Original Article

Curettage of benign bone tumors and tumor like lesions: A retrospective analysis

Zile Singh Kundu, Vinay Gupta, Sukhbir Singh Sangwan, Parveen Rana[1]

Abstract

Background: Curettage is one of the most common treatment options for benign lytic bone tumors and tumor like lesions. The resultant defect is usually filled. We report our outcome curettage of benign bone tumors and tumor like lesions without filling the cavity.

Materials and Methods: We retrospectively studied 42 patients (28 males and 14 females) with benign bone tumors who had undergone curettage without grafting or filling of the defect by any other bone graft substitute. The age of the patients ranged from 14 to 66 years. The most common histological diagnosis was that of giant cell tumor followed by simple bone cyst, aneurysamal bone cyst, enchondroma, fibrous dysplasia, chondromyxoid fibroma, and chondroblastoma and giant cell reparative granuloma. Of the 15 giant cell tumors, 4 were radiographic grade 1 lesions, 8 were grade 2 and 3 grade 3. The mean maximum diameter of the cysts was 5.1 (range 1.1-9 cm) cm and the mean volume of the lesions was 34.89 cm^3 (range 0.94-194.52 cm^3). The plain radiographs of the part before and after curettage were reviewed to establish the size of the initial defect and the rate of reconstitution, filling and remodeling of the bone defect. Patients were reviewed every 3 monthly for a minimum period of 2 years.

Results: Most of the bone defects completely reconstituted to a normal appearance while the rest filled partially. Two patients had preoperative and three had postoperative fractures. All the fractures healed uneventfully. Local recurrence occurred in three patients with giant cell tumor who were then reoperated. All other patients had unrestricted activities of daily living after surgery. The rate of bone reconstitution, risk of subsequent fracture or the incidence of complications was related to the size of the cyst/tumor at diagnosis. The benign cystic bone lesions with volume greater than approximately 70 cm^3 were found to have higher incidence of complications.

Conclusion: This study demonstrates the natural healing ability of bone without filling with bone grafts or bone graft substitutes. In selected sizes and locations of the benign lytic tumors and tumor like lesions extended curettage alone can be sufficient.

Key words: Benign cystic tumors, curettage, tumor like cystic lesions

Introduction

Majority of the benign lytic bone tumors are treated adequately by curettage.[1] Compared with resection, curettage is associated with a higher rate of local recurrence; however, curettage often allows for a better functional result.[1] Curettage can be extended by the use of adjuvants, such as liquid nitrogen, phenol, polymethylmethacrylate (PMMA), or thermal cautery to extend destruction of tumor cells. Bone cavities have been reinforced with autologous bone grafts,[1,2] allograft,[3] PMMA bone cement,[4] demineralized bone matrix and bone graft substitutes.[5] These fillers augment final bone strength, reduce the risk of local recurrence (esp. giant cell tumors) and fill the empty cavities.[1] The auto grafts have limited availability, donor site morbidity, cosmetic problems and more blood loss. Risk of infection, rejection of foreign body and risk of disease transmission is associated with the use of allograft.[6] PMMA cement may provide instant stability, but there is concern that when used near the surface of a joint, it may cause thermal injury and damage chondrocytes leading to secondary osteoarthritis.[7] Regarding various bone graft substitutes, there is very little clinical data to support their efficacy and their role in filling and remodeling of bone defects. In benign lytic/cystic lesions and giant cell tumors of bone treated by curettage and without filling with bone graft or other substitute, the hematoma in the cavity has strong capacity to create new bone and remodel with

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Access this article online	
Quick Response Code:	Website: www.ijoonline.com
	DOI: 10.4103/0019-5413.111507

sufficient strength for daily activity.[8] We retrospectively evaluated the indications and the outcome in patients with benign bone tumors and tumor like lesions treated with extended curettage without grafting or filling of cavities with bone graft or other substitutes.

Materials and Methods

42 patients with benign bone tumors and tumor like lesions who had undergone curettage without grafting or filling of the defect without any other material between 2000 and 2010 were included in this retrospective study. The patients with solitary benign bone tumors and tumor like lesions treated with curettage only with a minimum of 2 years of followup were included in the study. Patients with multiple lesions, malignant lesions on biopsy, previously operated patients or recurrent cases and who had received adjuvant chemotherapy or radiotherapy were excluded from the study. Further the lesions with preservation of less than 5 mm of subchondral bone were also excluded. Preoperative biopsy was performed in all locally aggressive lesions except the simple bone cysts, fibrous dysplasias and enchondromas in the hand which were operated on the basis of radiological appearances.

The preoperative radiographs of concerned cystic lesions (anteroposterior and lateral views) were examined and measurements of size and volume of the lesions were estimated and documented sequentially as per the mathematical formula mentioned. Magnetic resonance imaging (n = 12), computed tomography (n = 16) and X-rays in all the patients were retrieved from the indoor treatment files of the patients to see the intraosseous extent and involvement of soft tissue or articular surface. The volume calculation for cystic lesions was done as follows, where A = width, B = depth, and C = height. The most appropriate formula was used in each case depending on the radiological shape of the defect.[8,9]

Cylinder defect = ABC × 0.785, i.e., (π × A/2 × B/2 × C)

Spherical defect = ABC × 0.52, i.e., (4/3× π × A/2 × B/2 × C/2)

Extended curettage was contemplated by first making a large cortical window over the lesion. The window was at least as large as the lesion itself [Figure 1]. The bulk of the tumor was scooped out with large curets and it was made sure that tumor on the under surface of the near cortex was too curetted out. Next, the cavity was enlarged with a high speed power burr. The curettage was considered complete as and when normal smooth cortical bony surface with punctate bleeding and medullary cavity was visible. The curetted material was sent for routine histopathological

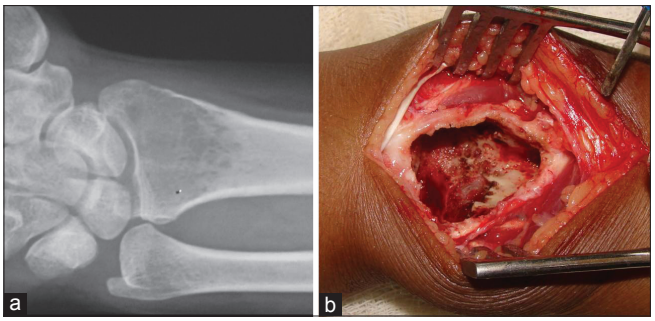

Figure 1: (a) X-ray anteroposterior view of wrist showing intraosseous giant cell lesion distal end radius and (b) peroperative photograph showing the size of window for a giant cell tumor of the distal radius; it is as large as the size of the lesion

examination. The cavity was copiously irrigated using jet lavage with normal saline to remove any debris and tumor cells and cavity was further washed with hydrogen peroxide. All the inner walls of cavity were spray cauterized to kill the residual tumor cells. Every nook and corner was treated repeatedly by curets, burr, and the electric cautery to leave no macroscopic disease anywhere in the cavity and wherever required confirmed by image intensifier. After curettage the walls of curetted cavity and the opened medullary canal were bleeding. The cavity was left empty without any augmentation in all these cases where good surrounding supporting bone was present. Closure in layers was done without negative suction drain to ensure the hematoma was confined inside the cavity. Plaster casts/orthoses for extremities were used almost for 3 months. Patients with a lesion on the femur, tibia and pelvic lesion were asked to undertake partial weight bearing after 8-10 weeks, depending on the size of the lesion and the radiological features. After that physiotherapy for the range of motion and loading for the remodeling of the cavity were started. Plain radiographs were taken postoperatively and then every 3 months for 2 years.

The plain radiographs before and after curettage were reviewed to establish the size of the initial defect and the rate of reconstitution, filling, and remodeling of the bone defect [Figures 2-5]. The outcomes were based on serial radiographic consolidation of the lesions along with subjective clinical assessment and function recorded in the patient records. Statistical significance was analyzed using the Chi-squared test and Mann-Whitney U test. A value of $P < 0.05$ was considered significant.

Results

The mean age of the patients was 28 years (range 14-66 years); there were 24 females and 18 males. The average followup was 26 months (range 24-52 months). The most common histological diagnosis was that of giant cell tumor followed by simple bone cyst, aneurysmal bone cyst,

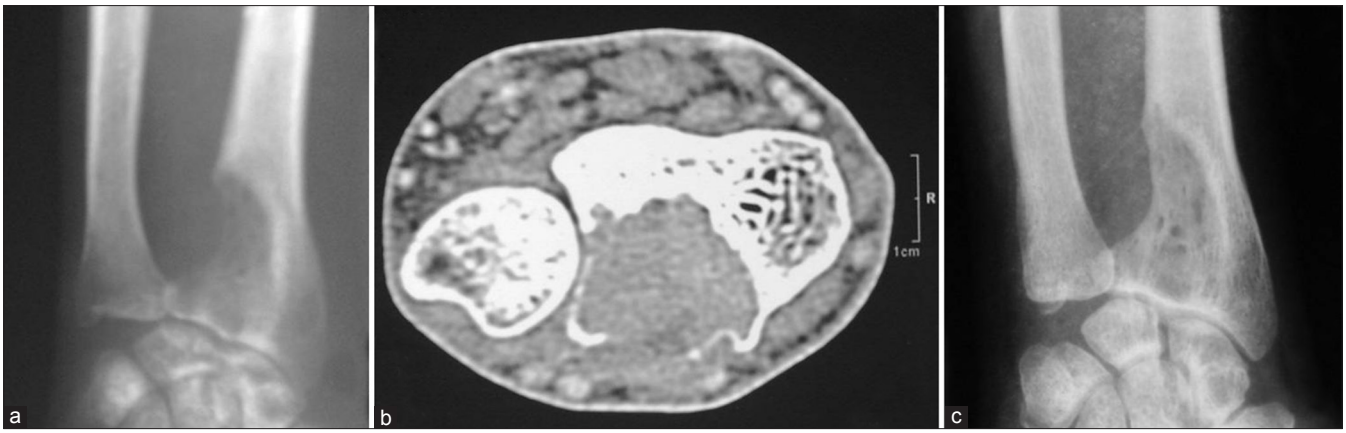

Figure 2: Preoperative X-ray anteroposterior view and computed tomography scan (a and b) showing GCT distal radius (c) postoperative radiograph after 2 years demonstrating the smoothening the wall of cavity and good supporting sub-chondral bone with no arthritic changes and no recurrence

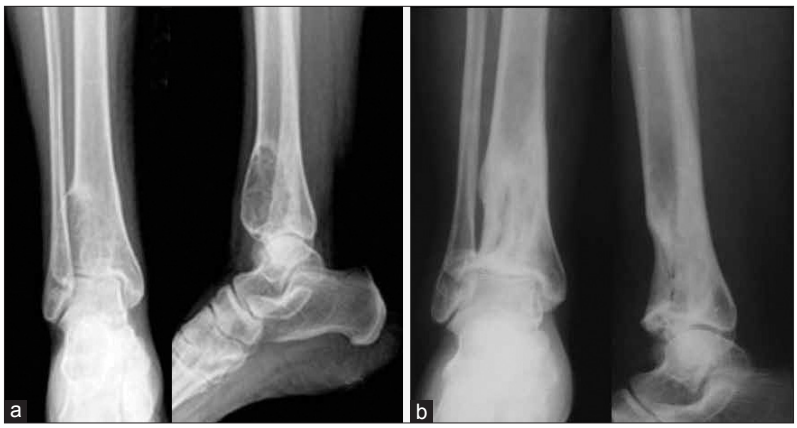

Figure 3: (a) X-ray anteroposterior and lateral views of distal tibia with ankle joint showing giant cell tumor distal tibia, volume 43.27 cm^3. (b) X-ray anteroposterior and lateral views of same patient after curettage at 4 years followup showing that there is supporting thickened cortices and bony ridges inside the cavity; mechanically strong enough for weight bearing; no arthritic changes in the ankle joint and no recurrence

enchondroma, fibrous dysplasia, chondromyxoid fibroma, chondroblastoma and giant cell reparative granuloma [Table 1]. According to Campanacci out of 15 giant cell tumors, 4 were radiographic grade-1 lesions, 8 were grade-2, and 3 were grade-3. The sites of the various cystic lesions included femur (n = 11), tibia (n = 10), humerus (n = 06), radius (n = 04), pelvis bone (n = 03), metacarpal (n = 04), metatarsal (n = 02), fibula (n = 01) and calcaneum (n = 01).

The mean maximum diameter of the cysts was 5.1 cm (range 1.1-9 cm) and the mean volume of the lesions was 34.89 cm^3 (range 0.94-194.52 cm^3). The mean volume of lesion in long bone (femur, tibia, humerus and radius) including pelvic lesion having large cystic benign lesion was 61.045 cm^3. The femoral cysts were larger than the tibial ones (P = 0.05). Pelvic bone too had large volume cysts. Twenty eight of the cysts had a maximum diameter of 5 cm or less, while 14 had a diameter of more than 5 cm. The mean volume of the lesions according to the anatomical location was from 1.09 cm^3 to 81.89 cm^3 [Table 2].

None of the patient had deep infection at wound site but

Table 1: Histological diagnosis (n=42)

Type of lesions	No. of lesions	Percentage
Giant cell tumor	15	35.71
Simple bone cyst	6	14.28
Aneurysmal bone cyst	6	14.28
Enchondroma	5	11.90
Fibrous dysplasia	3	07.14
Chondromyxoid fibroma	3	07.14
Chondroblastoma	3	07.14
Giant cell reparative granuloma	1	02.38

Table 2: The mean volume of the cavity (as measured on plain X-rays)

Bone	Mean volume (range) cm^3
Femur	81.89 (28.49-194.52)
Tibia	56.94 (12.93-129.93)
Humerus	43.79 (35.14-64.19)
Radius	13.12 (8.6-20.51)
Pelvic bones	80.70 (56.78-102.44)
Metacarpal	1.09 (0.94-1.34)
Metatarsal	2.175 (2.01-2.35)
Fibula	9.11
Calcaneum	24.17

two patients had superficial infection which responded to the prolonged antibiotic therapy as per culture sensitivity. Three patients of giant cell tumors developed local recurrence during the period of followup. Local recurrence occurred in one grade-2 and two grade-3 tumors. Two of them were reoperated with repeat curettage and cementing; and are disease free at the latest followup of two years. The third with grade-3 giant cell tumor at lower end femur required enblock excision of the distal end femur with knee arthrodesis using long intramedullary nail and bone grafting. Two patients; one with aneurysmal bone cyst and the other with simple bone cyst in humerus had preoperative displaced fractures. These were managed by curettage as per the protocol and an intramedullary Rush rod was inserted to provide the support [Figure 6]. After reconstitution of the cavity, both the nails were removed. Three patients had postoperative fractures through the cyst within 2 months of their operation. These were nondisplaced fractures which healed well in plaster in 8 weeks.

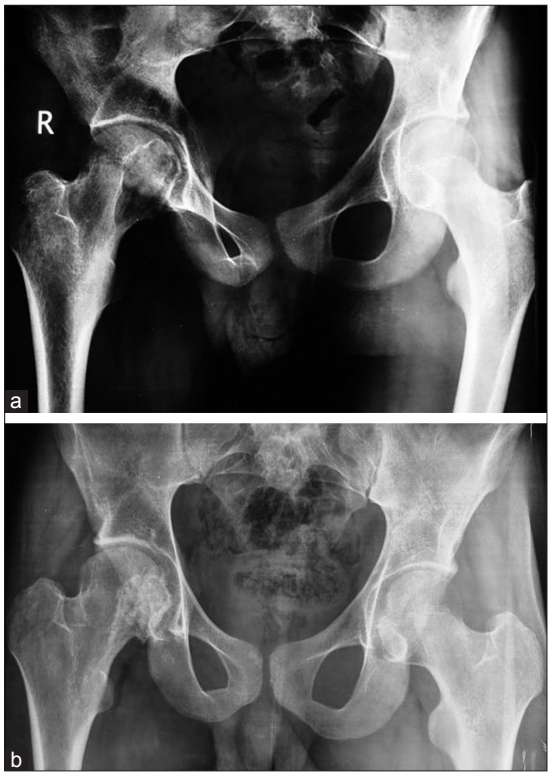

Figure 4: Chondroblastoma of the head of femur (a) preoperative and (b) postoperative X-ray of pelvis with both hips (at 4 years followup) showing good healing of lesion in head of femur

We found that average size of the cysts that fractured in long bone postoperatively was 126.52 cm^3, as compared to 49.352 cm^3 for the cysts that did not fracture. Only one patient with cystic lesion with volume of 68 cm^3 had fracture. The average size of the cysts that fractured in long bone of lower limb was 142.11 cm^3, as compared to 53.094 cm^3 for the cysts that did not fracture. Review of serial radiographs showed that while the smaller lesions filled up completely, the larger ones (>70 cm^3) tend to heal initially by thickening of the cortex and subsequently by development of septae running across the defect [Figure 7].

The average time of bone healing in upper limb, as judged by allowing routine activities (driving car and bike, combing hairs, lifting books and food plates etc.) was 6 (range 4-10 weeks) weeks whereas in lower limb, as judged by allowing full weight bearing, was 14 (range 10-16 weeks) weeks. The mean time to full weight bearing was 12 weeks (range 10-14 weeks) for patients with cysts up to 5 cm in diameter and 14 weeks (range 12-16 weeks) for those with cysts over 5 cm. All patients ultimately had unrestricted activities of daily living.

Discussion

Extended curettage is the commonest mode of the treatment of the benign bone tumors and the lytic lesions. If a tumor is very large and threatening to involve the joint, complete

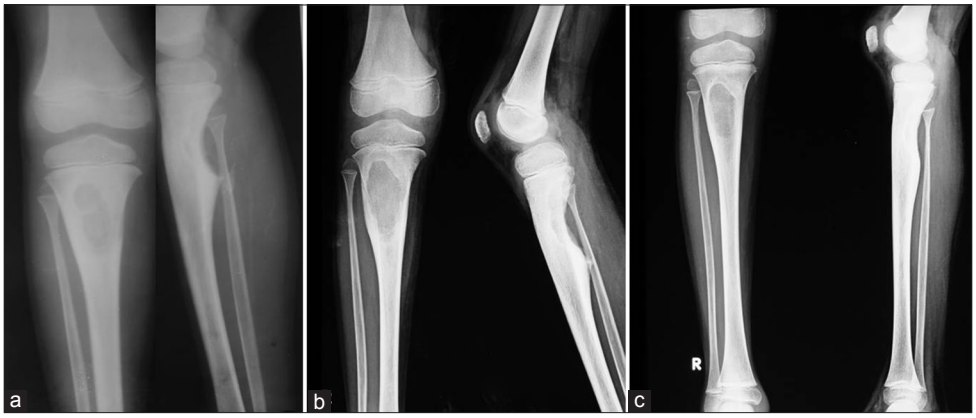

Figure 5: X-ray anteroposterior and lateral views of leg bones with knee joint showing (a) Condromyxoid fibroma of proximal tibia posterior aspect-tumor volume-35.32 cm^3; (b) and (c) 1 year and 2 years after curettage showing no recurrence and good smoothening and thickening of the edges of the cavity

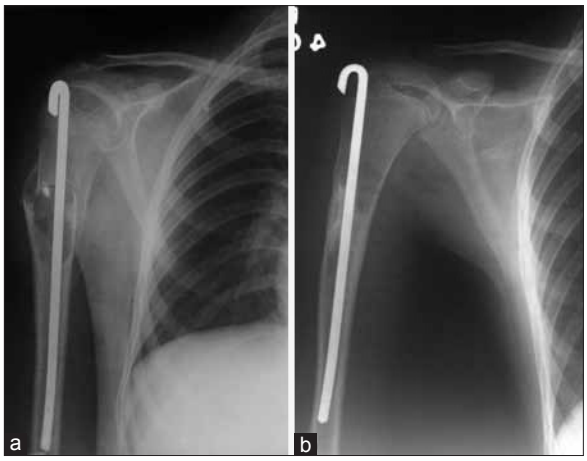

Figure 6: X-ray anteroposterior view of (R) arm with shoulder joint showing pathological fracture in a case of aneurysmal bone cyst humerus treated with curettage only; stabilised with rush nail (a), eventually healed well showing good remodelling at 3 years (b)

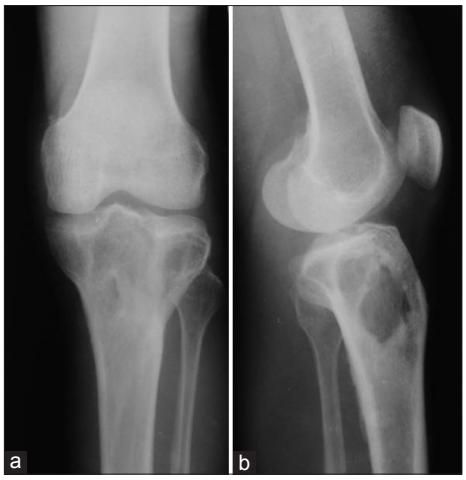

Figure 7: Postoperative radiograph anteroposterior (a) and lateral (b) views after 2 years followup in a patient of GCT treated by extended curettage showing the thickened septae inside the cavity supporting the articular surface (preoperative volume was 78.65 cm^3)

excision with joint reconstruction may be necessary. Cure rates of 90-95% have been achieved using curettage as the sole mode of treatment in benign bony lesions.[8,10] However this treatment is not devoid of controversy and many authors recommend that bone defect after curettage of benign bone tumors should be filled with bone grafts or substitutes such as cement, hydroxyapatite, or tricalcium phosphate.[5] Autograft are free of disease transmission or immunological reactions and have properties of osteogenesis, osteoinduction and osteo conduction, but are associated with the donor site morbidity.

PMMA is inert and non bio-degradable so it persists within the bone cavity. PMMA provides instant stability and sufficient quantity for large tumor cavities; its exothermic reaction kills tumor cells and causes less recurrence.[11,12] PMMA facilitates early radiographic detection of recurrence by increasing resorption of bone and pain at that site. The risk of thermal damage with PMMA use is the major concern as it may damage cartilage and subchondral bone leading to degenerative arthritis.[7,13] The long term persistence of PMMA may influence the rate of bone remodeling by affecting bone metabolism and trabeculae may be weakened by change in mechanical environment.[13]

Bone graft substitutes like calcium phosphate and hydroxyapatite are available but their interference with inflammatory cells and immunological reaction has been the matter of concern and their efficacy is also questionable.[14,15] Although, sufficient amount is available but high cost is another factor limiting its use. There is no consensus, neither any literature nor any controlled clinical trial to support the efficacy of bone cements or any bone cement substitutes. The nature of the filling material used or the type of adjuvant method or combination of both has failed to show any statistical impact on the recurrence risk or on bone remodeling and bone strength.[16] Rather it is the adequate exposure, histological type and curettage/removal of complete tumor cells followed by cauterizing the wall that is more important predictive factor for the successful outcome of surgery.

We observed that these cavities filled in well with bony septae and led to sufficient bone strength for weight bearing and day to day activities [Figure 7]. The margins of the curetted bone defect contain healthy cancellous bone which allows migrating osteoblasts to produce bone matrix in the hematoma that will fill the defect, a scenario very similar to the fracture healing. There is, however correlation between the risk of subsequent complications such as fracture and the size of the cyst at the time of diagnosis. In our experience, cysts larger than 70 cm^3 have the greater risk of complications and the smaller cysts have lower risk. This was well observed by us clinicoradiologically and by measurement of tumor volume. In our study, we did not obtain any histological evidence of new bone formation in the cavities due to ethical reasons. Hence, plain radiographs were studied for bone remodeling.

Review of serial radiographs revealed that while the smaller cysts filled up completely, the larger ones (70 cm^3) tend to heal initially by thickening of the cortex and then by development of septae running across the defect. Most of the bone defects ($n = 34$) were completely filled with bone while rest of the defects ($n = 8$) reconstituted partially only. The lesions began to show bone formation on radiographs at 3 months: The thickness and sclerosis of the cavity wall increased and the cavity gradually became radio-opaque, although complete bone filling of all cavities was not achieved. We used plain radiographs to assess the bone remodeling, we still believe histological

evidence of new bone formation in the cavities is the gold standard and a prospective study to document this should be conducted. We also observed that the weight bearing or daily routine activities were not affected even if the cavity has not totally reformed as cortical bone was found to be quite thick. In an experimental study it has been shown that bone defects that are left empty heal just as well as when filled with a bone substitute and defect protection alone was sufficient to allow for healing even of critical size defects.[15] Even if the bone cavity did not reform completely, the cortical bone was thick enough to carry the load. Inside the cavity, there were many smaller cavities divided by several new septae.

In our series, 3 giant cell tumor patients developed local recurrences. Recurrences in patients treated with curettage for long bone GCT are common and most often occur within the first 2 years postoperatively. It has been postulated that extensive curettage of the tumor may be more important than the use of adjuvant therapies.[17,18] We believe that use of extensive curettage followed by treatment of cavity wall with high speed burr, cauterizing wall on spray mode and using hydrogen peroxide gives excellent results and prevents recurrences. Three patients had postoperative fractures through the lesions either introoperatively or immediate postoperatively. Two of these postoperative fractures were in patients with giant cell tumors, and one occurred in aneurysmal bone cyst. Two occurred in distal femur, and one in distal tibia. None of these required internal fixation; all were stable non displaced fractures and were treated conservatively in plaster of Paris with restriction of weight bearing and movements.

We observed that average size of the cysts in long bone (femur, tibia, humerus and radius) and pelvis that fractured postoperatively was 126.52 cm^3, as compared to 49.352 cm^3 for the cysts that did not fracture. There was no correlation between preoperative fracture and size of the cyst, but there was a correlation between risk of postoperative fracture and both the size and volume of the cyst. The risk of fracture was less in long bones and pelvic bones with cysts less than 70 cm^3, as compared to for those with cysts larger than 70 cm^3 ($P < 0.05$). The lesions with larger diameters and volumes with more cortical destruction were more prone to fracture. Additionally the risk was more when the lesion had more side to side diameter with more circumferential destruction and endosteal scalloping of the bone instead of the lesions, which were more longitudinally placed with good thick cortices to tolerate the load and bending forces. We encountered no postoperative fracture after curettage of cystic lesions in short bones (metacarpal, metatarsal or calcaneum). There was no correlation between the risk of postoperative fracture and size/volume of the cyst in short bones. We observed that at least two cortices must be preserved to prevent iatrogenic fracture. Whenever more than two cortices are involved, support in the form of plaster slab or brace must be given for 6-8 weeks and guarded physiotherapy and weight bearing should be initiated for about four months. If even these cortices are also thinned out due to curettage there should be no hesitation of prophylactic internal fixation with an intramedullary implant. Also the lesions with very little (less than 5 cm) subchondral bone are not suitable for this procedure as there are chances of joint collapse and intraarticular fracture. Hirn *et al.* too found a strong correlation between risk of postoperative fracture and both the size and volume of the cyst. In their study the average size of the cysts that fractured postoperatively was 108 cm^3, as compared to 58 cm^3 for the cysts that did not fracture. The risk of fracture was 5% in patients with cysts less than 60 cm^3, as compared to 17% for those with cysts larger than 60 cm^3. The risk was 3% when the maximum diameter of the cyst was ≤5 cm, but 15% when the diameter was >5 cm.[8]

There are certain limitations of this study that it was a retrospective study and only the cases treated in the past with this particular method have been selected so it being a subjective rather than the objective one; secondly different type of benign lesions with different biological behavior treated with same kind of treatment were included. We observed that treatment of benign lytic lesions with curettage alone without adjuvant appears to be acceptable method of treatment. The rate of recurrence is also low provided the quality of curettage is good. The remodeling and reconstitution of cavities with cortical thickening over time can give sufficient strength even without filling. However, it is suggest that there is a need for prospective randomized studies to evaluate the effect of different filling materials on the remodeling of bone.

To conclude, in this retrospective study we observed that the benign lytic bone lesions/tumors which are contained within the bone can fill up with ossification of haematoma and may need no filler.

References

1. Malek F, Krueger P, Hatmi ZN, Malayeri AA, Faezipour H, O'Donnell RJ. Local control of long bone giant cell tumor using curettage, burring and bone grafting without adjuvant therapy. Int Orthop 2006;30:495-8.
2. Bickels J, Meller I, Shmookler BM, Malawer MM. The role and biology of cryosurgery in the treatment of bone tumors. A review. Acta Orthop Scand 1999;70:308-15.
3. Sethi A, Agarwal K, Sethi S, Kumar S, Marya SK, Tuli SM. Allograft in the treatment of benign cystic lesions of bone. Arch Orthop Trauma Surg 1993;112:167-70.
4. Campanacci M, Capanna R, Fabbri N, Bettelli G. Curettage of

giant cell tumor of bone. Reconstruction with subchondral grafts and cement. Chir Organi Mov 1990;75:212-3.
5. Hirata M, Murata H, Takeshita H, Sakabe T, Tsuji Y, Kubo T. Use of purified beta-tricalcium phosphate for filling defects after curettage of benign bone tumors. Int Orthop 2006;30:510-3.
6. Tomford WW. Transmission of disease through transplantation of musculoskeletal allografts. J Bone Joint Surg Am 1995;77:1742-54.
7. Dunne NJ, Orr JF. Curing characteristics of acrylic bone cement. J Mater Sci Mater Med 2002;13:17-22.
8. Hirn M, de Silva U, Sidharthan S, Grimer RJ, Abudu A, Tillman RM, *et al*. Bone defects following curettage do not necessarily need augmentation. Acta Orthop 2009;80:4-8.
9. Yanagawa T, Watanabe H, Shinozaki T, Takagishi K. Curettage of benign bone tumors without grafts gives sufficient bone strength. Acta Orthop 2009;80:9-13.
10. Saikia KC, Bhattacharyya TD, Bhuyan SK, Bordoloi B, Durgia B, Ahmed F. Local recurrences after curettage and cementing in long bone giant cell tumor. Indian J Orthop 2011;45:168-73.
11. Augat P, Rapp S, Claes L. A modified hip screw incorporating injected cement for the fixation of osteoporotic trochanteric fractures. J Orthop Trauma 2002;16:311-6.
12. Bini SA, Gill K, Johnston JO. Giant cell tumor of bone. Curettage and cement reconstruction. Clin Orthop Relat Res 1995;321:245-50.
13. Szalay K, Antal I, Kiss J, Szendroi M. Comparison of the degenerative changes in weight bearing joints following cementing or grafting techniques in giant cell tumor patients: Medium-term results. Int Orthop 2006;30:505-9.
14. Grandjean-Laquerriere A, Tabary O, Jacquot J, Richard D, Frayssinet P, Guenounou M, *et al*. Involvement of toll-like receptor 4 in the inflammatory reaction induced by hydroxyapatite particles. Biomaterials 2007;28:400-4.
15. Lemperle SM, Calhoun CJ, Curran RW, Holmes RE. Bony healing of large cranial and mandibular defects protected from soft tissue interposition: A comparative study of spontaneous bone regeneration, osteoconduction, and cancellous autografting in dogs. Plast Reconstr Surg 1998;101:660-72.
16. Turcotte RE, Wunder JS, Isler MH, Bell RS, Schachar N, Masri BA, *et al*. Giant cell tumor of long bone: A Canadian Sarcoma Group study. Clin Orthop Relat Res 2002;397:248-58.
17. Prosser GH, Baloch KG, Tillman RM, Carter SR, Grimer RJ. Does curettage without adjuvant therapy provide low recurrence rates in giant-cell tumors of bone? Clin Orthop Relat Res 2005;435:211-8.
18. Blackley HR, Wunder JS, Davis AM, White LM, Kandel R, Bell RS. Treatment of giant-cell tumors of long bones with curettage and bone-grafting. J Bone Joint Surg Am 1999;81:811-20.

How to cite this article: Kundu ZS, Gupta V, Sangwan SS, Rana P. Curettage of benign bone tumors and tumor like lesions: A retrospective analysis. Indian J Orthop 2013;47:295-301.

Source of Support: Nil, **Conflict of Interest:** None.

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