had bone incorporation without pathological fracture, one recurrence, and pain at the site of internal fixation in distal femur persisted for 6 months in two patients. Residual defects in five cases ranged from 15 to 250%. Superficial infection with serous drainage was observed in two cases treated conservatively. Kelly *et al.* [8] reported four cases of serous wound drainage using $CaSO_4$ in tibia sites. Matsumine *et al.* [12] reported two cases of serous wound drainage in large defects treated with an injectable $CaPO_4$.

Conclusion

The early results of this study indicate that the $CaSO_4$–$CaPO_4$ incorporated with bone marrow aspirate can give good results in treating benign bone cysts with bone formation, which can stand for normal bone strength and low rate of complications (stand here for the duration needed for normal bone creebing and consolidation and not absorbed before). Residual defects were less effective and did not compromise bone integrity. The limitation of this study was the small number of cases and short follow-up period.

Figure 3



Nine-year-old girl. (a and b) Preoperative radiography with osteolytic lesion of the talus; (c and d) MRI of foot and ankle showing size and boundaries of the lesion; (e) 6 months postoperatively; (f) 1 year postoperative radiography

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Conflicts of interest
There are no conflicts of interest.

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