

Utilizing the wall of a maxillary sinus window as a block graft for horizontal ridge augmentation: case report

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Abstract

Objective: This case report describes a novel technique that combines a lateral window sinus lift with simultaneous lateral ridge augmentation using an autogenous block graft. **Materials and methods:** A patient presented with a left maxillary edentulous ridge deficient both vertically, due a pneumatized left maxillary sinus, and horizontally. A lateral window sinus lift was completed, and the window of the sinus wall was used as an autogenous block graft for simultaneous ridge augmentation. The patient was allowed to heal for six months, and the site was re-entered to place three implants. The implants were allowed to osseointegrate for three months, and were subsequently restored with screw-retained restorations. **Results:** An increase in ridge width from approximately 3 mm to 7 mm was achieved at the site of the autogenous block graft, and created an edentulous ridge suitable for dental implant placement in a prosthetically driven position. **Conclusion:** This novel technique avoids complications and patient morbidity of an additional donor site for an autogenous block graft, and should be considered when ridge augmentation is needed adjacent to a lateral window sinus lift.

Keywords: Dental implant. Ridge augmentation. Bone grafting. Alveolar bone.

Introduction

Tooth loss and partial edentulism affects nearly all adults. Dentate adults, 20-64 years old, have an average of 25.5 teeth remaining; and dentate older adults, 65 years or older, have an average of only 21 teeth.¹ Maxillary first and second molars are among the most common teeth to be lost.² After tooth extraction, horizontal ridge resorption can reach up to 50% after 12 months. This often leaves a clinician with inadequate bone dimensions to place a dental implant in a favorable prosthetic position.³

In the maxilla, the presence of the maxillary sinuses and the progressive pneumatization phenomenon add another layer of complexity to restoring these edentulous areas. The maxillary sinus has been shown to have pneumatization of over 5 mm in some cases,⁴ leaving inadequate bone height for an implant. Even when ridge preservation is performed at the time of extraction, only approximately 1 mm of additional bone height is preserved in most cases.⁵ There are many techniques for sinus floor elevation available to augment an atrophic maxillary ridge prior to implant placement.⁶

A lateral window maxillary sinus elevation is one of the commonly used techniques, through which bone height is predictably gained by removing a window of

bone over the maxillary sinus, lifting the Schneiderian membrane, packing particulate bone grafting materials, and placing a resorbable membrane over the window and graft material.^{7,8} In many cases, the window of bone is obliterated with a hand piece or Piezo unit. However, if this window of bone is preserved, it can be transplanted to an adjacent site as an autogenous block graft. Autogenous block grafts have a long history of success, but also have increased morbidity, due to the invasive nature of harvesting bone from a separate intraoral site.⁹⁻¹¹

This case report presents the application of the maxillary sinus bony window as an autogenous block graft for horizontal bone augmentation. This technique preserves the advantages of using autogenous bone grafts, while avoiding a second surgical site.

Materials and Methods

A 72-year-old Caucasian male presented with the chief complaint of replacing missing teeth on the upper left side. His medical history included rheumatic arthritis, hypertension, and high cholesterol. His medications included metoprolol and atorvastatin. The patient had been edentulous on the maxillary left side, missing teeth #11-15, for more than 10 years. Tooth #10 was deemed hopeless due to extensive secondary caries and was thus planned for extraction. He expressed desire for a fixed restorative option to replace teeth #10-#14. A clinical exam

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revealed the edentulous ridge distally to #10 was insufficient for dental implant placement. The dimensions of the future implant site were deficient both vertically, due to a pneumatized left maxillary sinus, and horizontally (Fig. 1). The treatment plan included extraction and ridge preservation of #10, lateral sinus floor elevation of the left maxillary sinus, and ridge augmentation at sites #11-14. The patient would be allowed to heal for six months. After sufficient healing, the site would be re-entered for implant placement. The restorative treatment plan included three implants placed at sites #11, 13, and 14. A 5-unit fixed prostheses would be fabricated with implant crowns on #11, 13 and 14, a cantilever crown at #10, and a pontic for #12. Informed consent for the treatment was obtained verbally and in writing from the patient after being fully informed about the procedure.

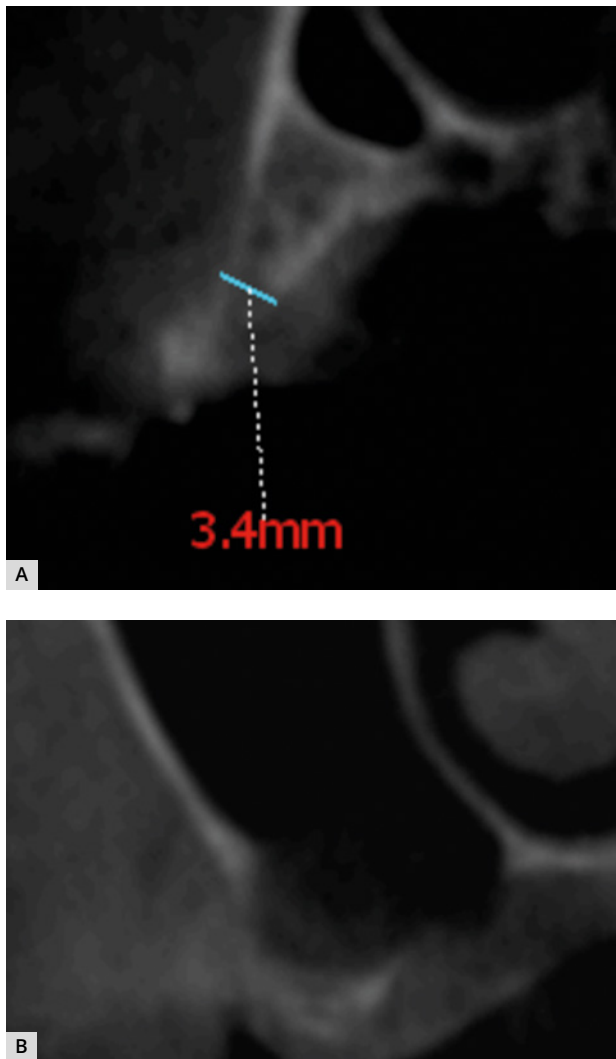


Figure 1. Preoperative CBCT images: A) Preoperative CBCT showing sagittal view of the narrow ridge at #11 site; B) Preoperative CBCT showing sagittal view of sinus wall thickness over #12-#14 sites.

The treatment was performed under intravenous moderate sedation and local anesthesia. A palatally displaced crestal incision was made at sites #11-15, with intrasulcular incisions and vertical releasing incision at the mesial facial line angle of tooth #10. A full thickness flap was reflected (Fig. 2C). Tooth #10 was extracted with elevators and forceps, as atraumatically as possible. A window into the sinus, approximately 15 x 10 mm was created using a surgical handpiece with round diamond surgical burs and sterile water irrigation. The window of bone, approximately 2 mm in thickness, was removed as a block graft and fixated to the buccal of #11-12 edentulous ridge with a 6-mm bone screw (TruFix, ACE Southern) (Fig. 2D). The Schneiderian membrane was lifted without any perforations. Particulate allograft (Cortical Cancellous Allograft, 250-1000 microns, Straumann®) was packed into the sinus, around the block graft, and into the #10 extraction site (Fig. 2E). A resorbable collagen membrane (Flex Collagen Membrane, Straumann®) was placed over the bone graft and sinus window. The flap was released by periosteal stretching technique¹² and passive, primary closure was achieved with 5-0 chromic gut sutures (Ethicon) (Fig. 2F, 2G). Postoperative instructions were given to the patient. He was prescribed Amoxicillin 500 mg TID for 7 days and Ibuprofen 600 mg every 4–6 hours.

The patient was seen at 14 days for a postoperative evaluation and suture removal. He was seen again at three and six months postoperatively. Six months after surgery, a CBCT was taken to evaluate healing and assess the bone volume for implant placement. The CBCT revealed an integrated bone graft and an increase in width of the edentulous ridge (Fig. 3).

The implant placement surgery was performed under intravenous moderate sedation and local anesthesia. A midcrestal incision was made over #10 - #14 edentulous ridge. A full thickness flap was reflected (Fig. 4A and 4B). The fixation screw was removed without complication. Bone level tapered implants (SLActive BLT Implant, Straumann®) were placed at sites #11 (3.3x12 mm), #13 (4.1x10 mm) and #14 (4.1x10 mm) according to manufacturer's guidelines. All three implants had adequate primary stability (> 35 ncm) (Fig. 5). Healing abutments were placed (Fig. 4C and 4D). The flaps were sutured around the healing abutments with 5-0 chromic gut sutures (Ethicon). Postoperative instructions were given to the patient. He was prescribed Amoxicillin 500 mg TID for seven days and Ibuprofen 600 mg every 4–6 hours. The patient was seen after fourteen days for a postoperative evaluation and removal of any remaining sutures. Three months after the implant placement surgery, all three implants were restored with a screw-retained final restoration.

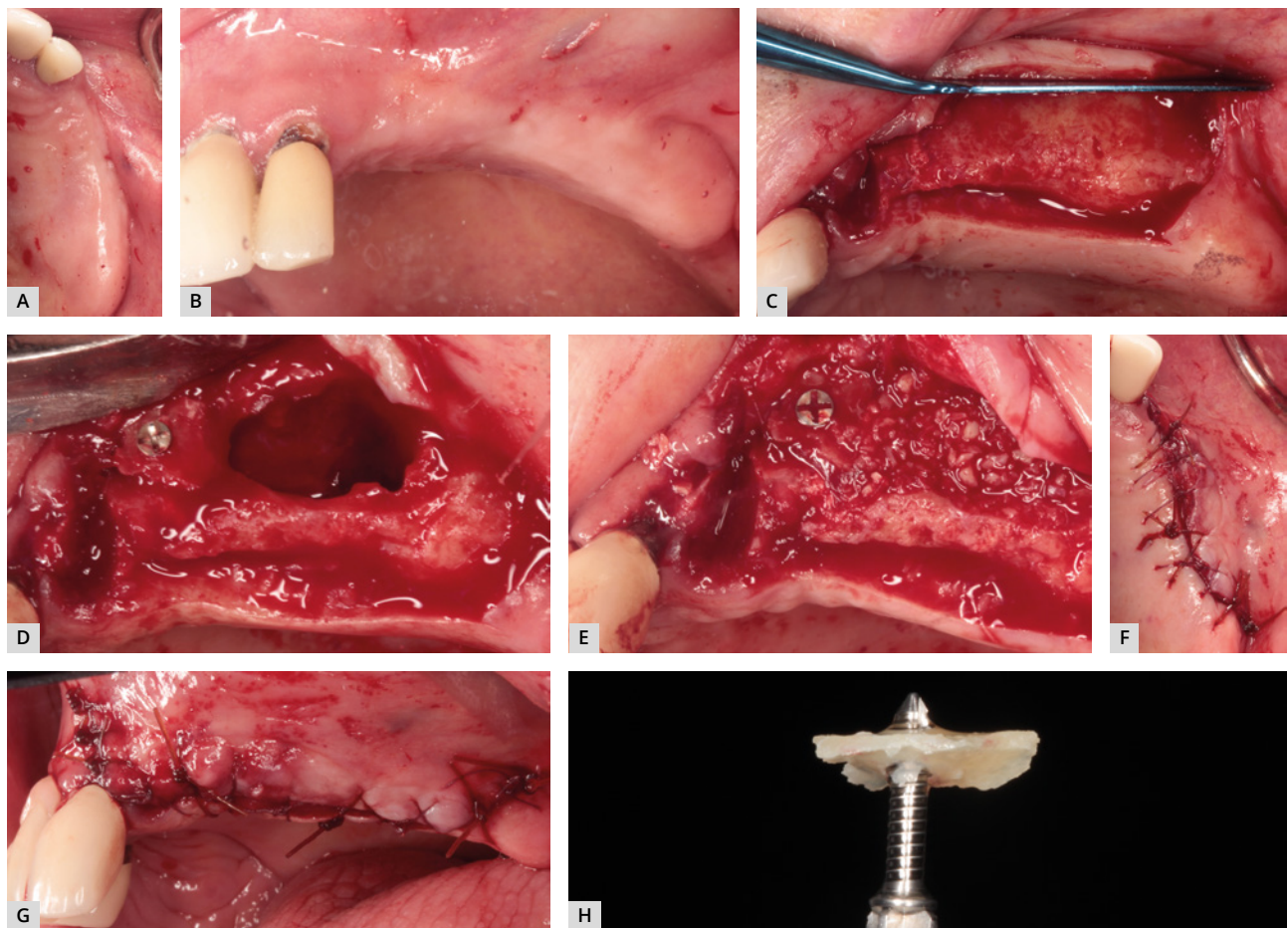


Figure 2. Clinical photographs of the ridge augmentation and sinus floor elevation surgery. A) Preoperative edentulous ridge occlusal view. B) Preoperative edentulous ridge buccal view. C) Flap reflection. D) Lateral window completed, and bony window fixated to #11 site. E) Bone graft packed into sinus and around block graft. F) Occlusal view of primary closure obtained. G) Buccal view of immediate postoperative. H) Lateral wall of sinus and bone fixation screw.

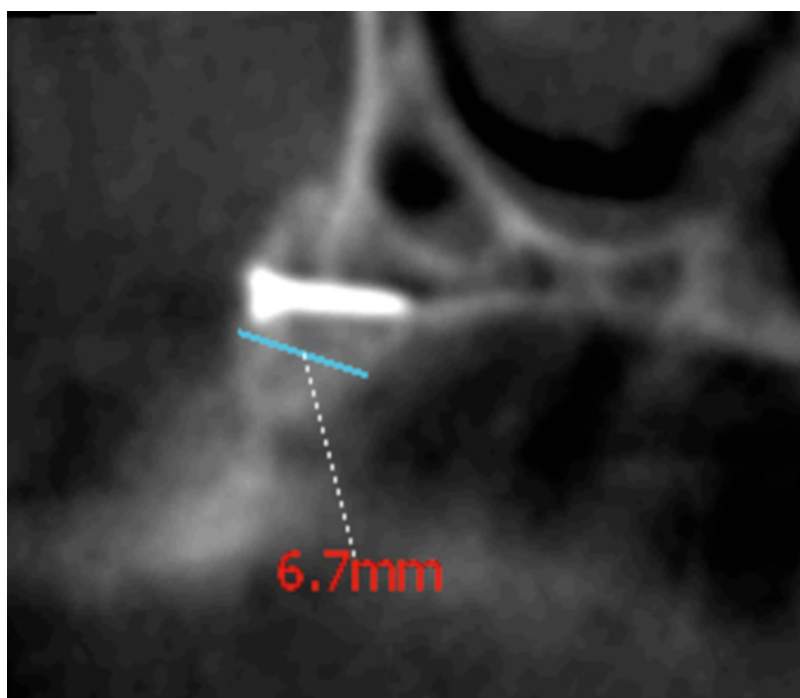


Figure 3. Postoperative CBCT showing axial view of the ridge at #11 site, with the integrated block graft and increased ridge width.

Results

The block graft and lateral window sinus lift healed uneventfully and without complication. The CBCT at six months postoperative showed adequate bone width and height for implant placement in the ideal prosthetic positions. The final width of the ridge at #11 location was approximately 7 mm, a 4-mm increase from approximate initial width (Fig. 4). At one year postoperative, all three implants were free of inflammation and bleeding on probing. All three implants exhibited no bone loss past initial crestal remodeling (Fig. 6).

Discussion

In edentulous maxillary posterior regions, it is often necessary to perform a lateral window sinus floor elevation in conjunction with horizontal bone augmentation, to gain sufficient height and width for implant placement. Several studies have evaluated the peri-implant thickness of bone necessary for long term implant stability.¹³ The current evidence supports at least 2 mm peri-implant bone, especially on the buccal surface, is needed for long-term stability of peri-implant hard and soft tissues.¹³ Additionally, short implants have been

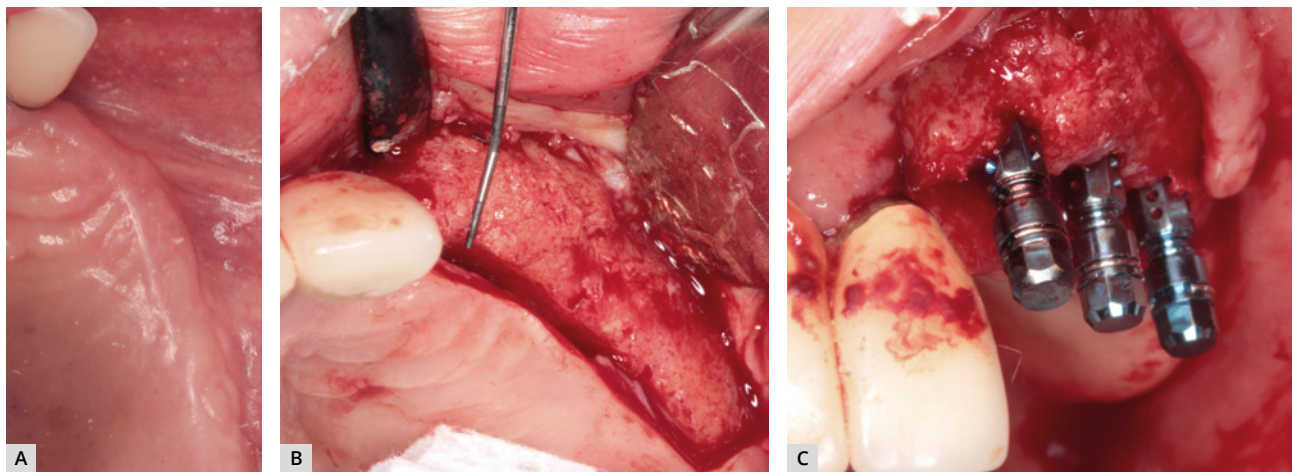


Figure 4. Clinical photographs of implant surgery performed six months after ridge augmentation and sinus floor elevation. A) Edentulous ridge six months postoperatively. B) Ridge width dimension at #11 site after six months of healing. C) Implant placement into grafted sites #11, #13 and #14.

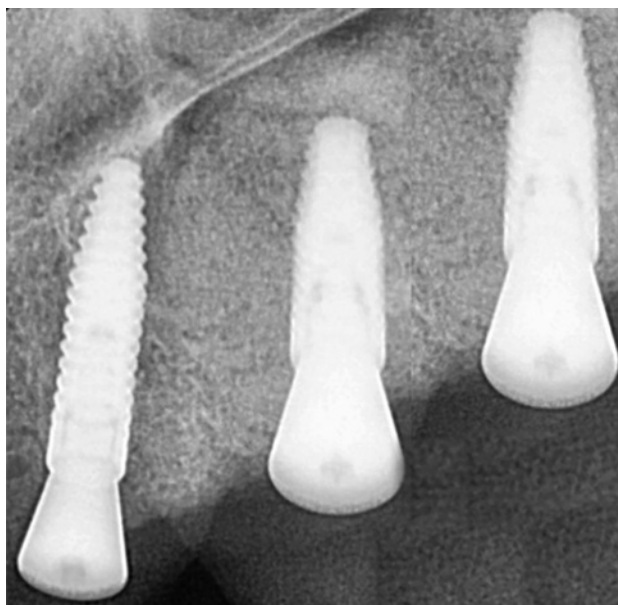


Figure 5. Immediate postoperative periapical radiograph of implant placement.

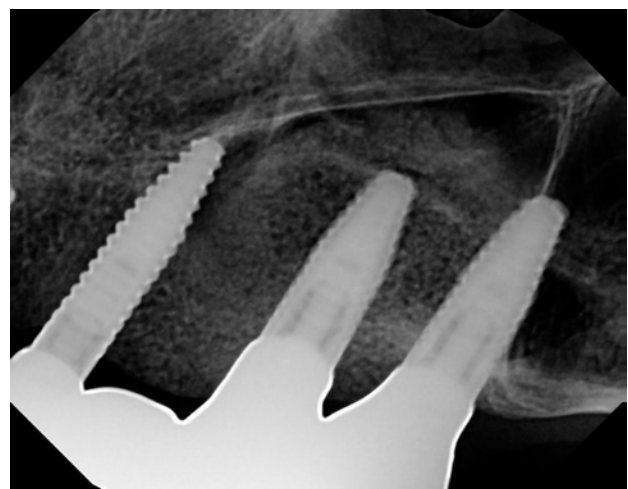


Figure 6. One-year postoperative periapical radiographs of the three implants.

investigated as potential means to reduce invasive procedures, such as sinus lifts and bone augmentation.¹⁴ The ITI consensus report concluded that while short implants (≤ 6 mm) may be suitable for patients not optimized to undergo certain surgical procedures, they had greater variability and less predictability in survival rates.¹⁴ This evidence supports the need for innovation in the procedures currently utilized to increase bone volume to adequate dimensions for implant placement.

Autogenous bone is considered the gold standard bone grafting material. Block grafts have been shown to provide an additional 1 mm over bone augmentation methods using particulate graft only¹⁵. These types of grafts are often avoided primarily due to the need for an additional surgical site, pain and/or delayed healing at the donor site, as well as increased patient morbidity.^{15,16} Using the window of the sinus as the block graft in this case provided the benefits of an autogenous block graft, such as increased vital bone and bone width gain.^{15,16} It also eliminates the traditional disadvantages of harvesting an autogenous block graft.^{15,16} Typically, a mandibular ramus block graft provides 2.5 mm - 3 mm of thickness.¹⁷ While specific guidelines for the minimum thickness required for its use as a block graft are not well-defined in the literature, successful applications of block grafts with a thickness of 1–2 mm to create a cortical shell have been well documented.¹⁸ The average width of the lateral wall of the maxillary sinus ranges from < 1 mm up to > 2 mm, depending on the study and the condition of the edentulous ridge.^{19,20} By selecting patients with a lateral wall of approximately 2 mm or more for the procedure, this block graft can produce a significant augmentation in width for many horizontal defects.

Previous case reports using the lateral window of the maxillary sinus as a block graft are scarce. In studies by Park et al.^{21,22}, the feasibility of utilizing the bony window for wide post-extraction defects was evaluated, focusing on clinical applications for defecting repair at the time of extraction. In the first study, a block graft from the sinus wall was used as an autogenous socket graft, without fixation to stabilize the block.²¹ Sinus augmentation was completed independently, using a synthetic osteoconductive bone graft.²¹ This approach differs from the present case, in which the use of allograft bone material aimed to enhance bone quality for future implant placement.²³ Moreover, guided bone augmentation in healed sites, such as in this case, poses greater challenges in achieving favorable outcomes, compared to socket grafting.²⁴ Park's studies also demonstrated, through 1- to 7-year follow-up, that utilizing the sinus bony window as a block graft for post-extraction sockets can successfully address localized vertical deficiencies.^{21,22} In another case report, the lateral wall of the

sinus was utilized as a block graft for horizontal augmentation, at the same site as the lateral window sinus lift was being completed for vertical augmentation.²⁵ This report is similar to the present case, in which fixation screws were used to stabilize the graft, and the lateral window was deployed as a block graft in the same quadrant as the sinus augmentation.²⁵ This study differs from the present in that it specifically addressed pathology of the maxillary sinus, and xenograft bone material was used.²⁵ Additionally, the site of the block graft was not an adjacent site, but the same site as the sinus lift for future implant placement.²⁵ These studies underscore the versatility of the sinus bony window, while addressing different clinical scenarios and techniques in terms of site selection and the type of bone graft material used.^{21,22,25} Incorporating allograft in both the sinus augmentation and block graft procedure is a significant difference, compared to the previously discussed studies. While xenograft and synthetic bone substitutes are considered viable alternatives for sinus augmentation, utilizing allograft materials can enhance outcomes by improving bone quality.^{23,26-28}

In this case, by preserving the lateral wall of the sinus, the patient benefited from the osteogenic, osteoinductive, and osteoconductive properties of the autogenous bone graft at site #11, without the need for a second donor site for harvesting.²⁹ A comparison of the healing patterns between site #10, grafted with only allograft bone material and a resorbable collagen membrane, and the #11 site, in which the block graft was used, shows a more favorable buccolingual width increase at the #11 site.

The imperative characteristics in case selection are: the need for horizontal augmentation at a site adjacent to a pneumatized sinus, and adequate thickness of sinus wall (≥ 2 mm). The success of this procedure depends on several factors, such as: firm fixation with one or more bone screws, the addition of a resorbable membrane over the block graft and sinus window, as well as achieving passive primary closure of the flaps.

Conclusion

This case report presented a unique and innovative technique for the treatment of an atrophied posterior maxillary ridge with a severely pneumatized sinus. The lateral wall of the maxillary sinus can be successfully used as an autogenous block graft, combined with bone allograft material, to perform horizontal ridge augmentation. This technique is particularly advantageous as a cost-effective and less invasive block grafting approach. By avoiding the need for a second surgical site for graft harvesting, patient morbidity is reduced, while still achieving predictable outcomes.

AUTHORS' CONTRIBUTIONS: ORCID**Pooria Fallah-Abed (PFA): 0009-0002-9859-9623****Stephanie C. Bowers (SCB): 0009-0004-7692-5250****Sajjad Ashnagar (SA): 0000-0003-3078-8540****Sayed H. Bassir (SHB): 0000-0001-8794-0895****Conception or design of the study:****PFA, SCB****Data acquisition, analysis or interpretation:****PFA, SCB, SA, SHB****Writing the article:****PFA, SCB, SA, SHB****Critical revision of the article:****PFA, SCB, SA, SHB****Final approval of the article:****PFA, SCB, SA, SHB****Overall responsibility:****PFA, SCB, SA, SHB****References**

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