ORIGINAL RESEARCH

Evaluation of Block Allograft Efficacy in Lateral Alveolar Ridge Augmentation

Bhuvaneswari Birla Bose[1], Prabhu Manickam Natarajan[2], Anitha Logaranjani Kannan[3], Juala Catherine Jebaraj[4], Raghunathan Jagannathan[5], Thodur Madapusi Balaji[6]

Abstract

Aim: The research was performed for the clinical and computerized tomography (CT) assessment of cortico-cancellous block allograft in the reconstruction of lateral alveolar ridge width deficiency prior to placement of dental implants.

Materials and methods: Ten patients who had atrophic mandibular ridge necessitating bone augmentation prior to implant placement were randomly selected, and corticocancellous block allografts were used to augment the lateral ridge deficiency. The grafted site was assessed clinically and with CT preoperatively and 6 months postoperatively. Surgical re-entry was done after 6 months for dental implant placement.

Results: During the 6-month evaluation period, all the block allografts had integrated well with the host tissue. Clinically, all the grafts were found to be firm in consistency, well-incorporated, and vascularized. Both the clinical and CT measurements showed increase in bone width. The dental implants had good primary stability.

Conclusion: Bone-block allografts can be employed as a marked graft material for the management of lateral ridge defects.

Clinical significance: During precise and accurate surgical methods, this type of bone graft can be safely used in regions of implant placement as a convenient alternative to autogenous grafts.

Keywords: Block allograft, CT-scan evaluation, Lateral ridge deficiency, Ridge augmentation.

The Journal of Contemporary Dental Practice (2022): 10.5005/jp-journals-10024-3377

Introduction

Replacement of missing tooth with dental implants is the mainstay treatment strategy and the success mainly depends on the quantity and quality of the remaining alveolar bone. Lateral ridge deficiency is one of the major clinical events, which occurs as a result of mounting reasons such as extraction, cysts, tumors, and trauma.[1] A wide range of surgical methods such as bone grafting, guided-bone regeneration (GBR), ridge splitting, and distraction osteogenesis are used to augment the deficient ridges. Among these, utilization of bone grafts is the widely used method to augment the deficient ridges. Albeit autogenous bone elicits biocompatibility and provides viable osteogenic cells, it also requires an additional bone-harvesting procedure.[2] Autogenous bone warrants its procurement from extra-oral sites also, which needs expertise in surgical technique. Thus, need for an additional invasive procedure and limitation in the quantity of bone graft procured, has warranted the use of other graft materials over autogenous grafts. Hence, bone allografts, xenografts, and alloplasts (substitutes) are employed in many cases to restrict the autogenous bone harvesting.[3] Guided-bone regeneration is not successful for ridge dimension less than 4 mm, and block grafts are the mainstay for the management of ridge augmentation. In these cases, bone allograft serves as an effective alternative for the requirement of primary or supplementary graft material. For lateral ridge augmentation, block allografts are preferred over particulate grafts. In addition, corticocancellous block grafts extracted from the chin or ramus elicit adequate bone for the treatment of ridge width deficiencies.[4] Previous studies show that irradiated (2.5–3.8 Megarads), pretrimmed corticocancellous block graft harvested from the spinal column has been used as a substitute for autogenous bone in the treatment of horizontal augmentation in ridge deformities.[5]

[1,4–6]Department of Periodontics, Tagore Dental College and Hospital, Chennai, Tamil Nadu, India

[2]Department of Periodontics, College of Dentistry, Ajman University, Ajman, United Arab Emirates

[3]Department of Periodontics, Sri Meenakshi Ammal Dental College & Hospital, Chennai, Tamil Nadu, India

Corresponding Author: Bhuvaneswari Birla Bose, Department of Periodontics, Tagore Dental College and Hospital, Chennai, Tamil Nadu, India, Phone: +91 9789912002, e-mail: drbhuvanabirla@tagoredch.in

How to cite this article: Bose BB, Natarajan PM, Kannan AL, *et al.* Evaluation of Block Allograft Efficacy in Lateral Alveolar Ridge Augmentation. J Contemp Dent Pract 2022;23(8):807–812.

Source of support: Nil

Conflict of interest: None

Mounting studies indicate that irradiated block grafts possess similar efficacy like autogenous bone grafts for synchronization and adequate new bone formation. Further, they are less morbid and more cost-effective as compared with autogenous graft.[6,7]

Materials and Methods

The present study was conducted in 10 patients in the age group of 18–35 years and was randomly selected from the outpatient pool who visited the Department of Periodontics, Ragas Dental College and Hospital, Chennai. The study was approved by the Ethical Committee of Ragas Dental College and Hospital, Chennai, India. The study was conducted over a period of 1 year from the time of case selection till implant placement.

Inclusion Criteria

Healthy, non-smokers, without active periodontal disease, but who had anterior/posterior edentulous spaces with remaining alveolar bone width corresponding to division B (4–5 mm of horizontal bone width) and vertical bone height of ≥10 mm according to Misch and Judy[8] with bone density of D2 and D3, were included in the study.

Exclusion Criteria

Immunocompromised patients, pregnant and lactating mothers, and patients with infectious diseases were excluded from the study.

Preoperative Assessment

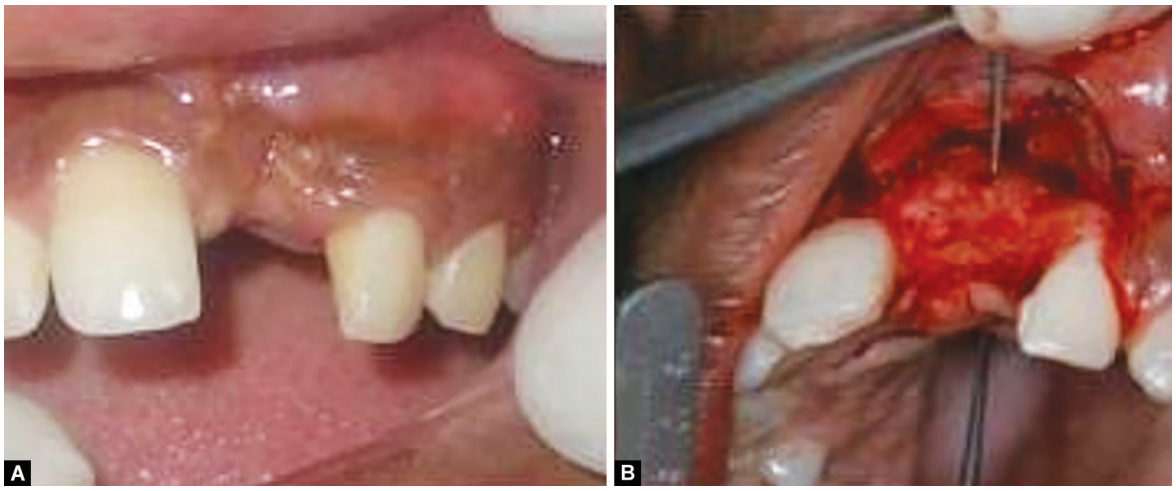
Periodontal health was assessed by recording gingival index and periodontal index. The width of the ridge was measured at three sites, namely, at the crest, 2 mm, and 4 mm from the crest with a standard Vernier caliper.[9] All these measurements were recorded by the same examiner, and a customized acrylic stent was used to standardize as well as to aid in reproducibility of the same positions to measure the ridge dimensions during the 3rd- and 6th-month recall visit (Fig. 1). The head and neck CT scan was taken for all the patients preoperatively and 6 months postoperatively to assess the width of the edentulous ridge. The quality of bone in Hounsfield units was also assessed using the CT scan.

Surgical Procedure

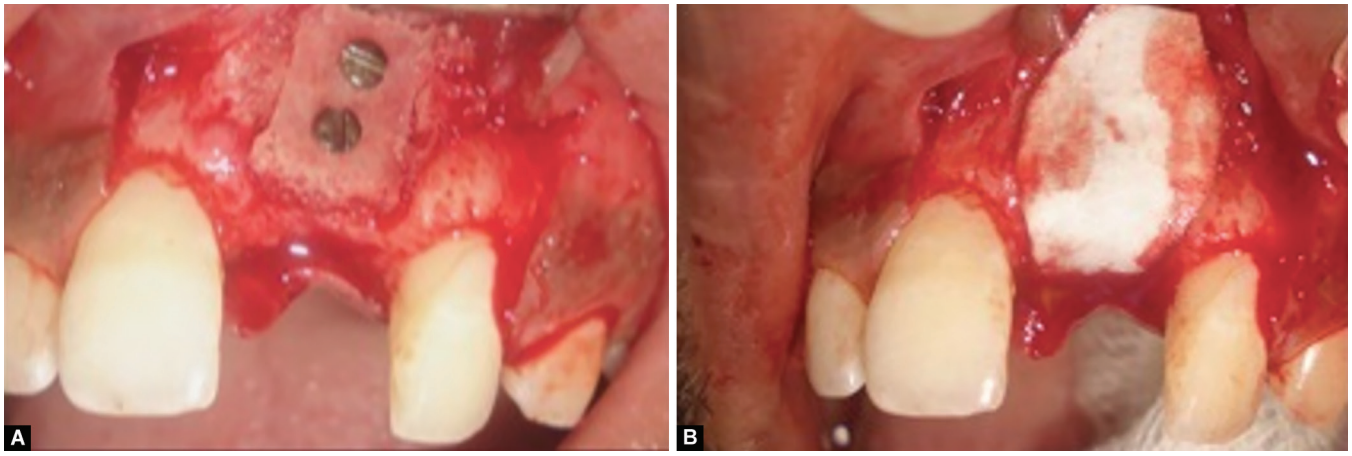
Ridge augmentation procedure was performed under aseptic conditions. The patients were advised to use 10 mL of 0.2% chlorhexidine mouth rinse as pre-procedural mouthrinse. The patient's recipient site was administered 2% lignocaine hydrochloride and adrenaline 1:80,000 as local anesthetic. The initial crestal incision was placed in the keratinized mucosa slightly lingual/palatal and the incision was continued intrasulcularly one tooth mesial and distal to the edentulous site. A vertical releasing incision was made at the mesial and the distal aspect of the edentulous flap. Full-thickness mucoperiosteal flap was raised to gain access to the deficient bony area. Recipient bone bed was prepared using a cross-cut fissure bur and a recipient seat of approximately 1 mm in depth was prepared at the recipient site to create a positive seat for corticocancellous block allograft. The block allograft (RMTB Block Allograft™) with 5 mm × 5 mm × 5 mm measurement was then contoured into position with maximum contact. Precise care was taken to preserve the cortical layer of the block allograft as it provides rigidity for fixation of the screws and prevents rapid resorption of the graft. Two titanium fixing screws measuring 1.5 mm in diameter and 6 mm in length were placed minimum 3 mm apart to stabilize and reduce stress fracture in the allograft. The graft edges were beveled, and graft chips were used to fill the gap between the block and the recipient bed (Fig. 2). Normal saline irrigation was done. A long-lasting resorbable collagen membrane (BioMend-R™) was used to cover the entire block graft. The membrane was tucked on the labial and palatal/lingual aspects (Fig. 2). Primary tension-free closure was obtained via periosteal release, and the flap was sutured with 3-0 Mersilk suture using Cortellini technique[10] on the center of the horizontal incision area, and simple interrupted sutures were placed on the mesial and distal aspect of the flap. Amoxicillin 500 mg thrice daily for 5 days and ibuprofen 400 mg thrice daily for 5 days were prescribed to the patients postoperatively. Patients were instructed to be careful while tooth brushing as not to disturb the surgical site. They were instructed chemical plaque control measures with 10 mL of 0.2% chlorhexidine rinse for 10 days. Suture removal was done 2 weeks postoperatively, and it was reviewed after 1 month, 3 months, and 6 months postoperatively. The clinical measurements were taken during the 3rd- and 6th-month. Computerized tomography scan of the jaw was taken at the end of 6 months and measurements were compared with preoperative CT scan (Fig. 3).

Surgical Re-entry

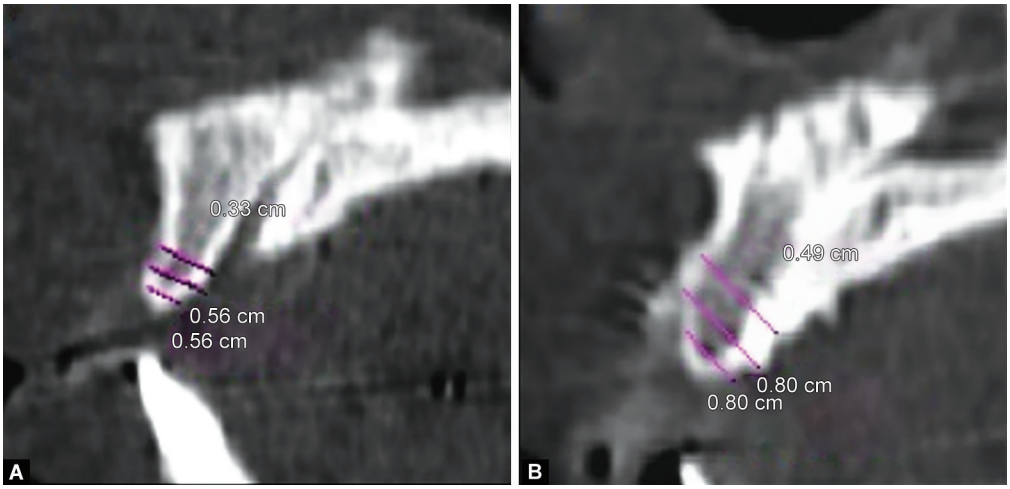
Surgical re-entry for implant placement at the site of augmentation was done at the end of 6 months. Under local anesthesia, crestal incisions with extending crevicular incisions involving two teeth on either side of the edentulous sites were placed. Full-thickness mucoperiosteal flap was reflected, and the augmented underlying bone was visualized. The titanium screws were removed from the allograft and the site was irrigated with normal saline. The augmented ridge dimension was recorded using a standard Vernier caliper at the crest, 2 mm from the crest, and 4 mm from the alveolar bone crest. Appropriate endosseous implants were placed in the augmented site according to the ridge width and



Figs 1A and B: Preoperative view and measurement of alveolar ridge with caliper



Figs 2A and B: Block allograft placed in the ridge defect and held with screws, membrane placed



Figs 3A and B: CT showing preoperative and increase in ridge width measurements

the height. Mucoperiosteal flap was approximated with 3-0 Mersilk nonresorbable sutures after implant placement (Fig. 4). The sutures were removed 2 weeks postoperatively. The implant prosthesis was placed 4 months after implant placement.

Data Analysis

Data were collected and statistical analysis was performed using one-way ANOVA test and Tukey–HSD test to evaluate the overall significance of clinical and radiological changes in the ridge dimension at different time intervals. $p < 0.001$ was considered as statistically significant.

Results

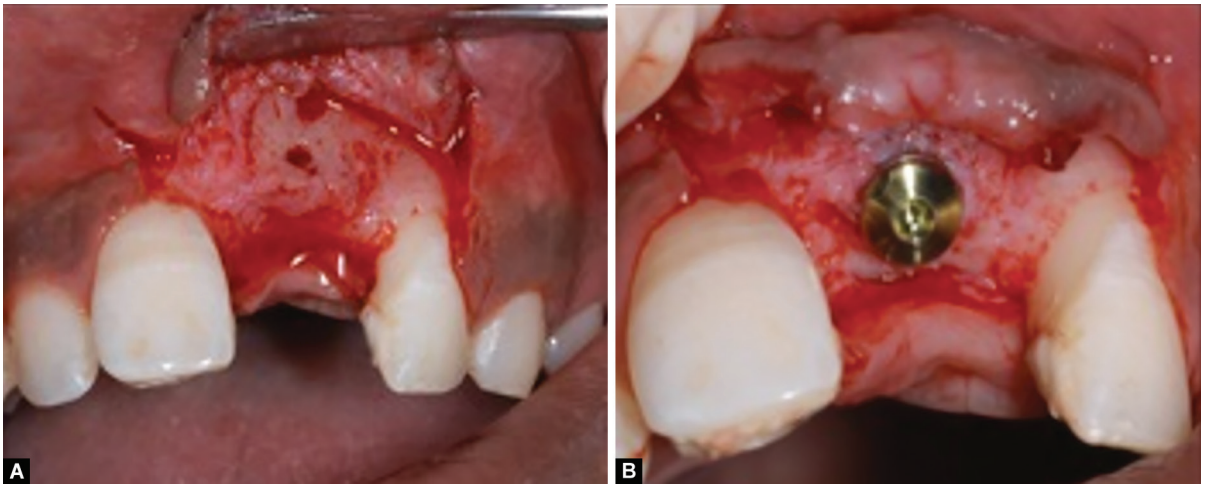
All the 10 patients were instructed to visit at the end of 1st, 3rd, and 6th month postoperatively. Hard- and soft-tissue measurements were recorded and tabulated at the zero-, 3rd-, and 6th-month time intervals. Pre- and 6-month postsurgical CT scans were used to measure the width ridge.

Combined Soft Tissue and Bone Measurement

The mean value of combined soft- and hard-tissue measurements at baseline and at the end of 6 months at the alveolar crest level were 3.29 ± 0.95 mm and 5.71 ± 1.11 mm, respectively. The combined soft- and hard-tissue measurements for 2 mm from the crest level at baseline and at the end of 6 months were 4.14 ± 0.90 mm and 7.71 ± 1.09 mm, respectively, and for 4 mm from the crest level at baseline and at the end of 6 months were 5.00 ± 0.82 mm and 9.71 ± 2.41 mm, respectively. Mean increase in the combined soft- and hard-tissue measurements at various positions on the ridge at different time intervals was found to be significant ($p < 0.001$) (Table 1).

Hard-tissue Measurement

The mean value of direct hard-tissue measurement at baseline at the crest level was 2.50 ± 1.26 mm, and with the graft was 5.97 ± 0.98 mm, and the mean hard-tissue dimension at the end of 6 months was 5.08 ± 0.66 mm. The mean value of hard tissue at 2 mm from the crest level at baseline was 3.96 ± 1.18 mm, and with the graft was 7.69 ± 1.89 mm, and at the end of 6 months was 6.33 ± 1.03 mm. Similarly, the mean value of bone at 4 mm from the crest level at baseline was 4.61 ± 0.75 mm, and with the graft was 9.16 ± 1.64 mm, and the dimension of hard tissue at the end of 6 months was 8.17 ± 1.17 mm. Comparing with the baseline value, the progressive changes in the hard tissue at various positions on the ridge at different time intervals were found to be statistically significant ($p < 0.001$) (Table 2).



Figs 4A and B: Block graft incorporated in the alveolar ridge and implant placement after 6 months

Table 1: Comparison of mean clinical changes in soft-tissue and hard-tissue dimension at various position of the ridge at different time intervals

	Baseline		*6 months*		
Edentulous site	*Mean*	*SD*	*Mean*	*SD*	*p-value*
At the crest	3.29	0.95	5.71	1.11	0.001**
2 mm from the crest	4.14	0.90	7.71	1.89	<0.001**
4 mm from the crest	5.00	0.82	9.71	2.41	<0.001**

***p*-value <0.001 was considered as statistically significant

Table 2: Comparison of mean clinical changes in hard-tissue dimension at various position of the ridge at different time intervals

	Baseline		*Bed + Graft*		*6 months*		
Edentulous site	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*p-value*
At the crest	2.50	1.26	5.97	0.98	5.08	0.66	0.001**
2 mm from the crest	3.96	1.18	7.69	1.89	6.33	1.03	<0.001**
4 mm from the crest	4.64	0.75	9.16	1.61	8.17	1.17	<0.001**

***p*-value <0.001 was considered as statistically significant

Table 3: Comparison of mean CT changes in hard-tissue dimension at various positions of the ridge at different time intervals

	Baseline		*6 months*		
Edentulous sites	*Mean*	*SD*	*Mean*	*SD*	*p-value*
At the crest	3.86	0.32	5.34	1.00	0.003**
2 mm from the crest	5.20	0.68	7.29	1.98	0.022*
4 mm from the crest	6.09	1.37	8.86	2.29	0.018*

**p*-value <0.001 at the crest was considered as statistically significant
***p*-value <0.05 at 2 mm and 4 mm from the crest was considered as statistically significant

Alveolar Ridge Measurement in CT Scan

Using the CT scan, the mean value of horizontal dimension of alveolar ridge at the crest at baseline was 3.86 ± 0.32 mm, and the mean 6-month postoperative dimension was 5.34 ± 1.00 mm. The mean value of alveolar ridge dimension at 2 mm from the crest at baseline was 5.20 ± 0.60 mm, and the mean 6-month postoperative dimension was 7.29 ± 1.98 mm, the alveolar ridge dimension at 4 mm from the crest at baseline was 6.09 ± 1.37 mm, and the mean 6-month postoperative measurement was 8.86 ± 2.29 mm. Thus, comparison of the pre- and postsurgical CT scans revealed an overall increase in the volume of the bone in the defect sites (Table 3).

Inference: Block allograft proved effective in increasing the dimension of the alveolar ridge in the lateral aspect.

Discussion

Allogenic bone substitutes in the form of corticocancellous block have shown promising results as an alternative for autogenous

monocortical block grafts, as this procedure could be performed with less morbidity such as elimination of the need for the patient donor site and reduced surgical time.[11] There have been more reports on the use of corticocancellous blocks, which retains the cortical plate, thereby resisting early resorption.[12,13] Block grafts being corticocancellous in nature have the ability to maintain the three-dimensional (3D) space needed for bone regeneration.[14,12] Block graft used in this study has proved to be effective by providing adequate space and showed successful bone regeneration.

Effective bone regeneration requires simultaneous revascularization and replacement of graft material from host bone without marked loss. The new bone-substitution quality and pattern are evaluated by graft-material interaction and host bone in the event of healing. Allogeneic bone placement warrants extended time as compared with autologous bone and has no effects on graft incorporation at initial stages and completely depends on the host site to elicit adequate substrate for healing.[15,16] Allogeneic bone functions as a mineral matrix or scaffold for cell migration and proliferation.[17] During osteoconduction, the host osteoprogenitor cells and vascular elements use the graft as a matrix for the formation of new bone in the defect. Within the graft, the host cells undergo differentiation and maturation to form a functional skeletal network and thus replace the graft through a "creeping substitution" process.[18,19] The allograft used in this study aided to be a supportive framework for new bone formation.

Collagen possesses diverse biological properties such as hemostatic, chemotactic, and cell-adhesion functions, and has displayed marked results in GBR trial ridge-width augmentation.[20] In contrast, other studies show that collagen's fast absorption rate remains a concern to most clinicians.[21] The collagen membrane used in this study has served its purpose by attracting the various growth factors aiding in the bone-formative process. The Cortellini suture placed had produced excellent flap closure, and the soft-tissue healing was also uneventful. On surgical re-entry, the graft had blended well with the adjacent host bone. The block allograft used in this study has successfully proved to be an efficient scaffold for new bone formation and thus increases the ridge width for ideal implant placement. There is an evident gradient increase in the clinical measurements in the recall visits and during the surgical re-entry. An overall increase of 2.5–4 mm in the width of the ridge was noted in all the 10 patients. The CT-scan measurement preoperative and 6 months postoperative confirmed the clinical measurements. There was an average increase of 2.5–4 mm increase in the width of the ridge over a period of 6 months at all the levels of the ridge, thus indicating the homogenization of the block allograft.

Reza Shahmohammadi et al.[22] similar to this study showed successful bone regeneration with block allografts in patients with insufficient alveolar ridge width and concluded that block allografts serve as excellent scaffolds.

Limitation of The Study

The efficacy of the block allograft can be evaluated with increase in the sample size. Histochemical analysis of the newly formed bone can be done to assess the quality of the bone formed. Long-term follow-up could be more substantiating the results.

Conclusion

Dental care professionals seek excellence in cosmetic results due to increase in discerning and demanding patients. Utilizing the concept that bone is an excellent body tissue capable of regeneration and remodeling, several graft materials have been used to augment the bony defects. The use of corticocancellous block allografts had given promising results, thus allowing the placement of implants of standard length and diameter, thereby improving the long-term prognosis of the implant-supported reconstruction. This study proves that corticocancellous block allograft can be used efficiently for ridge augmentation. However, long-term studies with more number of patients would substantiate the efficacy of the block allograft.

Acknowledgment

All the patients included in this study are acknowledged.

References

1. Johnson K. A study of the dimensional changes occurring in the maxilla following tooth extraction. Aust Dent J 1969;14(4):241–244. DOI: 10.1111/j.1834-7819.1969.tb06001.x.
2. Misch CE, Dietsh F. Bone-grafting materials in implant dentistry. Implant Dent 1993;2(3):158–166. DOI: 10.1097/00008505-199309000-00003.
3. Kumar P, Vinitha B, Fathima G. Bone grafts in dentistry. J Pharm Bioallied Sci 2013;5(Suppl 1):S125–S127. DOI: 10.4103/0975-7406.113312.
4. Dias RR, Sehn FP, de Santana Santos T, et al. Corticocancellous fresh-frozen allograft bone blocks for augmenting atrophied posterior mandibles in humans. Clin Oral Implants Res 2016;27(1):39–46. DOI: 10.1111/clr.12509.
5. Kloss FR, Offermanns V, Kloss-Brandstätter A. Comparison of allogeneic and autogenous bone grafts for augmentation of alveolar ridge defects – A 12-month retrospective radiographic evaluation. Clin Oral Implants Res 2018;29(11):1163–1175. DOI: 10.1111/clr.13380.
6. Pendarvis WT, Sandifer JB. Localized ridge augmentation using a block allograft with subsequent implant placement: A case series. Int J Periodontics Restorative Dent 2008;28(5):509–515. PMID: 18991002.
7. Wallace S, Gellin R. Clinical evaluation of a cancellous block allograft for ridge augmentation and implant placement: A case report. Implant Dent 2008;17(2):151–158. DOI: 10.1097/ID.0b013e318177784a.
8. Misch CE, Judy KW. Classification of partially edentulous arches for implant dentistry. Int J Oral Implantol 1987;4(2):7–13. PMID: 3269839.
9. Leonetti JA, Koup R. Localized maxillary ridge augmentation with a block allograft for dental implant placement: Case reports. Implant Dent 2003;12(3):217–226. DOI: 10.1097/01.id.0000078233.89631.f8.
10. Cortellini P, Prato GP, Tonetti MS. The modified papilla preservation technique. A new surgical approach for interproximal regenerative procedures. J Periodontol 1995;66(4):261–266. DOI: 10.1902/jop.1995.66.4.261.
11. Krasny K, Kamiński A, Krasny M, et al. Preparation of allogeneic bone for alveolar ridge augmentation. Cell Tissue Bank 2017;18(3):313–321. DOI: 10.1007/s10561-017-9631-8.
12. Peleg M, Sawatari Y, Marx RN, et al. Use of corticocancellous allogeneic bone blocks for augmentation of alveolar bone defects. Int J Oral Maxillofac Implants 2010;25(1):153–162. PMID: 20209198.
13. Pereira E, Messias A, Dias R, et al. Horizontal resorption of fresh-frozen corticocancellous bone blocks in the reconstruction of the atrophic maxilla at 5 months. Clin Implant Dent Relat Res 2015;17(Suppl 2):e444–e458. DOI: 10.1111/cid.12268.
14. Mellonig JT. Autogenous and allogeneic bone grafts in periodontal therapy. Crit Rev Oral Biol Med 1992;3(4):333–352. DOI: 10.1177/10454411920030040201.
.15. Lima JL de O, Sendyk DI, Sendyk WR, et al. Growth dynamic of allogeneic and autogenous bone grafts in a vertical model. Braz Dent J 2018;29(4):325–334. DOI: 10.1590/0103-6440201801994.
16. Moest T, Frabschka J, Kesting MR, et al. Correction to: Osseous ingrowth in allogeneic bone blocks applied for vertical bone

augmentation: A preclinical randomized controlled study. Clin Oral Investig 2020;24(9):3323. DOI: 10.1007/s00784-020-03466-3.
17. Gomes KU, Carlini JL, Biron C, et al. Use of allogeneic bone graft in maxillary reconstruction for installation of dental implants. J Oral Maxillofac Surg 2008;66(11):2335–2338. DOI: 10.1016/j.joms.2008.06.006.
18. Kim Y-K, Ku J-K. Ridge augmentation in implant dentistry. J Korean Assoc Oral Maxillofac Surg 2008;46(3):211–217. DOI: 10.5125/jkaoms.2020.46.3.211.
19. McAllister BS, Haghighat K. Bone augmentation techniques. J Periodontol 2007;78(3):377–396. DOI: 10.1902/jop.2007.060048.
20. von Arx T, Buser D. Horizontal ridge augmentation using autogenous block grafts and the guided bone regeneration technique with collagen membranes: a clinical study with 42 patients. Clin Oral Implants Res 2006;17(4):359–366. DOI: 10.1111/j.1600-0501.2005.01234.x.
21. Meloni SM, Jovanovic SA, Urban I, et al. Horizontal ridge augmentation using GBR with a native collagen membrane and 1:1 ratio of particulate xenograft and autologous bone: A 3-year after final loading prospective clinical study. Clin Implant Dent Relat Res 2019;21(4):669–677. DOI: 10.1111/cid.12808.
22. Shahmohammadi R, Moeintaghavi A, Radvar M, et al. Clinical and histological evaluation of increase in the residual ridge width using mineralized corticocancellous block allografts: A pilot study. J Dent Res Dent Clin Dent Prospects 2017;11(4):229–235. DOI: 10.15171/joddd.2017.040.