Utilizing the Lateral Wall of the Maxillary Sinus as a Donor Site for Autogenous Block Grafts:

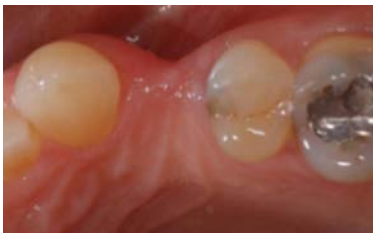
A CASE SERIES

ABSTRACT

Autogenous corticocancellous bone grafts are the gold standard for the reconstruction of alveolar bone whether it is for a sinus or ridge augmentation. This report describes the use of the anterior border of the sinus wall as a donor site for block grafting of a deficient lateral ridge in an adjacent surgical area. This procedure can be done alone or in combination with a sinus augmentation procedure.

LEARNING OBJECTIVES

- Understand the use of the maxillary sinus as a graft donor site
- Improve readers' comprehension of autogenous graft procedures
- Discuss benefits of graft donor site in proximity to recipient site



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A common challenge for predictable dental implant placement in the posterior maxilla is the presence of large pneumatized maxillary sinuses, which results in insufficient bone height.[1] The lateral window sinus augmentation technique is a predictable procedure aimed at increasing vertical bone volume to enable implant placement.[2,3] Similarly, in deficient alveolar ridges, bone grafts are necessary to reconstruct alveolar bone width and/or height to augment the ridge prior to dental implant placement. A number of allogeneic and alloplastic materials have been used by dental practitioners for both of these purposes, but autogenous corticocancellous bone grafts have remained the gold standard for the reconstruction of alveolar bone whether it be for a sinus or ridge augmentation.[4]

TABLE

Patient	Age	Sex	Sites	Simultaneous Sinus Augmentation	Particulate Graft Used	Complications
1	62	F	#13	Yes	FDBA Resorbable Collagen Membrane	No
2	55	F	#12	No	FDBA Resorbable Collagen Membrane	No
3	68	F	#13	Yes	FDBA Resorbable Collagen Membrane	No
			#5	Yes	FDBA Resorbable Collagen Membrane	No
4	66	F	#13	No	FDBA Resorbable Collagen Membrane	No

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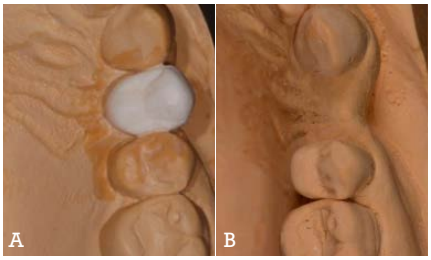

Figure 1: Preoperative occlusal view of edentulous #12 site with (A) and without (B) diagnostic waxup in place.

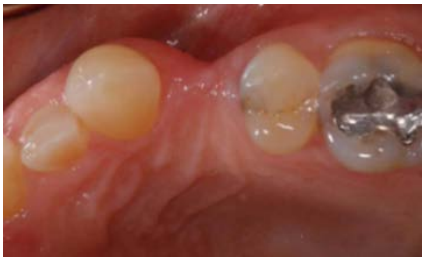

Figure 2: Preoperative occlusal view demonstrating buccal concavity.

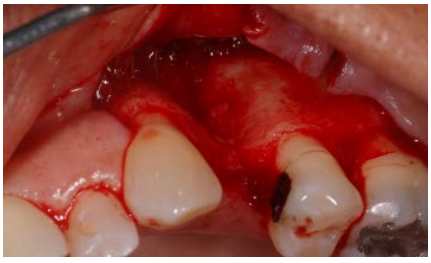

Figure 3: Recipient site following reflection of full-thickness flap.

A current trend in augmentation procedures for dental implant surgery is the use of less invasive or alternative techniques. An in-office bone harvesting procedure performed under local anesthesia decreases the cost of the treatment by eliminating the need for more expensive inpatient hospital care.[4] Recently, harvesting the lateral sinus wall during sinus grafting has been introduced as a source of an intraoral bone graft for the reconstruction of maxillomandibular ridge defects. The accessibility of the lateral sinus wall bone via an intraoral approach makes it an excellent candidate for bone graft harvesting to reduce complications and postoperative morbidity.[4,5]

MATERIALS AND METHODS

Clinical data in this study were obtained from the Implant Database (ID). This data set was extracted as de-identified information from the routine treatment of patients at the Ashman Department of Periodontology and Implant Dentistry at New York University College of Dentistry. The ID was certified by the Office of Quality Assurance at NYUCD. This study was performed in compliance with Health Insurance Portability and Accountability Act (HIPAA) requirements.

STUDY SUBJECTS

Five partially edentulous sites in patients with posterior maxillary atrophy, each of whom underwent single implant placement using the lateral wall of maxillary sinus as a donor site for ridge augmentation procedure from 2009 - 2012, were selected from the ID and included in the study. The study consisted of 4 female patients with a mean age of 63 years ranging from 55 to 68 years old (Table).

All subjects had final implant restorations in function for a minimum of 6 months. Each subject selected conformed to the following criteria prior to undergoing the procedure:

Inclusion Criteria

1. A posterior maxillary partially edentulous area with limited horizontal bone width (i.e., 2mm to 4mm) that required single implant placement.
2. A healed ridge at least 3 months following tooth extraction.

Exclusion Criteria

1. Presence of uncontrolled diabetes, immunological diseases, or other systemic conditions that contraindicated surgery.
2. Periodontal diseases, or an unwillingness to undergo needed periodontal therapy, around the subject's remaining teeth.
3. Active sinus infection, or a history of persistent sinus infections.
4. Cigarette smoking habit of one pack or more per day and unwillingness to enter a smoking cessation protocol.
5. Psychological problems, which, in the opinion of the surgeons, would have, render the delivery of comprehensive therapy untenable. Such concerns ranged from severe manic depression for which a patient was under professional care, to extreme nervousness or agitation, which precluded the patient from undergoing numerous, lengthy treatment visits.
6. Unwillingness to commit to a long-term, post-therapy maintenance program.

Prior to surgery, a complete examination of oral hard and soft tissues was conducted on each patient, and a dental treatment plan was formulated in conjunction with the treating restorative dentist. Reformatted computed tomography (CT) scans were taken of the 4 patients. Diagnostic casts, waxups, and surgical templates were also utilized (Figures 1 and 2).

A 3D printed model was fabricated according to dicom data, and the lateral window sinus donor site, was designed based on the 3D model. The minimum window size was 5mm x 10mm. Following the bone augmentation procedure, single implants were placed following either one stage or two stage protocols.

The time between implant placement and restoration ranged from 4 to 5 months. All implants were restored as single tooth restorations. Patients were recalled every 3 months for supportive care and evaluation.

Implant Survival Criteria

The criteria for implant survival required that the implant be in function for at least 6 months. In addition, the implant had to meet the following conditions (modifications of Albrektsson success criteria,[6] to be considered a success:

1. The individual, unattached implant must be immobile when tested clinically.
2. Periapical radiographs must demonstrate no evidence of peri-implant radiolucency.
3. The implant had to be characterized by an absence of persistent and/or irreversible signs such as pain, infection, neuropathy, or paresthesia/anesthesia.

CLINICAL PROCEDURE

A standardized protocol was followed for each of the patients:

1. The patients were prescribed 2g of Amoxicillin 1 hour prior to surgery or, if allergic, 600mg of clindamycin.
2. Local infiltration anesthesia of lidocaine 2% containing epinephrine at a concentration of 1:100,000 was used, or carbocaine 3% was administered in cases where a vasoconstrictor was contraindicated.
3. A midcrestal incision between the two adjacent teeth was performed and followed by two vertical releasing incisions from both the mesial and distal aspects of the adjacent teeth to the mucogingival junction. A full-thickness mucoperiosteal flap was reflected, exposing the lateral sinus wall (Figure 3).
4. A small, round-shaped osteotomy (2mm-3mm in diameter) was prepared in the lateral wall of the sinus, using a high-speed round #6 diamond bur with copious irrigation (Figure 4), and followed by the use of a piezosurgical tip to harvest a 5mm x 10mm block graft. This window was created above the apex of the-planned implant. The window site and position was decided by the 3D printed model, and the integrity of the Schneiderian membrane was assessed visually.
5. The lateral wall of the maxillary sinus was completely separated from the underlying membrane (Figures 5). The recipient site was then decorticalized, and the graft was placed and stabilized with a fixing screw (Figure 6).
6. A conventional maxillary sinus augmentation procedure was subsequently completed in patients where gain in alveolar bone height was also required. The sinus membrane was fully elevated mesiodistally and medially over the future drilling site using a sinus membrane elevator (SSC1-3, EBI Inc, Kyungsan, South Korea) inserted through the access slot on the lateral wall. Particulate bovine bone graft materials (Bio-Oss, Osteohealth, Shirley, NY)were packed and condensed from the lateral wall.
7. At the recipient site, particulate bovine bone graft materials (Bio-Oss, Osteohealth, Shirley, NY) were used to fill the voids between the block graft and the recipient bed. A resorbable membrane was used to cover the grafted site Bio-Gide, Osteohealth, Shirley, NY).
8. Interrupted resorbable sutures were placed using 4.0 Vicryl (Ethicon, Inc. Somerville, NJ, USA) for mid-crestal closure, and 5.0 Chromic Gut for closure of the vertical incisions.
9. Postoperative medications, consisting of amoxicillin 500 mg or Clindamycin 150 mg, were prescribed for 7 days (TID). Chlorohexidine 0.2% was prescribed starting 24 hours after surgery and was used twice a day for 2 weeks. Analgesics as needed for pain were prescribed (Ibuprofen 600mg q 4h-6h.). Postoperative care instructions, including a soft diet and oral hygiene procedures, were also given to the patient.

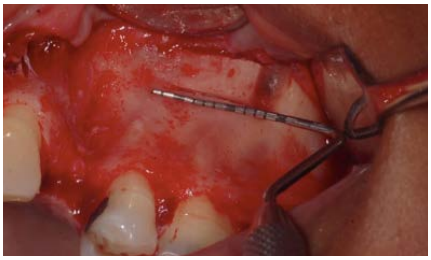

Figure 4: Minimum window created for accessing sinus membrane and measurement of the planned block.

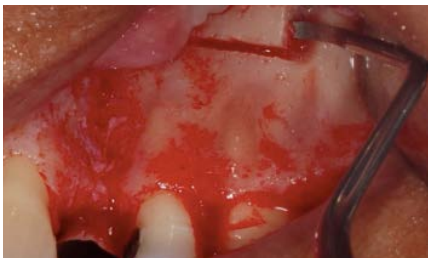

Figure 5: The membrane was separated before the block graft was harvested.

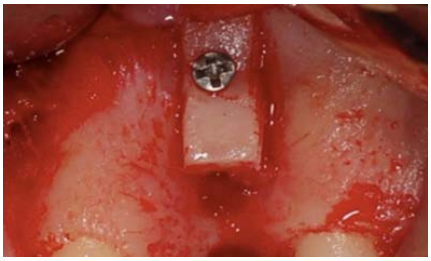

Figure 6: The block was stabilized by a titanium fixation screw.

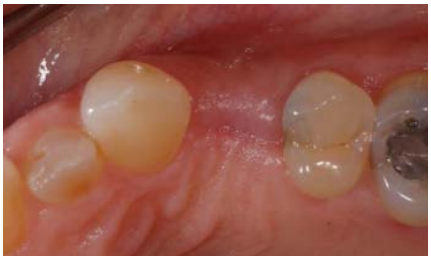

Figure 7: Occlusal view of the grafted maxillary site at 5 months postoperatively.

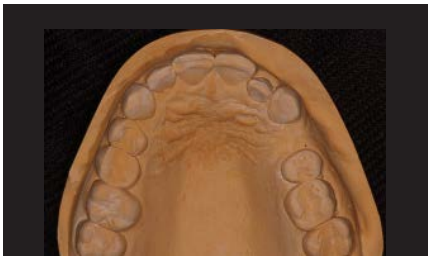

Figure 8: Occlusal view of cast at 5 months postoperatively.

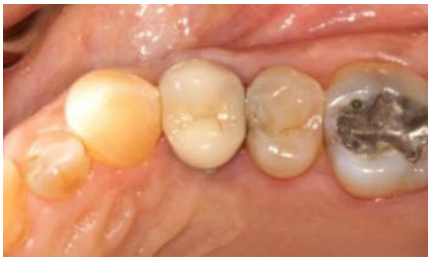

Figure 9: Occlusal view of the definitive restoration in situ.

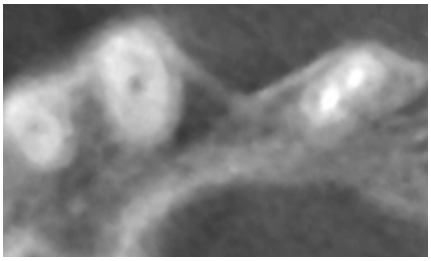

Figure 10: Preoperative CT scan for assessment of alveolar bone deficiency.

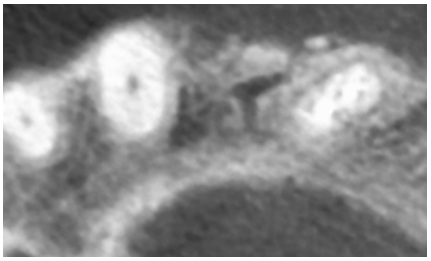

Figure 11: Postoperative CT scan demonstrating gain in alveolar bone width.

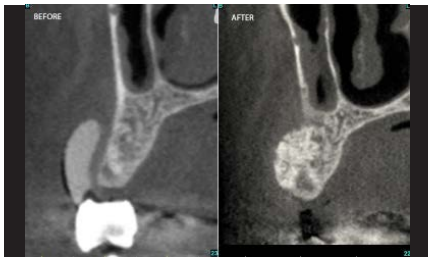

Figure 12: Pre- and postoperative CT scans demonstrating status of the treatment site.

10. Follow up examinations, inclusive of periapical radiographs, were performed 7 to 14 days postoperatively, and subsequently at 5 months postsurgery (Figures 7 and 8).
11. Implant placement was performed 4 to 5 months following the bone graft procedures. Depth drilling was performed in a serial sequence under irrigation to the final implant diameter drill. A cover screw or a healing abutment was inserted following the implant placement. Postoperative medications were prescribed and the patient was scheduled for implant restoration.
12. Osseointegration was assessed radiographically and clinically 2 to 3 months after implant insertion. Osseointegration was confirmed by the absence of radiolucency and mobility and the final restorations were constructed and placed (Figure 9).
13. The patients were recalled at 3, 6, 12, 18, and 24 months following final restoration placement for clinical and radiographic follow-up examination.

All patients were monitored with routine follow up for all surgical and restorative implant procedures. Radiographic parameters measured included preoperative crestal bone height, postoperative augmented bone height, and crestal bone loss around the implant from time of implant placement, to the final follow-up visit, and measurements were then compared.

RESULTS

Five single implants were placed in 4 patients in a delayed placement protocol using the lateral wall of maxillary sinus as a donor site. All 5 implants were successful at the 6- to 24-month interval following insertion of the definitive implant-supported restoration.

The mean bone gain in width was 3.6mm (range of 3mm-4mm) (Figures 10 through 12). Buccal bone loss around the implants from the time of placement to the final follow up averaged 0.5mm (range from 0.3mm-0.8mm).

DISCUSSION

This technique was designed to harvest autogenous bone from the lateral wall of maxillary sinus to augment small- to medium-sized alveolar defects in the maxilla premolar area.[4] A CT scan is necessary to evaluate the condition and anatomy of the sinus, the thickness of the lateral wall, the location of the maxillary artery and the size of alveolar defect (Figure 11).[7] This technique can be used for bone harvest alone or in combination with a sinus augmentation procedure.

The main advantage of harvesting bone from the lateral wall of maxillary sinus at the premolar site is the elimination of secondary surgery at distant intraoral donor sites, such as the ramus or the chin. This approach allows for one single surgical site as the donor area is in close proximity to the recipient site. All five implants were clinically successful during the 6- to 24-month follow-up period.

Harvesting autologous grafts from the ramus has the disadvantage of potential fracture.[8,9] Postoperative trismus has also been reported in high frequency.[8]

Grafts from the chin area carries the risks of postoperative hypesthesia or paresthesia in the mental region.[10] Altered sensation in the mandibular incisors has been reported by 29% of the patients who underwent the procedure[10] and some teeth have been shown to require root canal treatment after the procedure.[11]

Furthermore, additional surgical site requires longer procedure time and increases postoperative morbidity for the patient. The general disadvantage of all intraoral donor sites is the limited quantity of available bone.[8] However, the thickness of the lateral wall of the maxillary sinus bone is usually sufficient to permit autogenous block grafting and subsequent single implant placement into the edentulous maxillary premolar area.

Autologous bone graft has the potential disadvantage of resorption. Grafts from the ramus provide mainly cortical blocks whereas grafts from the chin area have a more corticocancellous consistency.[8] Harvesting bone with similar characteristics to the recipient site may have less bone resorption, however further study is necessary to evaluate the long term outcome of the described technique.

CONCLUSION

Lateral wall of the maxillary sinus region can be used predictably as a donor site to augment deficient alveolar ridge in an adjacent surgical area. The technique can be used alone or in conjunction with sinus membrane elevation for the augmentation of an edentulous maxillary premolar region.

References

1. Esposito M, Piattelli M, Pistilli R, et al. Sinus lift with guided bone regeneration or anorganic bovine bone: 1-year post-loading results of a pilot randomised clinical trial. Eur J Oral Implantol. 2010;3(4):297-305.
2. Aghaloo T, Moy PK. Which hard tissue augmentation techniques are the most successful in furnishing bony support for implant placement? Int J Oral Maxillofac Implants 2007;22(Suppl):49-70.
3. Wallace SS, Froum SJ, Effects of maxillary sinus augmentation on the survival of endosseous dental implants. Asystemic review. Ann Periodontol 2003;8:328-343.
4. Kainulainen VT, Sàndor GKB, Clokie CML, et al. The zygomatic bone as a potential donor site for alveolar reconstruction—A quantitative anatomic cadaver study. Int J Oral Maxillofac Surg 2004;33:786-791.
5. Sy F, Almutairi S, Fallah-Abed P, et al. Anterior wall of sinus as monocortical block graft donor site for horizontal ridge augmentation – A case series. 100th Annual Meeting American Academy of Periodontology September 19-22, 2014.
6. Albrektsson T, Zarb G, Worthington P, Eriksson A. The long-term efficacy of currently used dental implants: a review and proposed criteria of success. Int J Oral Maxillofac Implants 1986; 1: 11–25.
7. Elian N, Wallace S, Cho SC, et al. Distribution of the maxillary artery as it relates to sinus floor augmentation. Int J Oral Maxillofac Implant 2005;20(5):784-787.
8. Pikos MA. Mandibular block autografts for alveolar ridge augmentation. Atlas Oral Maxillofacial Surg Clin N Am 2005; 13:91-107
9. Stübinger S, Robertson A, Zimmerer KS, et al. Piezoelectric harvesting of an autogenous bone graft from the zygomaticomaxillary region: Case report. Int J Periodont Restorative Dept 2006;26(5):453-457.
10. Misch CM. Comparison of intraoral donor sites for onlay grafting prior to implant placement. Int J Oral Maxillofac Implants 1997;12:767–776.
11. Cordaro L, Torsello F, Miuccio MT, di Torresanto VM, Eliopoulos D. Mandibular bone harvesting for alveolar reconstruction and implant placement: subjective and objective cross-sectional evaluation of donor and recipient site up to 4 years. Clin Oral Implants Res 2011;22:1320–1326.