**International Journal of Current Advanced Research**
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 9; Issue 06(B); June 2020; Page No.22488-22491
DOI: http://dx.doi.org/10.24327/ijcar.2020.22488.4437

**Research Article**

# FUNCTIONAL OUTCOME OF BONE SUBSTITUTES FOR FILLING DEFECTS AFTER EXTENDED CURETTAGE IN BENIGN LYTIC BONE LESIONS- A RETROSPECTIVE ANALYSIS OF 34 PATIENTS

**[1]Umesh Yadav, [2]Ajay Singh, [3]Sujit Kumar Singh, [4]Kshitish Chandra Behera, [5]Ashish Devgan, [6]Vasudha Dhupper and [7]Ajay Sheoran**

[1]Assistant Professor, Dept of Orthopaedics, PGIMS, ROHTAK, HARYANA
[2,4]Senior Resident, Dept of Orthopaedics, PGIMS, ROHTAK, HARYANA
[3]Junior Resident, Dept of Orthopaedics, PGIMS, ROHTAK, HARYANA
[5]Senior Professor, Dept of Orthopaedics, PGIMS, ROHTAK, HARYANA
[6]Assistant Professor, Dept of Biochemistry, PGIMS, ROHTAK, HARYANA
[7]Assistant Professor, Dept of Orthopaedics, PGIMS, ROHTAK, HARYANA

**A R T I C L E I N F O**

***Article History:***
Received 12th March, 2020
Received in revised form 23rd April, 2020
Accepted 7th May, 2020
Published online 28th June, 2020

***Key words:***

Bone tumors; Benign tumors; Bone substitutes; Orthopaedic oncology

**A B S T R A C T**

**Background-**Extended curettage remains the treatment of choice for most of benign bony lesions. Defect after curettage can be filled with autograft , allograft or bone substitutes. We hereby retrospectively analyzed functional outcome of bony lytic lesion in which bone substitutes were used.

Material and methods- 34 patients of benign bony lytic lesions limited to extremities were treated by extended curettage and finally defect was filled with β-Tricalcium phosphate (β-TCP). Patients were evaluated clinic-radiologically at regular intervals. Graft uptake was assessed using Irwin method while final functional outcome was assessed using Musculoskeletal Tumor Society Rating Scale (MSTS) Score.

**Results-** Mean age was 26±6.5 years ranging from 5-62 years. . Aneurysmal bone cyst was found to be the most common diagnosis (n=14, 41.2%) followed by Giant cell tumor (n=10, 29.4%). Femur was most commonly affected bone (n=8, 23.5%) followed by radius (n=6, 17.6%). 76.5% patients achieved Irwin Grade III. Mean healing time was 10.2±2.2 weeks. The overall average Musculoskeletal Tumor Society (MSTS) score was 26.8 (range 23–30).

**Conclusion-** Bone substitutes remains a good choice in filling defect after curettage for benign lytic bony lesions specially in children and elderly patients in whom harvesting of autograft is not feasible.



## INTRODUCTION

Benign bony lesions are common entity seen in orthopaedics varying widely in clinical presentation and functional outcome. Some Benign lytic lesions of bone may be asymptomatic like non-ossifying fibroma, simple bone cyst, enchondroma, bone infarcts or occasionally they may present with mild pain and swelling.Further there are certain locally aggressive lesions like giant cell tumor, chondroblastoma, chondromyxoid fibroma, aneurysmal bone cysts and osteoblastomas.[1,2]

Extended curettage remains the standard treatment for most of benign lesions which includes the use of adjuvants, such as liquid nitrogen, phenol, high speed burr, polymethyl methacrylate, or thermal cautery to extend destruction of tumor cells. The defect after curettage can be filled with autologous bone graft, allografts and bone substitutes.[3,4]

**Corresponding author:* **Umesh Yadav**
Assistant Professor, Dept of Orthopaedics, PGIMS, ROHTAK, HARYANA

Traditionally, the autogenous bone graft has been the gold standard for all grafting procedures. Limited supply and substantial donor site morbidity, however, make this option less desirable[5,6]

Allografts are also indicated in the elderly patients who are poor operative risks and patients from whom not enough acceptable autogenous bone is available. However they are associated with the transmission of infectious agents, particularly transmission of HIV and Hepatitis C, a concern virtually eliminated through tissue-processing and sterilization.[7,8]

Bone graft substitutes composed of calcium sulfate (CaSO4) or calcium phosphate (CaPO4) are reasonable alternatives because they are biodegradable. Other more recently introduced graft materials include β-tricalcium phosphate (β-TCP), and hydroxyapatite. Various studies have compared the efficacy of one group with the other.

This retrospective study was designed to compare the healing and functional outcome using bone substitutes for defects after curettage in benign lytic bone lesions.

## MATERIAL AND METHODS

This retrospective observational study included 34 patients of benign lytic bone lesions treated with extended curettage and cavity filled with bone substitutes during last 5 years.

Clinico-radiologically and histopathologically diagnosed benign tumors in extremities which were confined within the bone with 2/3rd intact circumferential cortex and amenable to curettage were included in the study. The malignant tumor and those benign lesions with extensive soft tissue infiltration on MRI and not amenable to curettage requiring excision were excluded from the study.

All patients underwent routine investigations including plain X-ray in two views i.e. anteroposterior and lateral views. Computerized Tomography (CT) Scan, and/or Magnetic Resonance Imaging (MRI) were done for the local extent of the lesions. A preoperative biopsy confirmed the diagnosis in all the cases. 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. For cylinder defect = ABC × 0.785, i.e., (π × A/2 × B/2 ×C) and for spherical defect = ABC × 0.52, i.e., (4/3× π ×A/2 × B/2 × C/2).[11,12]

A large cortical window was made in the cavity to have a good exposure and to prevent leaving the tumor cells around the corner, and under the overhanging shelves. Extended curettage was done using the sharp curettes and high-speed burr. At the end of curettage, a pulsatile jet lavage system was used to wash any residual tumor cell. β-Tricalcium phosphate (β-TCP) was used as bone substitute in all cases. The graft substitutes were mixed with patient's blood on the table and the cavity was snuggly packed with grafts.

Patients were evaluated clinically and radiologically at 6 weeks, 3 months, 6 months and 12 months interval thereafter. Functional assessment was done as per Musculoskeletal Tumor Society Rating Scale (MSTS) Score [13] while radiographic assessment of graft uptake was done as per Irwin grading (Table **1**)[14]. The average time of bone healing in upper limb was judged by allowing routine activities (driving car and bike, combing hairs, lifting books and food plates etc) where as in lower limb, by allowing full weight bearing.

**Table 1** Irwin Grading for Radiological Assessment of Graft Uptake.

| | |
|---|---|
| Stage I | Obvious margin |
| Stage II | Hazy margin |
| Stage III | Obvious incorporation |

## RESULTS

**Table 2** Result of the Study

| Parameter | Value (n=34) |
|---|---|
| Mean Age | 26±6.5 years |
| Mean tumor volume | 28.42 $cm^3$ |
| Sex | |
| Male | 23 (67.6%) |
| Female | 11 (32.4%) |
| Histopathological Diagnosis | |
| Aneurysmal Bone cyst | 14 (41.2%) |
| Giant cell tumor | 10 (29.4%) |
| Simple Bone cyst | 6 (17.6%) |
| Enchondroma | 2 (5.9%) |
| Chondroblastoma | 1 (2.9%) |
| Chondromyxoid fibroma | 1 (2.9%) |
| Site- | |
| Femur | 8 (23.5%) |
| Tibia | 5 (14.7%) |
| Ulna | 2 (5.9%) |
| Radius | 6 (17.6%) |
| Humerus | 5 (14.7%) |
| Fibula | 4 (11.8%) |
| Metacarpal | 2 (5.9%) |
| Phalanx | 1 (2.9%) |
| Talus | 1 (2.9%) |
| Graft Uptake as per Irwin Grading- | |
| Grade III | 26 (76.5%) |
| Grade II | 7 (20.6%) |
| Grade I | 1 (2.9%) |
| Healing time (In weeks) | 10.2±2.2 |
| Post op complications- | |
| Serous Discharge | 9 (26.5%) |
| Infection | 2 (5.9%) |
| Recurrence | 1 (2.9%) |
| Mean MSTS Score | 26.8 |

As seen in table 2, mean age was 26±6.5 years ranging from 5-62 years with peak incidence in second and third decade. There was male preponderance over the female patients with ratio of 2:1. Aneurysmal bone cyst was found to be the most common diagnosis (n=14, 41.2%) followed by Giant cell tumor (n=10, 29.4%). Six cases were of Simple bone cyst (17.6%) while 2 cases were of enchondroma and one case each of chondroblastoma and chondromyxoid fibroma.

Femur was most commonly affected bone (n=8, 23.5%) followed by radius (n=6, 17.6%). Humerus and tibia were involved 5 cases each (14.7% each). Fibula involvement was seen in 4 cases (11.8%) while ulna and metacarpals were involved in 2 cases (5.9%). One case each was localized to phalanx and talus. Mean tumor volume was 28.42 $cm^3$.

Among 34 patients,26 patients (76.5%) achieved Irwin grade III while 7 patients (20.6%) radiological grade II was achieved. Mean healing time was found to be 10.2±2.2 weeks ranging from 8 to 14 weeks,.

Serous discharge was seen in 9 patients (26.5%) which was non purulent and resolved spontaneously in 14-21 days. 2 patients developed infection out of which infection in one case settled with change in antibiotics. Infection in other patient settled with removal of infected bone substitutes and insertion of vancomycin beads. Recurrence was seen in one patient (2.9%) for which resection and reconstruction with arthrodesis was done. No neurovascular deficit or fracture seen in any of the patients. The overall average Musculoskeletal Tumor Society (MSTS) score was 26.8 (range 23–30). Few examples of X-ray of a child showing lytic lesion (Bone cyst) in proximal femur; (**a**) treated with curettage, filling with β-tricalcium phosphate bone substitutes and prophylactic internal fixation with rush rod; (**b**) and the lesion healed well; (**c**) and the rod was removed after complete healing.


a ) X-ray of a patient of giant cell tumour of distal tibia; b) treated with curettage, filling with β-tricalcium phosphate bone substitutes; c) Follow up showing healed lesion.

## DISCUSSION

The ideal bone-graft substitute should be biocompatible, bioresorbable, osteoconductive, osteoinductive, structurally similar to bone, easy to use and cost-effective. Within these parameters a growing number of bone alternatives are commercially available for orthopaedic applications. They may serve as a matrix for bone regeneration and can be apposed to the surface of the bone or fill a defect or bone gap. The main types include hydroxyapatite, calcium sulfate, calcium phosphate, calcium carbonate, β-tricalcium phosphate, and others.

Defect after extended curettage can be filled with autograft , allograft or bone substitutes. Fresh autogenous cancellous possess all the essential properties, osteogenesis, osteoinduction and osteoconduction but have disadvantage of additional scar and prolongation of surgery time and residual pain and cosmetic deformity. Problem arises in children and elderly patients where harvesting autograft is not feasible. Allograft and bone substitutes remains an option in these extreme of ages. Allograft processing is time consuming and requires strict sterilization methods, still they are associated with risk of transmission of Hepatitis C and HIV.[15,16]

One of the major advantages of bone graft substitute is their unlimited availability, the reduction in operating time and blood loss, and the exclusion of donor site morbidity but in a developing country like India cost remains a big limiting factor in their usage especially in large cavities where a large amount of bone substitutes is required. Table 3 compares the literature of bone substitutes with complications encountered.

**Table 3** Literature review of Bone substitutes (BS)

| Author | Year | BS used | Cases | Fracture | Infection | Cellulitis | Rate (%) |
|---|---|---|---|---|---|---|---|
| Takeuchi *et al*[17] | 2018 | Calcium Phosphate | 26 | 1 | 1 | 0 | 7.69 |
| Sakamoto *et al.* [18] | 2017 | Calcium Phosphate | 4 | 0 | 0 | 0 | 0 |
| Rosario *et al.*[19] | 2017 | Calcium Phosphate | 12 | 0 | 0 | 0 | 0 |
| Guida *et al.*[20] | 2016 | Calcium Phosphate | 116 | 0 | 0 | 3 | 2.59 |
| Reppenhagen *et al*[21] | 2012 | Calcium Phosphate | 51 | 0 | 0 | 1 | 5.88 |
| Kelly and Wilkins *et al*[22] | 2004 | Calcium Sulfate | 15 | 1 | 1 | 1 | 20 |
| Nakamura *et al.*[23] | 2016 | Calcium sulfate + tricalcium phosphate | 33 | 1 | 1 | 0 | 6.06 |
| Present study | 2020 | Calcium Phosphate | 34 | 0 | 2 | 0 | 8.8 |

As seen in table 3, complication rate varies from study to study and also from graft to graft. Though studies with small groups had less complications than groups with large number of patients. Complication rates varies from nil to up to as high as 20%. Serous discharge which we described as complication in table 2, was encountered in almost all studies but not mentioned as complication as it resolved spontaneously without any intervention. So our results are in consistent with the previous studies.

Hence we can say that, for small cavities, bone substitutes are excellent option to fill the defect. However in large cavities, considering the cost effectiveness, they can be used in combination with allograft/autograft.

## CONCLUSION

In our study, we conclude that bone substitute is an effective option to fill the defect after extended curettage especially in children and old age population. Although there remains a debate over filling the defect in children as they have excellent healing and osteogenic potential but literature also suggests that, if affordability is not an concern, bone substitutes can act as excellent defect filler.

## References

1. Ahn JI and Park JS. Pathological fractures secondary to unicameral bone cysts. Int Orthop 1994; 18: 20-22.
2. Arata MA, Peterson HA and Dahlin DC. Pathological fractures through non-ossifying fibromas: review of the Mayo Clinic experience. J Bone Joint Surg Am 1981; 63: 980-8.
3. Roudbari S, Haji Aliloo Sami S, Roudbari M. The clinical results of benign bone tumor treatment with allograft or autograft. Arch Iran Med 2015;18:109-13
4. Toy PC and Heck RKJr. General principles of tumors. In: Canale ST, Beaty JH, editors. Campbell's operative orthopaedics.12th ed. Philadelphia: Mosby Elsevier 2013;788.
5. Ebraheim NA, Elgafy H, Xu R. Bone-graft harvesting from iliac and fibular donor sites: techniques and complications. J Am Acad Orthop Surg. 2001;9:210–218
6. Banwart JC, Asher MA, Hassanein RS. Iliac crest bone graft harvest donor site morbidity: a statistical evaluation. Spine (Phila Pa 1976). 1995;20:1055–1060.
7. Aydin M, Togral G, Kekec F, Arikan M, Gungor S. Painful, pediatric sacral aneurysmal bone cyst treated by curettage and fresh frozen allograft. Eklem Hastalik Cerrahisi. 2016;27(2):103–107.
8. Morii T, Yabe H, Morioka H, Suzuki Y, Anazawa U, Toyama Y. Curettage and allograft reconstruction for giant cell tumours. J Orthop Surg (Hong Kong). 2008;16(1):75–79.
9. Guida P, Ragozzino R, Sorrentino B, Casaburi A, D'Amato RD, Federico G, *et al*. Three-in-One minimally invasive approach to surgical treatment of pediatric pathological fractures with wide bone loss through bone cysts: ESIN, curettage and packing with

injectable HA bone substitute. A retrospective series of 116 cases. Injury. 2016;47(6):1222–8.
10. Andreacchio A, Alberghina F, Testa G, Canavese F. Surgical treatment for symptomatic non-ossifying fibromas of the lower extremity with calcium sulfate grafts in skeletally immature patients. Eur J Orthop Surg Traumatol. 2018;28(2):291–7
11. Hirn M, de Silva U, Sidharthan S, Grimer RJ, Abudu A, *et al*. Bone defects following curettage do not necessarily need augmentation. Acta Orthop 2009; 80: 4-8.
12. Yanagawa T, Watanabe H, Shinozaki T and Takagishi K. Curettage of benign bone tumors without grafts gives sufficient bone strength. Acta Orthop 2009; 80: 9-13.
13. Enneking WF, Dunham W, Gebhardt MC, Malawar M and Pritchard DJ. A system for the functional evaluation of reconstructive procedures after surgical treatment of tumors of the musculoskeletal system. Clin Orthop Relat Res 1993; 286: 241-6.
14. Irwin RB, Berhard M and Biddinger A. Coralline hydroxyapatite as bone substitute in orthopaedic oncology.Am J Orthop 2001; 30: 544-50.
15. Yang Y, Niu X, Zhang Q, Hao L, Ding Y, Xu H. A comparative study of calcium sulfate artificial bone graft versus allograft in the reconstruction of bone defect after tumor curettage. Chin Med J (Engl). 2014;127(17):3092–7.
16. 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(4):167–70.
17. Takeuchi A, Suwanpramote P, Yamamoto N, Shirai T, Hayashi K, Kimura H, *et al*. Mid- to long-term clinical outcome of giant cell tumor of bone treated with calcium phosphate cement following thorough curettage and phenolization. J Surg Oncol. 2018;117(6):1232–8.
18. Sakamoto A. Reconstruction with beta-tricalcium phosphate for giant cell tumor of bone around the knee. J Knee Surg. 2017;30(1):75–7.
19. Rosario MS, Hayashi K, Yamamoto N, Takeuchi A, Miwa S, Taniguchi Y, *et al*.Functional and radiological outcomes of a minimally invasive surgical approach to monostotic fibrous dysplasia. World J Surg Oncol. 2017;15(1):1.
20. Guida P, Ragozzino R, Sorrentino B, Casaburi A, D'Amato RD, Federico G, *et al*. Three-in-One minimally invasive approach to surgical treatment of pediatric pathological fractures with wide bone loss through bone cysts: ESIN, curettage and packing with injectable HA bone substitute. Aretrospective series of 116 cases. Injury. 2016;47(6):1222–8.
21. Reppenhagen S, Reichert JC, Rackwitz L, Rudert M, Raab P, Daculsi G, *et al*. Biphasic bone substitute and fibrin sealant for treatment of benign bone tumours and tumour-like lesions. Int Orthop. 2012;36(1):139–48.
22. Kelly CM, Wilkins RM. Treatment of benign bone lesions with an injectable calcium sulfate-based bone graft substitute. Orthopedics. 2004;27(1 Suppl):s131–5.
23. Nakamura T, Matsumine A, Asanuma K, Matsubara T, Sudo A. Treatment of bone defect with calcium phosphate cement subsequent to tumor curettage in pediatric patients. Oncol Lett. 2016;11(1):247–52.

**How to cite this article:**

Umesh Yadav *et al* (2020) 'Functional Outcome of Bone Substitutes for Filling Defects After Extended Curettage in Benign Lytic Bone Lesions- A Retrospective Analysis of 34 Patients', *International Journal of Current Advanced Research,* 09(06), pp. 22488-22491. DOI: http://dx.doi.org/10.24327/ijcar.2020.22488.4437

*******