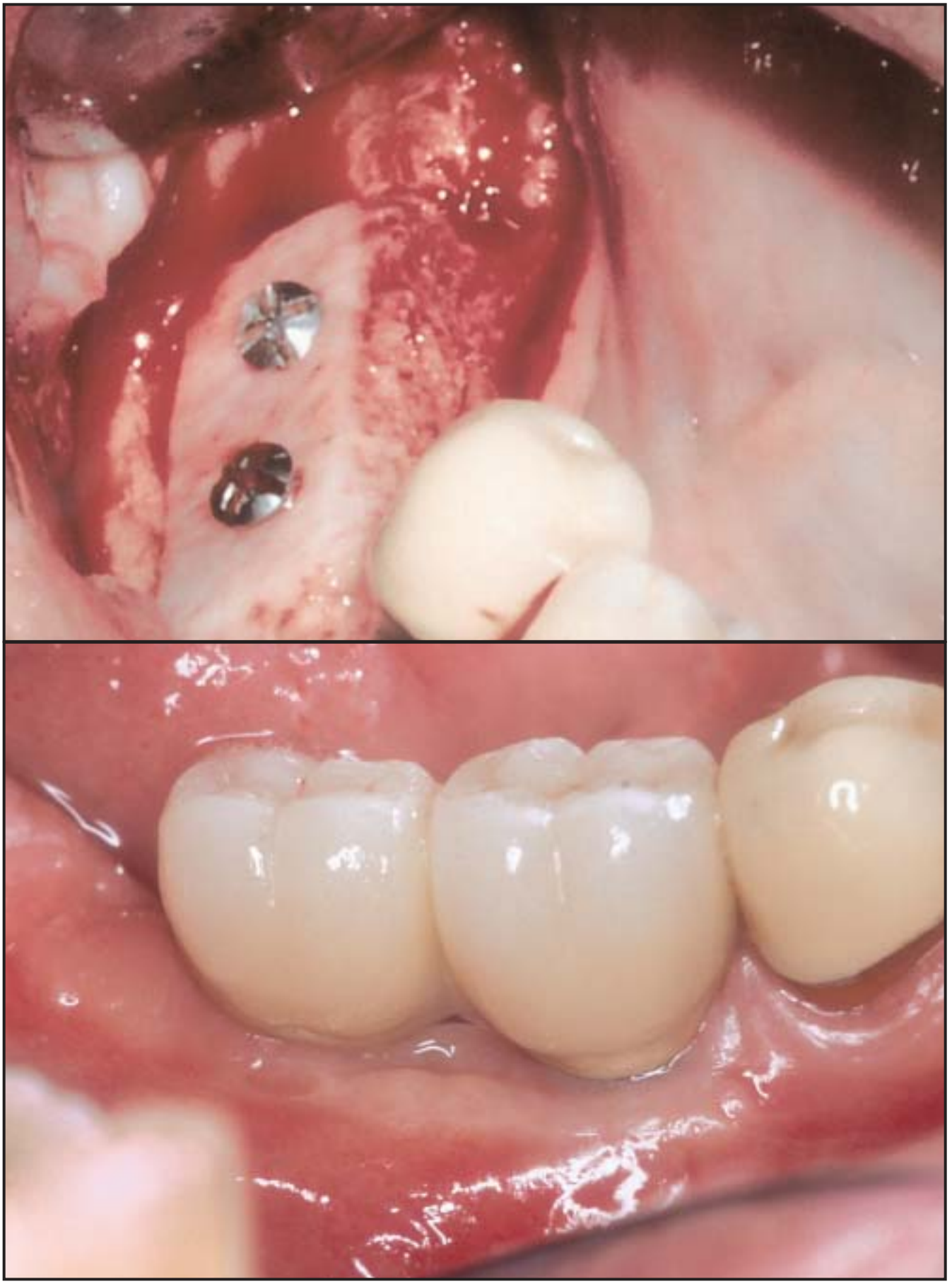
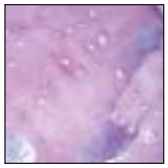


Localized Ridge Augmentation Using a Block Allograft with Subsequent Implant Placement: A Case Series



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The most significant local factors for successful implant placement are the quality and quantity of bone present. Bone loss occurs on a predictable basis following loss of the natural dentition, provided no interceptive therapies are carried out. Restoration of considerable hard tissue defects can be achieved using a variety of techniques, including autogenous blocks and newer methods such as corticocancellous allograft blocks. This report demonstrates successful ridge augmentation using an iliac crest monocortical allograft. Nine patients in need of ridge augmentation for the placement of 16 dental implants were included in this series. Histology from one case after the 6-month healing period demonstrated newly formed woven bone with vascular ingrowth, suggestive of osteoconduction. All grafted sites appeared integrated with clinically visible bleeding following removal of the fixation screw. The mean gain of ridge augmentation at the 6-month reentry was 3.0, 3.2, 3.1, and 3.0 mm, respectively, at the crest and 1, 3, and 5 mm apical to the crest, with individual gains up to 7 mm. Implants were successfully placed in all sites. This method represents an alternative source of block allograft bone for significant alveolar ridge augmentation. (Int J Periodontics Restorative Dent 2008;28:509–515.)

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Dental implants are a highly accepted and predictable mode of therapy to replace missing teeth. However, significant alveolar bone loss is a common finding in edentulous areas and necessitates ridge augmentation procedures before implants can be placed. Early reports of guided bone regeneration focused on particulate grafts covered by resorbable or nonresorbable membranes.[1–6] In the past decade, autogenous block grafts harvested from the symphysis or ramus area have shown promising results, but there are added risks of paresthesia, anesthesia, or other complications associated with the second surgical site required to procure the graft.[7–14] Recently, block allografts have been reported for successful implant site development, thus eliminating the need for a second surgical donor site.[15–18] One such material is a pretrimmed corticocancellous monocortical block sterilized using the Tutoplast process (Tutogen). This report of nine cases demonstrates the use of an alternative iliac monocortical allograft processed with the Allowash technique (LifeNet) to successfully augment deficient alveolar ridges.

Case report

Nine patients (four men and five women) who needed ridge augmentation for the placement of dental implants were included in this case series. The Institutional Review Board of the Medical University of South Carolina approved the study protocol. The patients' ages ranged from 31 to 58 years, and all were nonsmoking, systemically healthy individuals. The surgical sites included six maxillary anterior sites, one maxillary posterior site, two mandibular anterior sites, and seven mandibular posterior sites. Clinical and radiographic assessments revealed inadequate alveolar bone for implant placement. The risks, benefits, and alternative treatments were explained and discussed with all patients prior to definitive planning. These patients selected the allograft primarily to reduce the morbidity associated with the second surgical procedure required to obtain an autogenous graft. All patients agreed to participate in this protocol and gave written informed consent.

Ibuprofen (800 mg) was administered, and patients rinsed with 10 mL of 0.12% chlorhexidine digluconate for 30 seconds prior to surgery. Intravenous conscious sedation was achieved with midazolam and meperidine via titration to individual needs while monitoring with an automatic blood pressure cuff and pulse oximeter. Additionally, 8 mg of dexamethasone IV were added to minimize postoperative edema. After local anesthesia with vasoconstrictor was administered, a crestal incision was made slightly lingual/palatal to the crest of the edentulous site and extended one tooth mesial and distal to the site. Curvilinear releasing incisions were performed in a full-thickness manner to gain complete access to the bony defect.

Using a crosscut fissure bur, an inlay preparation approximately 1 mm in depth was prepared at the recipient site to create a positive seat for the allograft. The allograft was hydrated in a 60-mL syringe with 0.9% sterile saline under negative pressure until all visible air bubbles were removed. The block allograft was then trimmed to fit the precise dimensions of the defect and to ensure adequate horizontal width for ideal implant placement. When shaping the block allograft, the cortical layer was preserved to provide rigidity for fixation and protection against resorption during the healing phase.

Intramarrow perforations of the recipient site were completed immediately prior to block fixation. Two fixation screws were placed in an oblique fashion so as not to induce stress fractures in the allograft. The graft edges were slightly beveled, and freeze-dried mineralized particulate bone was placed mesially and distally to create a gradual flowing architecture. A long-lasting resorbable collagen membrane (Ossix, ColBar LifeSciences) was used to cover the entire site. Primary tension-free closure was obtained via periosteal release, and the flaps were sutured with polytetrafluoroethylene sutures. Using ridge-mapping calipers, the width of the ridges was recorded at the immediate crest and at 1, 3, and 5 mm apical to the crest. These measurements were taken upon initial flap reflection, after block placement (Figs 1 and 2), and at 6-month reentry (Fig 3). Patients were prescribed a post-operative antibiotic, nonsteroidal anti-inflammatory, analgesic, steroid, and antimicrobial rinse. Platelet-rich plasma (PRP) was used via centrifugation (SmartPReP, Harvest Technologies) in five patients after block fixation, in the particulate bone, and on the inner and outer aspects of the flap.

Healing progressed uneventfully in all cases, with no incision opening or infection present. Patients returned at 1, 2, and 4 weeks for clinical inspection and oral hygiene instruction. Sutures were removed at 2 weeks.

At 6 months, all measurements were repeated as the sites were reentered in a similar fashion for fixation screw removal and implant placement (Fig 4). All sites appeared integrated with clinically visible bleeding following removal of the fixation screw, and implants were then placed. In one case, the implant osteotomy was performed with a 4-mm-diameter trephine to a depth of 10 mm to obtain a core specimen for histology (Figs 5 to 7).

Sixteen sites in nine patients were measured and recorded. Table 1 shows the ridge width at each site prior to placement of the graft, immediately after graft placement, and at the 6-month reentry. These measurements were recorded at the crest and 1, 3, and 5 mm apical to the crest. The average gain in width among the 16 sites was 3.0 mm (range: 0 to 7 mm) at the crest, 3.2 mm (range: 2 to 7 mm) at 1 mm apical to crest, 3.1 mm (range: 0 to 7 mm) at 3 mm apical to the crest, and 3.0 mm (range: 0 to 6 mm) at 5 mm apical to the crest. Figures 8 and 9 show the final results after 6 months of healing.

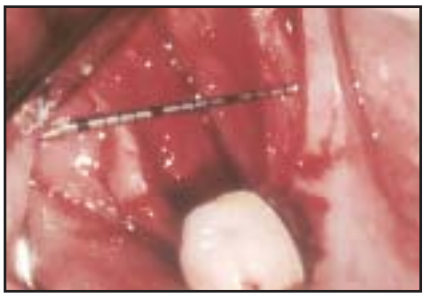
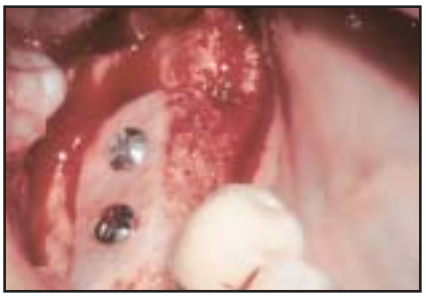


Fig 1 (left) *Occlusal view of deficient ridge (≈ 2.5 mm) with probe in place.*

Fig 2 (right) *Occlusal view with block allograft fixation.*



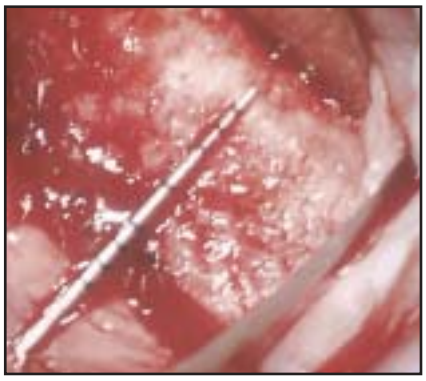
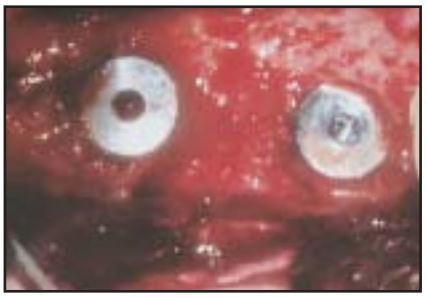


Fig 3 (left) *Occlusal view of grafted site at 6-month reentry showing approximately 9-mm ridge width.*

Fig 4 (right) *Occlusal view of implant in place (implant diameter: 4.7 mm).*



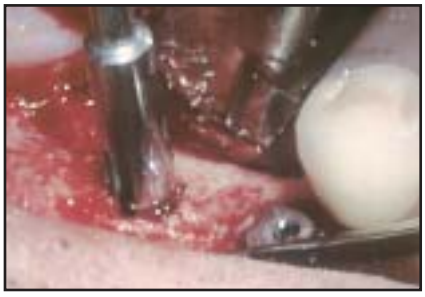


Fig 5 *Occlusal view of the osteotomy performed with 4-mm trephine to a depth of 10 mm.*

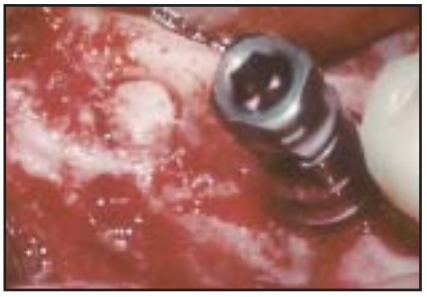


Fig 6 *Occlusal view of trephine osteotomy before core removal.*

Fig 7 *Trephine specimen in 10% formaldehyde solution.*

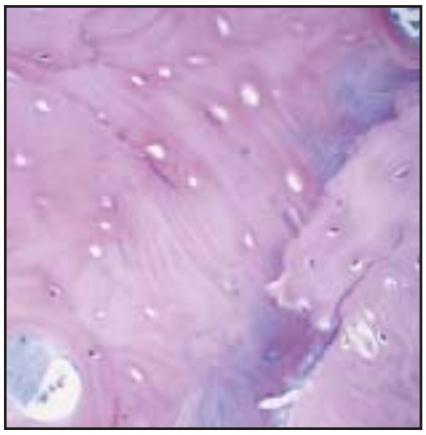


Fig 8 (left) *Histology after 6 months of healing showing a mixture of allograft and newly formed woven bone with the presence of osteocytes surrounding a blood vessel.*

Fig 9 (right) *Facial view 6 months after definitive restoration.*

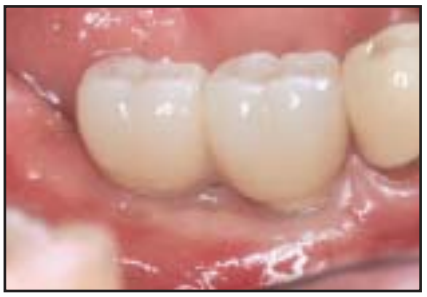


Table 1 Ridge width (mm) at each site apical to the crest during each stage of treatment

Patient (site*)		Depth			
		Crest	1 mm	3 mm	5 mm
1 (24)	Preoperative	3	3	4	4
	Immediately following graft placement	6	5	6	8
	6 mo postoperative	5	5	7	8
1 (26)	Preoperative	3	4	5	5
	Immediately following graft placement	5	6	7	8
	6 mo postoperative	5	6	7	8
2 (8)	Preoperative	3	4	5	5
	Immediately following graft placement	7	7	7.5	8
	6 mo postoperative	5	6	7	9
3 (19)	Preoperative	1	1	3	5
	Immediately following graft placement	8	8	10	10
	6 mo postoperative	8	8	10	10
4 (8)	Preoperative	5	5	7	8
	Immediately following graft placement	8.5	8	10	10
	6 mo postoperative	5	7	8	8
4 (9)	Preoperative	3	4	7	7
	Immediately following graft placement	8	7	10	10
	6 mo postoperative	5	6	7	10
5 (9)	Preoperative	4	4	5	5
	Immediately following graft placement	7	6	8	8
	6 mo postoperative	5	5	6	6
5 (10)	Preoperative	3	6	4	4.5
	Immediately following graft placement	6	6	8	9
	6 mo postoperative	5	6	6	7
5 (11)	Preoperative	3	3	4	6
	Immediately following graft placement	6	6	7	8
	6 mo postoperative	6	7	7	7
6 (29)	Preoperative	2	2	3	4
	Immediately following graft placement	5	5	6	7
	6 mo postoperative	5	5	6	7
6 (30)	Preoperative	4	4	4	5
	Immediately following graft placement	5	6	7	8
	6 mo postoperative	5	6	6	8
7 (5)	Preoperative	3	3	5	6
	Immediately following graft placement	7	8	10	10
	6 mo postoperative	5	6	8	10
8 (30)	Preoperative	2.5	3	4	4
	Immediately following graft placement	7	8	9	10
	6 mo postoperative	8	8	10	10
8 (31)	Preoperative	2.5	3	3.5	4
	Immediately following graft placement	7	9	10	10
	6 mo postoperative	7.5	7.5	8.5	10
9 (29)	Preoperative	1	1	3	5
	Immediately following graft placement	7	8	7	10
	6 mo postoperative	7	7	8	7
9 (30)	Preoperative	1	1	2	6
	Immediately following graft placement	6	6	7	7
	6 mo postoperative	6	6	7	7
Mean gain		3.0	3.2	3.1	3.0

*FDI tooth number.

Table 2 Statistical analysis of grafts placed with platelet-rich plasma (PRP) versus those placed without PRP

	PRP overall effect*		Treatment stage by PRP interaction**	
Depth	F	*P*	F	*P*
Crest	0.46	.50	0.93	.43
1 mm	0.20	.66	0.36	.78
3 mm	0.57	.45	0.95	.42
5 mm	0.30	.59	0.38	.77

*df = 1, 49; **df = 3, 49.

Discussion

Ridge augmentation has become a standard procedure for patients who otherwise would have insufficient bone for implant placement or for ensuring implant placement in a more ideal position. If it can be shown that the use of corticocancellous block allografts is an effective alternative for autogenous monocortical block grafts, this procedure could be performed with less morbidity since there is no surgical procedure required for procuring an autogenous block. Several sources of allograft block material are available for alveolar augmentation. Although the use of cancellous blocks has been reported,[15] there have been more reports on the use of corticocancellous blocks,[16–18] which retain the cortical plate. It is hypothesized that the cortical plate will provide rigidity for fixation and also prevent any resorption during the healing phase.

This report demonstrates an alternative source of material that has not been previously reported. This material is procured as a corticocancellous portion of the iliac crest and processed using the Allowash technique followed by low-dose gamma irradiation. All tissues are recovered from deceased humans whose medical histories are determined suitable and then tested for infectious disease. An intensive decontamination, disinfection, and scrubbing regimen designed to remove and inactivate viruses and bacteria is carried out, followed by the Allowash process to remove virtually all cellular elements of bone.

In this report, measurements were performed at different levels of the crest to better monitor possible resorption patterns. However, the reproducibility of these measurements is a limitation, since no stent or open-site impressions were used. For the crestal measurements, the calipers were placed as close as possible to the crest. However, most sites did not have a truly flat surface, and there was apparent variability in determining the true crestal horizontal measurement. Perhaps the measurements taken 1 mm apical to the crest peak are more reliable and reproducible than those that attempted to determine the exact crest. Changes in protocol measurements are being implemented to address this variable.

As noted above, reentry measurements may have been affected by caliper angulation and perforation. However, based on the review of digital photographs and the position of the fixation screw after 6 months, there appeared to be little or no resorption. It is apparent that the dimensions of the ridge plus the block at placement were stable, and there was very little resorption of the block during the healing process. Additionally, the grafts placed with PRP were compared to those without PRP via the F test and were found to have no statistically significant difference from graft placement to the 6-month reentry (Table 2). Neither the PRP overall effect nor the stages of treatment by PRP interaction were significant (F test). This indicates that there is not a significant difference between patients who received PRP treatment

and those who did not with respect to the hard tissue measurements. This was expected, since studies suggest PRP has limited value with allografts and the benefits would not be observable after a 6-month healing period.[19–22] The goal of the augmentation for each site was to achieve a minimum gain in width of 7 mm so that proper dimensions of bone would be sufficient for ideal esthetics and long-term stability of the tissue. Clinically, these goals were achieved, and implants were placed in ideal positions. Although the measurements in this case series suggest average gains of 3.0 to 3.2 mm, individual gains up to 7 mm were observed.

Figure 8 demonstrates the histology in cross section of the trephine core specimen taken after the 6-month healing period. The core consists primarily of grafted bone. A mixture of allograft and newly formed woven bone can be observed. In some areas, a junction between the allograft and new bone is evident by the presence of osteocytes surrounding a blood vessel (Fig 8). It is expected that from this ingrowth of vasculature from the viable bone, rapidly forming woven bone will result. Over time, this woven bone and some of the allograft will be replaced by an osteoclast cutting cone/osteoblast filling cone "bone remodeling unit," which brings its own vasculature.[23]

This is the first known report of this alternative Allowash-processed corticocancellous iliac crest allograft for successful ridge augmentation for dental implant placement.

Acknowledgments

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