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CASE REPORT

Alveolar Ridge Augmentation using the Allograft Bone Shell Technique

Mogammad Thabit Peck

ABSTRACT

Background: The loss of teeth, whether it is from trauma or pathology, is accompanied by a concomitant loss of the surrounding alveolar bone. Khoury introduced a new method for grafting ridge defects in 2007. This technique involved using thin cortical plates harvested from the ramus, and in a 'sandwich' type manner, interposed these bone plates with cancellous bone harvested from the same site. Although this has shown success, the technique suffers from similar disadvantages of most harvesting techniques, i.e. a need for a second surgical site, and donor site morbidity. In this case presentation, we report the use of an allograft bone plate in a similar manner as was previously described by Khoury, to reconstruction lost alveolar bone in order to facilitate the correct three dimensional (3D) placement of dental implants.

Case description: A 53-year-old female presented for the restoration of her missing dentition in her upper jaw. The cone bean computed tomography (CBCT) revealed a large horizontal bony defect in the region of the upper anterior teeth, with minimal remaining bone. Using bone fixation screws, the bone plates were fixed to the buccal defect and the space between the plate and the existing palatal bone wall was then filled using a combination of autograft bone scrapings and xenograft bone particles. Six months after the initial surgery, the grafted sites were surgically re-entered and showed a marked increase in ridge width.

Conclusion: Evidence exists for the use of bone allografts for a variety of alveolar bone augmentation procedures. The case presented outlines another use for this versatile biomaterial.

Clinical significance: Bone harvesting for large alveolar defects is invariably associated with increased morbidity and an increased risk of postoperative complications. The above technique described by the author, may be used as a suitable alternative to reconstruct these defects, without harvesting bone from a second surgical site.

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INTRODUCTION

The loss of teeth, whether it is from trauma or pathology, is accompanied by a concomitant loss of the surrounding alveolar bone.[1] Although this process is not debilitating, over time, it results in a significant reduction in amount of bone available for the installation of dental implants. This ultimately compromises the ideal position of the implant, thereby affecting both the long-term function and esthetics of the subsequent restoration.

In order to compensate for this 'lost bone', several bone regenerative techniques have been developed. The most common of these is guided bone regeneration or GBR.[2] It is the least invasive of all the bone regenerative techniques and often involves using a barrier membrane to isolate the bone defect from the surrounding soft tissue. This allows the slower growing bone regenerative cells to penetrate the defect without interference from the surrounding tissues. Although successfully used, collagen membranes do have several disadvantages, the most significant being their unpredictable degradation rate.[3] This compromises their ability to maintain their barrier function, thereby leading to decreased bone formation and a possible compromised clinical result.

Other methods of alveolar ridge augmentation include the use of autogenous bone derived directly from the patient, either intraorally or from an extraoral site, such as the iliac crest or rib.[4] This technique is, however associated with concomitant donor site morbidity, and is limited by the availability of the volume of donor bone.[5,6] In many cases, these grafts resorb to such an extent that is it standard practice to harvest bone at larger volumes to compensate for the inevitable decrease in graft size.[4] Khoury[7] introduced a new method for grafting ridge defects in 2007. This technique involved using thin cortical plates harvested from the ramus, and in a 'sandwich' type manner, interposed these bone plates with cancellous bone harvested from the same site. Although this has shown success, the technique suffers from the same disadvantages of most harvesting techniques, i.e. a need for a second surgical site, and donar site morbidity.

In this case presentation, we report the use of an allograft bone plate in a similar manner as was previously described by Khoury, to reconstruction lost alveolar bone in order to facilitate the correct three dimensional placement of dental implants.

CASE DESCRIPTION

A 53-year-old female presented for the restoration of her missing dentition in her upper jaw. She was medically fit and otherwise had no contraindications for dental treatment. Upon clinical examination, multiple missing teeth were noted in the anterior and posterior regions of the upper jaw. The few remaining teeth were otherwise healthy and required no further dental management. She was currently wearing removal prosthesis, but requested a 'fixed' restorative option.

A detailed cone beam computed tomography (CBCT) scan was requested to evaluate the underlying osseous contour for possible implant placement. 'The CBCT scan together with the reconstructed orthopantomograph (OPG) revealed a large horizontal bony defect in the region of the upper anterior teeth, with minimal remaining bone (Figs 1 to 3).'

The posterior edentulous regions revealed a minimal amount of vertical bone height available for dental implant placement. Based on the radiographic examination, a staged surgical approach was proposed that included alveolar ridge augmentation as well as maxillary sinus augmentation. Having presented all the options to the patient, it was decided to use the Allograft-Bone-Shell-Technique (ABST) to augment the upper anterior maxilla.

Augmentation Procedure

'After local anesthetic was obtained, a midcrestal incision was made in the anterior region that was extended intrasulcularly to include the adjacent teeth on both sides of edentulous site (Fig. 4).'

No vertical releasing incisions were made. A full thickness, mucoperiosteal flap was raised to expose the underlying alveolar ridge. The residual remaining bone in the area was minimal, with a maximum measured ridge thickness of 3 mm. 'To reconstruct the lost alveolar bone, an allograft bone plate (Lypholised Orbital Floor, Bone SA, Johannesburg, South Africa), approximately 1 mm thick was shaped, using a piezosurgery unit (Surgybone, Sifradent, Sofia, Italy) to the appropriate size for each of the defects in the anterior region (Figs 5 and 6)'. Using bone fixation screws (Synthes GmbH, Zuchwill, Switzerland) (1.2 × 8 mm), the bone plates were fixed to the buccal defect, using a single screw for each plate. 'The space between the plate and the existing palatal bone wall was then filled using a combination of autograft bone scrapings and xenograft bone particles (Neobone Granules, Biomatlante, Bretagne, France), in a 20:80 ratio (Fig. 6)'. Both edentulous sites in the posterior maxilla

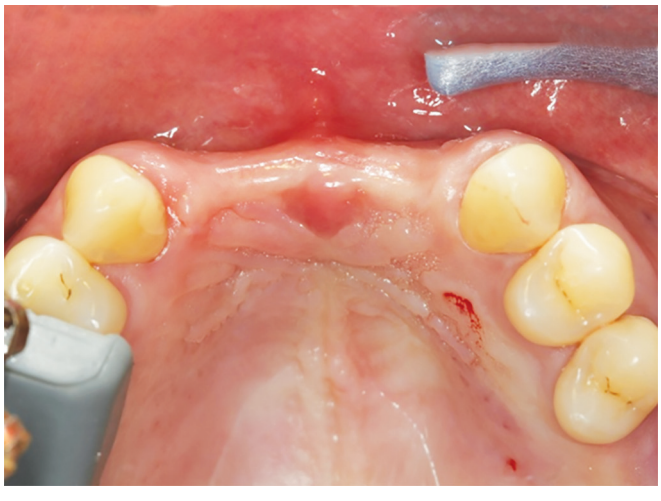

Fig. 1: Ridge at time of initial presentation

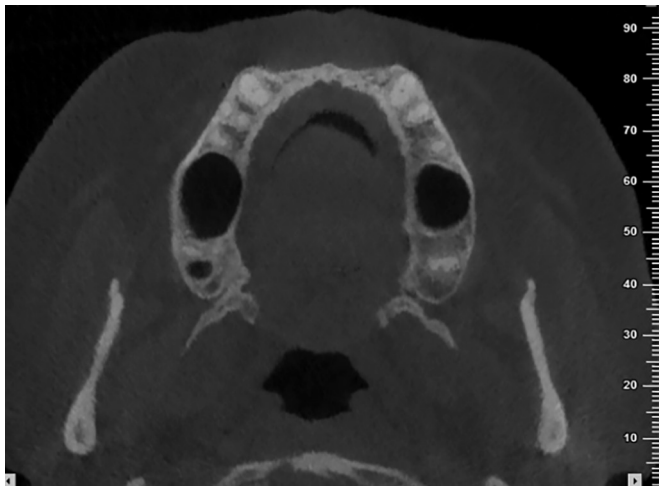

Fig. 2: Cone beam computed tomography at the time of initial presentation

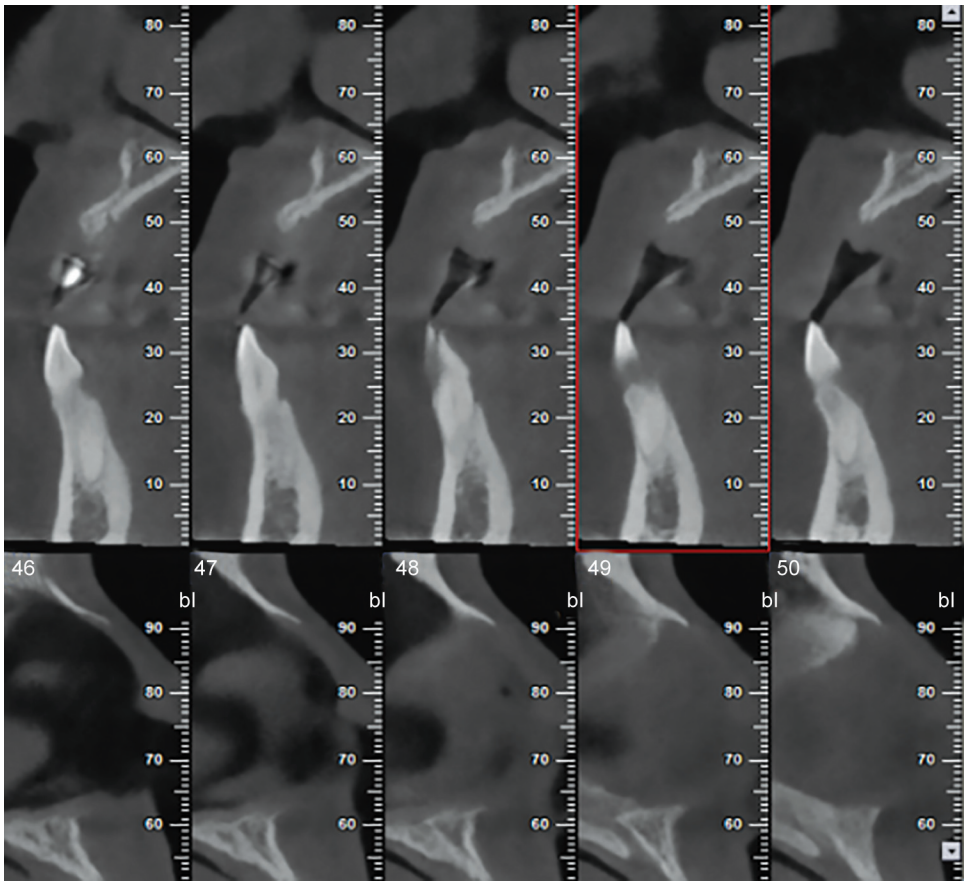

Fig. 3: Sagittal view CBCT at the time of initial presentation

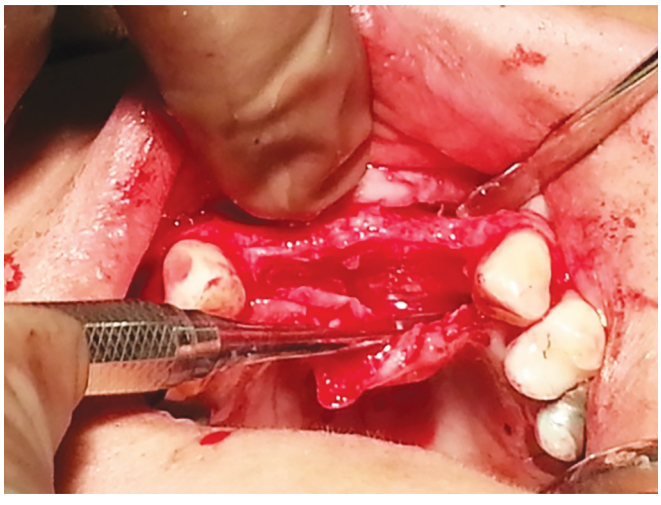

Fig. 4: Alveolar ridge exposed

Fig. 5: Allograft bone plate

were then grafted with the same xenograft material, using a standard lateral window sinus augmentation procedure. All the surgical sites were surgically closed, using 4-0 braided resorbable sutures (Clinisut, Port Elizabeth, South Africa). Oral analgesics and a chlorhexidine 0.2% mouth rinse were prescribed during the healing period, and the patient was scheduled for follow-up 2 weeks later. She was advised to restrict herself to a soft diet and not to use her removable prosthesis during the initial healing period.

Follow-up Visit

At the follow-up visit, 2 weeks after the initial surgical procedure, the patient was clinically well, and reported no untoward postoperative complications. The surgical sites were clinically healthy and all the remaining sutures were removed. Her prosthesis was adjusted and a soft denture liner (Visco-gel, Dentsply, York, USA) was added to increase retention and comfort. The patient was scheduled for routine follow-up 6 months later.

Implant Placement

Six months after the initial surgery, the grafted sites were surgically re-entered to allow for the placement of dental implants. 'The anterior region showed a marked increase in ridge width that was both clinically and radiographically evident (Fig. 7).'

Upon flap reflection, the bone plates appeared vital and fully integrated into the surrounding bone. The bone fixation screws were subsequently removed and this allowed for the placement of two surface modified 4.3 × 11.5 mm dental implants (Touareg X, Adin Dental Implant Systems, Afula, Israel), into the areas of the lateral incisor teeth in both sides of the upper jaw. At implant insertion, the quality of the newly formed bone was such that it allowed for the implant to be inserted at an insertion torque of at least 35 N cm. Similar implants from the same company but of varying lengths were placed in the upper left and right posterior areas, with the exception being that a NobelActive implant (Nobel Biocare, Goteborg, Sweden) was placed in the upper left second molar region. As before, all the surgical sites were surgically closed, using 4-0 braided resorbable sutures (Clinisut, Port Elizabeth, South Africa). A similar post-operative regime as her initial surgery was advocated and included the use of oral analgesics and a chlorhexidine 0.2% mouth rinse.

Implant Exposure

Five months following the implant placement, all the implants were surgically exposed and tested for osseointegration. All the implants were fully integrated and the appropriate healing abutments were placed. A postoperative CBCT scan was taken. 'When comparing this CBCT scan with the preoperative scan, a clear difference in the ridge width was evident in the anterior region (Figs 8 to 11).'

Prosthetic Management

At the present time, the patient is undergoing prosthetic rehabilitation of the integrated implants.

DISCUSSION AND CONCLUSION

Alveolar ridge augmentation using guided bone regeneration is a common surgical technique used to

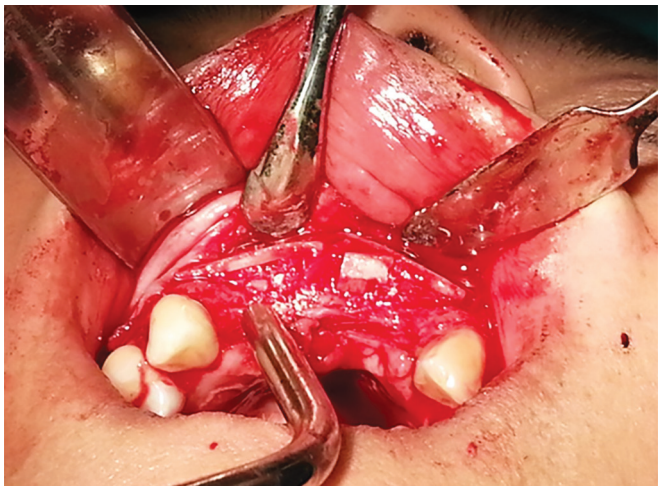

Fig. 6: Plates screwed into position and defect filled with xenograft bone

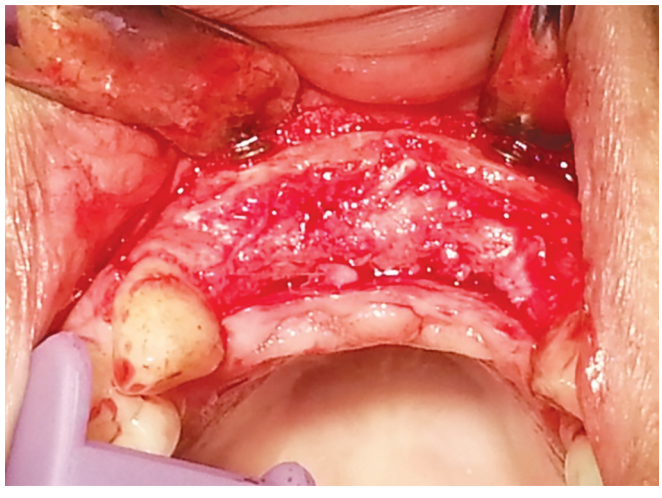

Fig. 7: Alveolar ridge 6 months after initial procedure

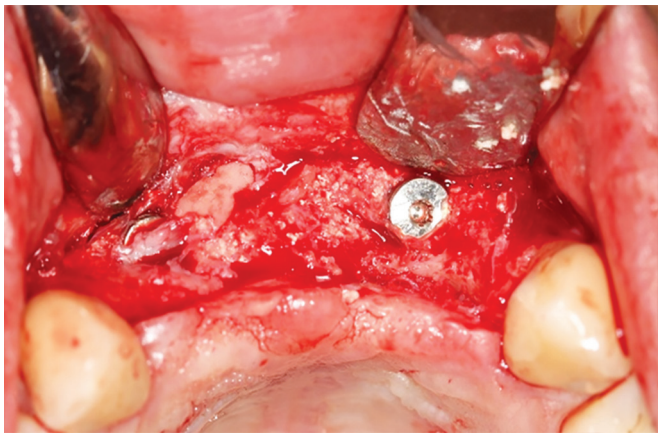

Fig. 8: Alveolar ridge at the time of implant uncovering

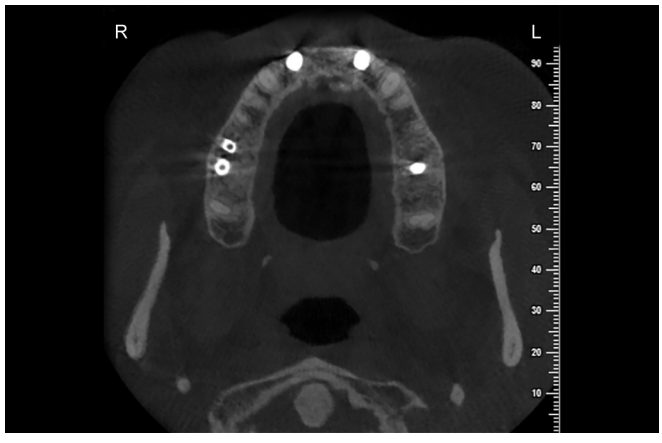

Fig. 9: Cone beam computed tomography at the time of uncovering

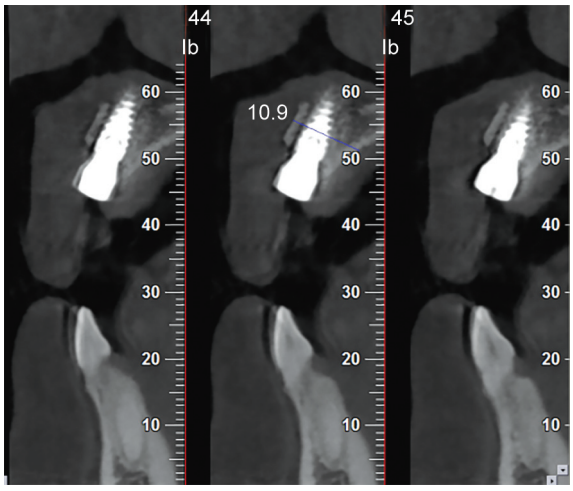

Fig. 10: Sagittal CBCT at the time of implant exposure

reconstruct lost alveolar bone for the purposes of placing dental implants.[8] Although several ridge augmentation techniques have been advocated, many of them remain unpredictable, especially for larger bone defects. In order to overcome this, Khoury,[7] introduced a new technique that involved using bone harvested from the patient's mandible, and placing this bone in a 'shell' type structure over the defect to induce new bone formation. Although this technique has been popularized since its inception, the lack of specific equipment resulted in a limited amount of practitioners adopting this protocol. Modifications of the Khoury technique have been developed, all of which show promising results.[9] However, as with all techniques that involve harvesting tissue from secondary donor sites, complications, such as morbidity and increased discomfort, occur.[10] These complications may be a limiting factor for patients accepting the treatment plan proposed.

In order to overcome the inherent problems associated with autogenous bone harvesting, we used an allograft bone plate in a similar technique as that proposed by Khoury.[7] This allowed us to benefit from the intrinsic advantages of the Khoury technique, whilst limiting the morbidity associated with the grafting procedure.

An allograft is defined as grafted tissue derived from the same species. The use of allograft material in ridge augmentation is well documented, and is often used as an alternative to the harvesting of native bone. When used for specific procedures, the use of allografts has also been reported to produce similar results as compared to autografts harvested from the mandible.[11] The authors also concluded that the allograft was a less invasive procedure to carry out. When allograft bone blocks were used to reconstruct the anterior maxilla, Schlee[12] showed that the esthetic results were comparable to using autogenous bone. Bone allografts have also been used for alveolar ridge preservation, with significantly less ridge resorption being observed.[13] Maxillary sinus augmentation, a common augmentation procedure for

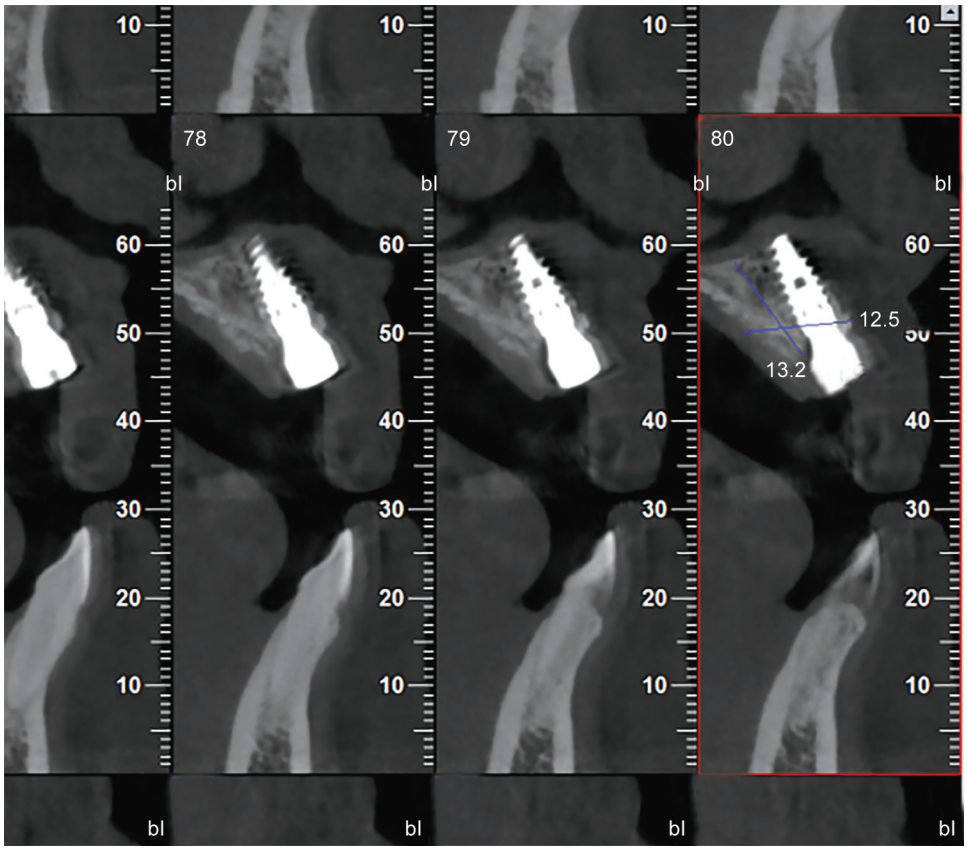

Fig. 11: Sagittal CBCT at the time of implant exposure

the reconstruction of lost bone, has been shown to benefit from the use of fresh frozen allograft (FFA), having comparable results to the use of autogenous bone.[14] The author concluded that it provided an alternative technique for the grafting of the maxillary sinus without the associated morbidity of harvesting bone from a second surgical site. In a similar study, Pereira E[15] showed that FFA had a low resorption rate at 5 months and could successfully be used to stabilise dental implants. In their study, a 97% implant survival rate was noted, all of which were successfully restored with fixed prosthesis. Novell[16] completed a 5 years analysis of implants placed in FFA. Although the study cohort was small, a 100% implant survival rate was noted. When using mineralized cortical bone allograft to regenerate small to medium vertical peri-implant defects bone, Le and Borzabadi-Farahani[17] showed that even when placing implants simultaneously, a successful outcome could be expected, and was sustainable for at least 3 years.

Evidence exists for the use of bone allografts for a variety of alveolar bone augmentation procedures. The case presented outlines another use for this versatile biomaterial. Using the ABST may reduce patient morbidity as well as increase patients acceptance of proposed treatment plans.

CLINICAL SIGNIFICANCE

Bone harvesting for large alveolar defects is invariably associated with increased morbidity and an increased risk of postoperative complications. The above technique described by the author, may be used as a suitable alternative to reconstruct these defects, without harvesting bone from a second surgical site.

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