

## Case Series

# Varied uses of bone allograft in plastic and reconstructive surgery

Vikas Singh, Shivam Dang\*

Department of Plastic Surgery, Army Hospital Research and Referral, Delhi, India

**Received:** 19 August 2020  
**Accepted:** 08 October 2020

**\*Correspondence:**

Dr. Shivam Dang,  
E-mail: shivamdang89@gmail.com

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

### ABSTRACT

The availability of safe, clinically useful and cost effective bone allografts have resulted in changes in surgical treatment with a concomitant increase in demand for bone allografts grafts for the purpose of reconstruction in plastic surgery. They offer an attractive alternative to bone autograft because their supply is less limited, they allow structural restoration of the skeleton, and their surfaces support bone formation. We report a case series of 13 patients where freeze dried bone allografts were used for reconstruction. All grafts met standards recommended by the Bone Banks and the FDA. Objective evaluation of the persistence of graft volume was obtained by radiography, whereas subjective estimation of graft volume was obtained by patient response on regular follow up upto a period of one year. Bone allografts can be used in any kind of surgery involving bone from minor defects to major bone loss after tumour resection. Freeze-dried allograft bone is a safe and equal alternative for bone autograft without donor-site morbidity.

**Keywords:** Bone allograft, Bone autograft, Freeze dried

### INTRODUCTION

Bone allografts have long been used as a natural substitute to repair skeletal defects. They offer an attractive alternative to bone auto graft because their supply is less limited, they allow structural restoration of the skeleton, and their surfaces support bone formation.

Bone allografts have long been used as a natural substitute to repair skeletal defects. They offer an attractive alternative to bone autograft because their supply is less limited, they allow structural restoration of the skeleton, and their surfaces support bone formation.<sup>1</sup>

The demand for bone allograft has increased rapidly particularly in reconstructive surgery where the need for bone grafts or substitutes is growing fast. They are generally used in two forms; freeze dried bone allograft (FDBA) and demineralized freeze dried bone allograft (DFDBA). In reconstructive craniofacial surgery,

autogenous bone was the material of optimal choice despite serious shortcomings, before the emergence of demineralized allogenic bone which was accepted as the most promising alternative to autogenous bone in 1900s.<sup>2</sup>

FDBA was first used in periodontal therapy in early 1970s. It is now the allograft of choice in reconstructive surgery as it provides an osteoconductive scaffold for bone growth and elicits resorption when implanted in mesenchymal tissues.<sup>3</sup> We report 13 such cases, where freeze dried bone allograft was used and discuss the results. Their integration, extrusion and subjective estimation of graft volume obtained by patient response.

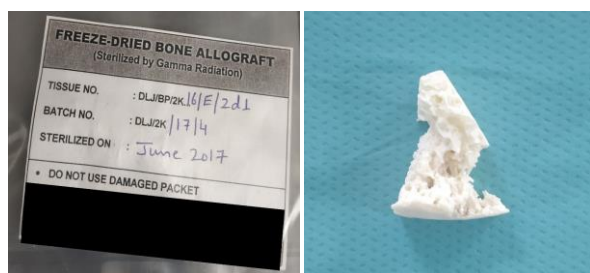
### CASE SERIES

13 patients were included in the study in which freeze dried bone allografts were used during surgery. Diagnosis and Indications for use of bone allograft are enumerated in (Table 1).

**Table 1: Diagnosis and indications for use of bone allograft.**

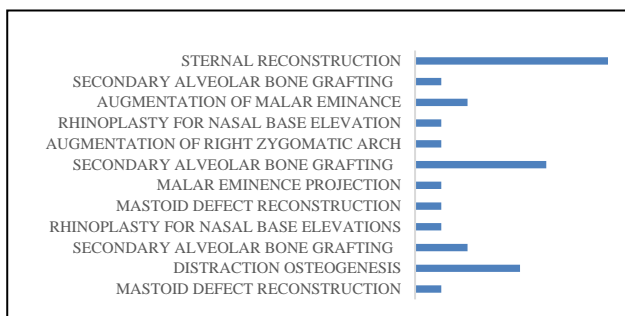
Diagnosis	Bone allograft used for	No. of packets used
Embryonal rhabdomyosarcoma	Mastoid defect	1
Rt lower limb dysplasia	Distraction osteogenesis	4
Cleft lip and palate	Secondary alveolar bone grafting	2
Cleft lip palate (OPTD)	Rhinoplasty for nasal base elevation	1
Rt microtia (OPTD)	Mastoid defect	1
Romberg's disease	Malar eminence	1
Group III cleft	Secondary alveolar bone grafting	5
Gun shot wound face	Augmentation of right zygomatic arch	1
Secondary cleft nose deformity	Rhinoplasty for nasal base elevation	1
Post traumatic mid face deformity	Augmentation of malar eminence	2
Group iii cleft	Secondary alveolar bone grafting	1
Sternal agenesis	Making sterum	12
Angiolymphoid hyperplasia forehead	Reconstructing forntal bone and to wall of frontal sinus with raff	5

Each bone allograft was processed under strict aseptic conditions and sterilized by gamma radiation and was made available in sterile packs. Each pack contained a single cortico cancellous bone allograft (Figure 1).



**Figure 1: Freeze dried bone allograft.**

All grafts met standards met by the FDA. In the case series average of 2.4 packets were used (Figure 2).



**Figure 2: Number of allografts used.**

These bone allografts were used in varied surgical indications. Secondary bone grafting of the maxilla and the residual alveolar cleft at the stage of transitional dentition preceding eruption of the canine has become an adjunctive procedure aiming to further improve the

functional and aesthetic habitation of patient with unilateral or bilateral cleft lip and palate.<sup>4</sup> In this case series 3 patients of group III cleft underwent secondary alveolar bone grafting using freeze dried bone allografts. The first choice for dorsal augmentation should be long pieces of septal cartilage followed by ear cartilage.<sup>5</sup>

However freeze dried allograft bone is a safe and equal alternative for dorsal augmentation without donor-site morbidity in cases of secondary cleft nasal deformities. In current study a case of 16 year old female was operated, who presented with Secondary cleft nasal deformity for which rhinoplasty for nasal base elevation was done with the help of bone allograft and the allograft was successfully integrated (Figure 3).



**Figure 3: Secondary cleft nasal deformity with nasal base elevation.**

Disfiguring post-traumatic deformities of the midface sometimes persist even after the treatment. Such deformities, after healing, are among the most formidable challenges faced by the surgeons, apart from the psychological impact on the patients. Following the basic principles of craniofacial reconstruction and with bone allografts, better results can be achieved. 21 year old presented with mid face traumatic deformity for which augmentation of malar eminence was done using a bone allograft integration of which can be seen in post CT done after 3 months (Figure 4).

Bone allograft was used in current study for reconstruction of sternum in a case of 4 month old baby girl who presented with peri membranous ventricular septal defect with atrial septal defect with sternal agenesis. Sternum was reconstructed using 12 bone allografts along with dual mesh. Surgical outcome was excellent and integration of the bone allograft was seen on follow up (Figure 5).



**Figure 4: Mid face traumatic deformity post reconstruction showing integration of bone allograft.**



**Figure 5: Sternal reconstruction using bone allograft in a case of sternal cleft.**

Angiolympoid hyperplasia with eosinophilia (ALHE) is an uncommon, vaso-proliferative, idiopathic condition that manifests in adults as isolated or grouped papules, plaques, or nodules in the skin of the head and neck. Most patients present with lesions in the skin of the periauricular region, forehead, or scalp.<sup>7,8</sup>

One such case presented with angiolympoid hyperplasia of the forehead. 41 year old underwent frontal sinus was filled with five bone allografts and coverage was done with radial artery forearm flap (RAFF) (Figure 6).



**Figure 6: Reconstruction of forehead defect with bone allograft and RAFF.**

An allograft will serve primarily as a spacer that allows osteo conduction of the host cells into its mass, resulting in progressive integration of the graft into the host bone. Integration is a series of events leading to gradual replacement of grafted bone by host bone. In our series all patients showed integration of the bone allograft except for the case of Right microtia where an attempt was made to cover the mastoid defect , however the bone graft failed to integrate (Figure 7) .

## DISCUSSION

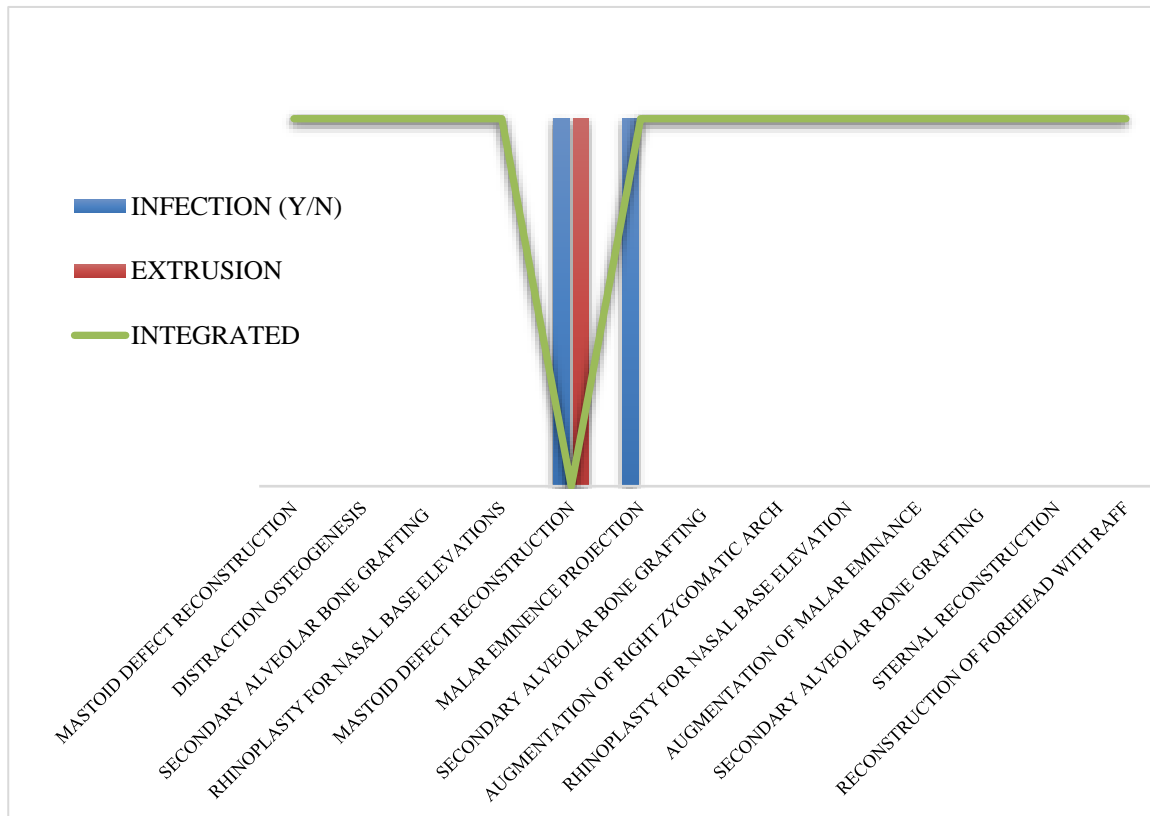
A bone graft is defined as any implanted material that promotes bone healing, whether alone or in combination with other material. Bone grafts can be divided into the following subtypes: autografts, allografts, xenografts, synthetic materials, and any combination thereof. Grafts that are transferred between two genetically unmatched subjects are called allografts. Bone allografts are unique in that the cellular component is typically removed to minimize their rejection. In addition, they are thoroughly treated to eliminate any possibility of disease transmission.<sup>9</sup>

Bone allografts have long been used as a natural substitute to repair skeletal defects. The goal of using bone allograft is to initiate a healing response from the host bed that will produce new bone at the host-graft interface and within the porous body of the graft material.<sup>10</sup>

Besides the properties of the graft itself, the vascularity of the bed and the mechanical stability of the graft are of vital importance. For optimal incorporation of the graft, the host bed should either already contain enough pre-osteogenic or osteogenic cells, or must be enriched by a source of these cells, such as autograft or autogenous bone marrow.<sup>11</sup>

Cortico cancellous bone has only an osteoconductive property but no osteogenic or osteo inductive capacity. It is prepared from femoral heads or from the extremities of long bones, and can provide some mechanical support, depending on its mode of preparation. It is the most widely used form of allograft. Processing will include defatting and removal of bone marrow. Delipidation has been shown to promote better osteoconduction.<sup>12-15</sup>

Processed bone can be machined in various forms, including morsellised disc, a dowel or a wedge. Bone which is processed under sterile conditions can be stored, frozen or freeze-dried, and if not processed in this way, it will usually be irradiated. Various preparations are commercially available, varying from particles to blocks to sheets of different sizes. A recent study has shown that the bone augmenting properties of bone allograft vary from one commercial preparation to another.<sup>16</sup> Generally, the smaller particles incorporate into the recipient bed faster than larger blocks or cortical sheets.



**Figure 7: Integration, extrusion and infection in bone allografts.**

A successful result with allograft is an interaction between three parties. The surgeon has to define his need; prepare the host bed and handle and fix the graft. The tissue bank selects and screens the donor. It then prepares and chooses the bone according to its intended use. The patient must benefit enough to allow successful healing of the graft, and must comply with the prescribed post-operative treatment.

## CONCLUSION

Ever increasing use of human bone allografts reflects positively on the usefulness and safety of these products in reconstructive surgery. Bone allografts can be used in any kind of surgery involving bone from minor defects to major bone loss after tumour resection. Freeze-dried allograft bone is a safe and equal alternative for bone autograft without donor-site morbidity.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: Not required*

## REFERENCES

- Greenwald AS, Boden SD, Goldberg VM, Khan Y, Laurencin CT, Rosier RN, et al. Bone-graft substitutes: facts, fictions, and applications. *J Bone Joint Surg Am.* 2001;83-A(Suppl 2.2):98-103.
- Salyer KE, Bardach J, Squier CA, Gendler E, Kelly KM. Cranioplasty in the growing canine skull using demineralized perforated bone. *Plast Reconstr Surg.* 1995; American academy periodontology. Tissue banking of bone allografts used in periodontal regeneration. *J Periodontol.* 2001;72:834-8.
- Ozawa T, Omura S, Fukuyama E, Matsui Y, Torikai K, Fujita K. Factors influencing secondary alveolar bone grafting in cleft lip and palate patients: prospective analysis using CT image analyzer. *Cleft Palate Craniofac J.* 2007;44:286-91.
- Gunter JP, Rohrich RJ. Augmentation rhinoplasty: dorsal onlay grafting using shaped autogenous septal cartilage. *Plast Reconstr Surg.* 1990;86:39-45.
- Ranganath K, Hemanth Kumar HR. The correction of post-traumatic pan facial residual deformity. *J Maxillofac Oral Surg.* 2011;10(1):20-4.
- Allen PW. Angiolymphoid hyperplasia with eosinophiia. *Histopathology.* 1991; 19:387.
- Wells GC, Whimster IW. Subcutaneous angiolymphoid hyperplasia with eosinophilia. *Br J Dermatol.* 1969;81;1-15.
- Connolly J, Guse R, Lippiello L, Dehne R. Development of an osteogenic bone-marrow preparation. *J Bone Joint Surg.* 1989;71-A:684-91.
- Prockop D. Marrow stromal cells as stem cells for nonhematopoietic tissues. *Science.* 1997;276:71-4.
- Hernigou P, Poignard A, Manicom O, Mathieu G, Rouard H. The use of percutaneous autologous bone marrow transplantation in nonunion and avascular

- necrosis of bone. *J Bone Joint Surg.* 2005;87-B:896-902.
11. Aspenberg P. A new bone chamber used for measuring osteoconduction in rats. *Eur J Exp Musculoskeletal Res.* 1993;2:69-74.
  12. Thoren K, Aspenberg P, Thorngren K. Lipid extracted bank bone: bone conductive and mechanical properties. *Clin Orthop.* 1995;311:232-46.
  13. Johnson C, Brown B, Lasky L. Rh immunization caused by osseous allograft. *N Engl J Med.* 1985;312:121-2.
  14. Jensen T. Rhesus immunization after bone allografting: a case report. *Acta Orthop Scand.* 1987;58:584.
  15. Bae HW, Zhao L, Kanim LE, Wong P, Delamarter RB, Dawson EG. Intervariability and intravariability of bone morphogenetic proteins in commercially available demineralized bone matrix products. *Spine.* 2006;31:1299-306.

**Cite this article as:** Singh V, Dang S. Varied uses of bone allograft in plastic and reconstructive surgery. *Int Surg J* 2020;7:3773-7.