# New Perspectives in the Treatment of the Severe Atrophic Posterior Maxilla: Interpositional Sandwich Osteotomy Combined with Sinus Floor Grafting Using Alpha-Bio Tec's NeO Implants

**Dr. Fahim Atamni**
DMD, PhD, Specialist in Oral surgery Germany, Israel

Dr. Fahim Atamni completed his dental degree in the Johann Wolfgang Goethe University, Frankfurt am main, Germany in 1984 and received his PhD in dental medicine in 1987. From 1985- 1989, he specialized in Oral Surgery at the Department of Oral and Maxillo-Facial Surgery (Prof. Dr. Dr. Frenkel, Prof. Dr. Dr. Bitter), Johann Wolfgang Goethe University and received his specialization certificate in Oral Surgery from the State Medical Board of Hessen, Germany. Earlier in his career he was a clinical instructor and lecturer for undergraduate and postgraduate dental students, Department of Oral and Maxillo-Facial Surgery at Johann Wolfgang Goethe University. Since 2004, postdoctoral education in Oral Surgery- Habilitation, Department of Oral and Maxillo-Facial Surgery and Oral Implantology, Prof. Dr.Dr. Topalo, USMF "N. Testemitanu" in Chisinau, Moldova.
He manages a private dental clinic in Tel-Aviv, Israel. Dr. Atamni is an author and co-author of over 40 scientific publications in the field of Maxillary Sinus Floor Augmentation and alternative methods and the author of the book "Lateral Wall Sinus Floor Augmentation – State of the Art".
He is an active member in number of leading organizations in the field of implantology.

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## Abstract

Dental implant rehabilitation in the posterior maxilla fundamentally depends on an adequate quantity of bone. Tooth loss in the posterior maxilla is naturally followed by extensive loss of the alveolar ridge and increased maxillary sinus pneumatization that often makes implantation unfeasible.

Traditionally, maxillary sinus floor augmentation is the common surgical technique used to overcome this situation. When the deficiency in the vertical dimension relates more to severe ridge resorption, crestal ridge augmentation should also be considered. Posterior maxillary sandwich osteotomy combined with sinus grafting, using interpositiona bone graft can also address this problem. This case study describes a successful application of this technique in a 55 year old male, who previously underwent failed implant surgery of the left posterior maxilla, which led to a severe vertical ridge defect.

Alpha-Bio Tec's NeO implants, with adequate length and diameter were inserted in two-stage lateral wall sinus floor augmentation, combined with interpositional sandwich osteotomy. Deproteinized natural bovine bone mineral (DBBM) and resorbable collagen membrane (Alpha-Bio's GRAFT) were also used. Prosthetic restoration was performed using solid abutments following a standard prosthetic protocol. This case report provides insight into an innovative technique for overcoming the combined bone deficiency resulting from intrasinusal and alveolar bon resorption. Additionally, the NeO implant system was employed. This system with its unique features, optimizes implant stability, maximizes tissue integration and improves long-term implant survival.


## Background

Continuous alveolar ridge resorption in the vertical dimension of the posterior maxilla accompanied with prominent sinus cavities, make implant placement difficult and prosthetic rehabilitation compromised or impossible. Rehabilitation of the severe atrophic posterior ridge can be resolved in different ways.

The most common surgical technique used to overcome this situation is maxillary sinus floor augmentation which is considered a reliable treatment procedure to regain bone volume deficiency. When the deficiency in the vertical dimension relates more to severe alveolar crest resorption due to previous pathologies or surgeries, vertical ridge augmentation in conjunction with sinus floor grafting should be considered to achieve both an aesthetic and functional rehabilitation [1-3].

Different surgical techniques are currently utilized to augment the alveolar ridge deficiency in the posterior maxilla which is related to alveolar crest resorption. The numerous surgical approaches consist of proposed guided bone regeneration (GBR), alveolar distraction osteogenesis (ADO), titanium mesh and autogenous bone graft (AB), and onlay bone graft [4-7].

Guided bone regeneration was introduced in 1991 by Dahlin and colleagues [6]. The use of an expanded polytetrafluoroethylene membrane is a treatment option that has been used with varying degrees of success [8, 9]. This technique has been considered to be a highly sensitive one. Distraction osteogenesis maintains the majority of the vascularity to the bone segment. The drawbacks of this technique are patient cooperation, high sensitivity and a second surgery to remove the device [10]. Titanium mesh and autogenous bone graft have been successfully used and have shown promising results since its introduction [7].

Onlay grafts have been well documented, but the results has not been promising. Bone resorption of up to 50% has been reported even when autogenous bone from different sites (symphysis menti, ramus mandible, calvaria, iliac crest) were used [5]. Vertical onlay grafting can also be complicated by graft exposure and infection [11,12].

Another possible approach is an interpositional bone graft [13,14]. The rationale of this technique is based on the theory that graft material placed between two pedicled bone segments, will undergo complete healing and graft consolidation with less resorption. This technique enables the positioning of the graft in a well-delimited area, offering the advantage of ensuring greater vascular supply to the inlay graft to maintain new bone formation. This is important since vascularity seems to be the main factor in determining whether the graft can be maintained in situ. This technique allows the simultaneous correction of both the vertical and the sagittal dimensions, if required, improving the intermaxillary relationship.

This procedure is also indicated for esthetic reasons, particularly for patients with broad smiles that extend to the first molar region. In addition, this procedure can avoid a ridge-lapped restoration due to mislocated implants which may create the need for long clinical crowns or bad conditions for adequate oral hygiene. Sandwich osteotomy (also known as interpositional sandwich osteotomy or segmental osteotomy) in the posterior maxilla has been scarcely covered in the literature. Conversely, sandwich bone graft in the anterior maxilla and posterior mandible has been well documented [15-17].

Since its description in the 70's, sandwich osteotomy with interpositional bone graft has been found to be reliable in the reconstruction of ridge deficiencies of atrophic mandibles. A visor osteotomy was first described in 1975 by Harle to increase the height of an atrophic posterior mandible to improve denture retention [18]. In 1976, Schettler and Holtermann described a sandwich osteotomy in the anterior mandible [19]. In 1974 Stoelinga et al. successfully combined both the sandwich technique and visor osteotomy technique, to successfully augment severely atrophic edentulous mandibles [20]. In 1977, Peterson and Slade modified Harle's description of the visor osteotomy by raising the pedicled portion along a greater length of the mandible [21]. Many modifications followed, but dental implants were not considered at that time [22-25]. In 1982, Frost et al. described a further modification of Harle's visor osteotomy by incorporating an interpositional onlay graft [26]. In 1987, Mercier et al. reported on various types of visor osteotomies, evaluating the long term rate and patterns of resorption of the mandible [27]. Due to high complication rates and risks of graft resorption, visor osteotomy became very unpopular and vanished for a long time from the literature.

Recently, sandwich osteotomy has become popular among surgeons due to the low incidence of graft exposure, lack of complications, and graft tissue vascularization. This type of graft has been reported as a viable and predictable procedure with a high success rate [28-30]. The main advantages of this technique are the potential for three-dimensional reconstruction, a more stable alveolar crest with long-term outcomes, and minimal morbidity [31, 32].

By using this technique, it is possible to readjust crestal ridge height defects of up to 8mm thus enabling the precise placement of the implants, and the repositioning of mislocated implants [16, 31, 33-35]. This optimizes the implants' long-term function, esthetics and stability.

Recent literature has shown a preference for using biomaterials as an alternative to autogenous grafts, without negatively affecting the clinical success. This is due to the fact that the technique leads to increased vascularization and predictability [36, 37]. Interpositional grafting in the posterior maxilla in conjunction with sinus floor grafting has very little literature exposure even though it is one of the most successful techniques to obtain alveolar height and width to enable placement of long implants [38-40]. Posterior segmental osteotomy as described by Wunderer and confirmed by Bell, combined with sinus floor grafting appears to be an optimal strategy for implant rehabilitation [41, 42]. To the best of my knowledge, this modified, procedure as described in the case study, has almost never been attempted. The technical aspects of this procedure will be presented here along with a clinical correlation using an innovative implant system.

Piezoelectric bone surgery was used to create the repositioning of the lateral window to the sinus cavity and to perform a complete osteotomy of the mobile segment. Piezosurgery was used since it can maintain the palatal periosteum and preserve the flap [43, 44].

This case study describes a new perspective in the treatment of severe atrophic posterior maxilla, based on the previous sandwich osteotomy techniques, with interpositional bone graft combined with sinus grafting using Alpha Bio Tec's NeO implants.

## Case Overview

A 55-year old male patient came to our clinic with a partially edentulous right posterior maxilla. This condition negatively affected him in terms of his chewing ability and esthetics. The patient reported that he underwent a previous implant surgery in the right posterior maxilla almost 10 years ago, and one year ago, the two inserted implants were removed due to a lack of osseointegration. The patient requested an evaluation for the purpose of rehabilitation with an implant supported prosthesis. The patient was in a good physical health, a nonsmoker with no contributing medical history including maxillary sinus diseases or allergies. The patient was not on any medications.

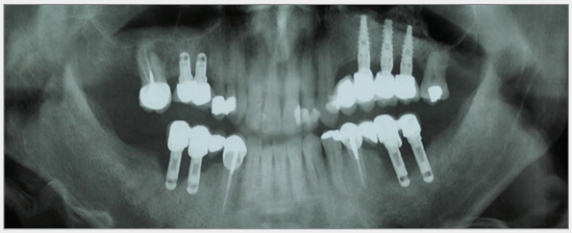
**A clinical history and examination including soft and hard tissue was completed with the following results:**

**Maxilla:** absence of teeth in positions 15 and 16, and severe bone deficiency of the vertical dimension of the alveolar ridge. An implant supported restoration from 24 to 26. Moderate periodontal problems with slight loss of bone support around almost all remaining teeth, pockets of 3-6 mm with bleeding on probing (BOP).

**Mandible:** implant supported restorations bilaterally including teeth 35-37, 45-47. Gingival height defects of the inserted implants 36,37,46,47 exhibiting progressive peri-implantitis and pocket depth of up to 12mm. the implants seemed to be in a hopeless condition.

**Radiographic Examination**

The first panoramic radiograph, taken two years prior to treatment, showed two inserted short implants at regions 15 and 16 with a certain degree of radiolucency around the implants. An apical lesion on the mesial root of the second right molar was seen. The patient also had three inserted implants in an augmented left sinus supporting a four unit fixed prosthesis. Severe angular bone defects of the implants in the mandible was clearly seen **(Fig 1)**.

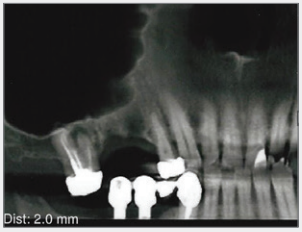


1 Panoramic radiograph demonstrating two inserted short implants in regions 15 and 16 with certain radiolucency around the implants and apical lesion on the mesial root of the second right molar.

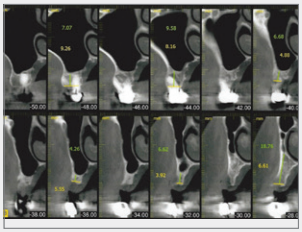
The second panoramic radiograph taken immediately before treatment showed severe alveolar ridge resorption due to previously failed implant surgery and the removal of two implants in the right second premolar and first molar area. An enlarged apical lesion of the mesial root of the right second molar was present. There was also a pneumatized maxillary sinus with limited residual bone height (RBH) that was insufficient for implant placement **(Fig 2)**.

2 Panoramic radiograph demonstrating severe alveolar ridge resorption due to a previous failed implant surgery and the removal of two implants in the right second premolar and first molar area, and an enlarged apical lesion of the mesial root of the right second molar.

CT scanning revealed a bone height deficiency of 6mm in the region of the failed implant surgery i.e. missing teeth related to the bone level of the remaining adjacent teeth. In addition, the CT scan showed a healthy maxillary sinus, no preexisting sinus pathology, a healthy osteomeatal complex, an RBH of 5.0mm and of 5mm width in average, and existing small-sized maxillary septa on the lateral wall. The posterior superior alveolar artery (PSAA) was small. Moderate thickness of the lateral wall and wide latero-medial angle of the sinus were recognizable **(Fig 3, 4)**.




3 Panoramic view of the CT-scan showing pneumatization of maxillary sinus coupled with severe marginal bone loss. An apical lesion of the mesial root of the right second molar is clearly visible.



4 CT-scan showing alveolar bone height of 5 mm in areas requiring augmentation procedure.

## Treatment Plan

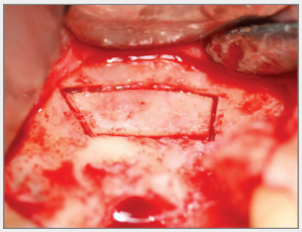
Based on the clinical and radiographic examination and due to the increased alveolar bone defect and lack of bone mass along with the pneumatized right maxillary sinus, the proposed treatment plan involved segmental sandwich osteotomy with the interposition of a DBBM bone graft combined with staged lateral wall sinus floor augmentation. Delayed implant placement at sites 15, 16 for a two-unit fixed implant supported prosthesis was planned for 6 months after the first surgery. In the second stage of surgery, radiectomy of the involved mesial root of the second right molar and corresponding bone grafting was also proposed. The patient gave his written informed consent.

## Surgical Technique

The surgical procedure was carried out under local anesthesia (Lidocaine 2% including 1:100,000 adrenaline) with a low-trauma surgical technique, following the concept of the outfracture osteotomy sinus grafting technique. The patient received a preoperative antibiotic prophylaxis, clavulanate- potentiated amoxicillin (Augmentin Glaxosmithkline). After a mid-crestal incision and adequate vertical releasing incisions **(Fig 5)**, a full-thickness mucoperiosteal flap was reflected to expose the sinus lateral wall, with the borders of the maxillary sinus kept in mind. No palatal mucosa was elevated. Using a piezoelectric surgical saw (Mectron piezosurgery, via Lorita, Italy) **(Fig 6)**, a thin osteotomy line was outlined 3mm away from the anterior and inferior borders and extended antero-posteriorly and in vertical dimension to be 10mm and 5mm respectively.

5

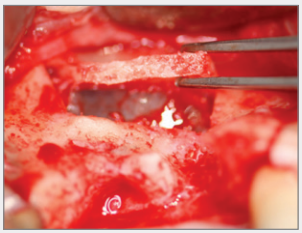
Clinical view showing the healthy conditions of the alveolar ridge.



6

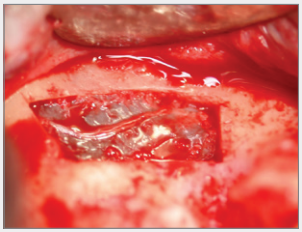
Rectangular bony window is outlined with piezoelectric saw, taking care to maintain the integrity of the Schneiderian membrane.

The size of the lateral window was determined by the number of implants to be placed taking into consideration the remaining adjacent teeth. Repeated outlining of the antrostomy borders with the piezosurgical saw was done to ensure that the bony window was completely separated from the surrounding bone and to minimize the risk of an unintended perforation of the sinus membrane. The piezosurgical saw was tilted to obtain a tapered osteotomy. This ensured the stability of the bony window when it was replaced. The bluish grey line beneath the osteotomy line indicated the Schneiderian membrane, a sign to cease further bone separation. After the lateral window was mobilized in one piece, a small Freer elevator was carefully inserted into the osteotomy line and the bony window was easily dissected from the sinus membrane and was placed in saline **(Fig 7, 8)**.



7

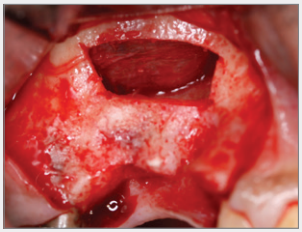
Removal of the repositioning lateral window – note the thickness of the lateral window.



8

Intact exposed sinus membrane with intact PSAA.

The sinus membrane was carefully elevated in traditional fashion, inferiorly, anteriorly, and posteriorly until the desired elevation was obtained to permit the placement of 13mm long implants and space was created for the bone graft under the sinus membrane **(Fig 9)**.



9

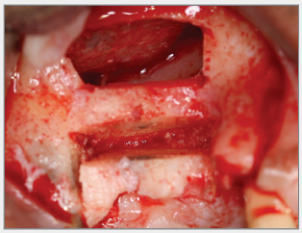
Elevated membrane – note the exposed medial wall.

Care was taken to mobilize the sinus mucosa around the inner bone surface. The elevation was accomplished without membrane perforation. Using a piezoelectric saw, a horizontal osteotomy was created, 2mm below and parallel to the sinus floor under direct visualization, and then connected to two vertical cuts which tapered to the alveolar crest just behind the first premolar, and in the posterior it reached to just in front of the second molar **(Fig 10).**

10

Using a piezoelectric saw, the alveolar bony segment is outlined keeping it attached to the palatal flap.

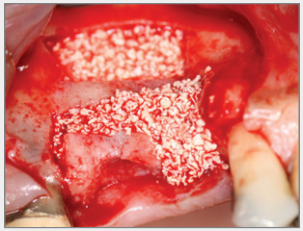
This buccal cut was then connected through the residual alveolar bone to the palatal bone. The osteotomy cuts were made through the palatal bone in a manner that I felt the piezoelectric saw exit the bone but not the palatal mucosa. After all the bone cuts were completed, chisels were used to down fracture and mobilize the palatal pedicled bone segment (about 8mm) to the desired alveolar level related to the adjacent teeth. Care was taken to maintain the soft tissue pedicle on the palatal surface and not to lacerate it. The coronal bone fragment was carefully mobilized by rotation and elevation. The lateral aspect of the segment was elevated more than the palatal aspect, producing a transverse width increase in addition to the vertical augmentation effect **(Fig 11)**.



11

Clinical view of the down-fractured and mobilized palatal pedicled bone segment taking care to maintain the integrity of the sinus floor and to maintain the segment attached to the gingiva.

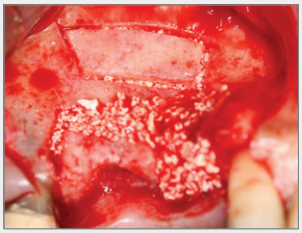
Once the segment has been moved inferiorly, the graft material (DBBM) was mixed with blood from the wound and hydrated with saline. It was then applied in the created space underneath the elevated sinus mucosa. The material was gently packed first at the superior aspect of the sinus and against the medial wall of the created compartment **(Fig 12)**.



12

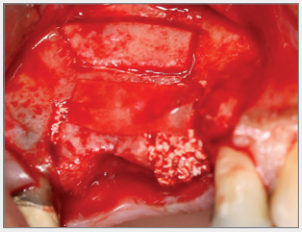
DBBM is inserted into the sinus cavity and in the created space after segment mobilization.

The material was not compressed but lightly placed into the sinus with a small bone condenser. Sufficient material was placed until the desired vertical height was achieved. DBBM was also placed as an interpositional graft into the created zone below the sinus floor. There was no need for fixating the segment because of the excellent primary stability, which was attributed to the fact that DBBM has excellent mechanical properties for stabilizing the fragment. Once the bone grafting was completed the previously removed lateral bony window was repositioned and gentle pressure was applied **(Figs 13, 14)**.



13

The removed bony window is positioned in situ – no fixation is required.



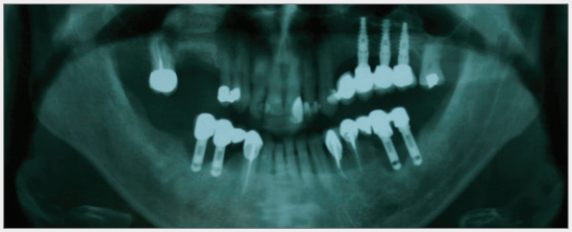
14

The interpositional grafted site is covered with a collagen membrane.

No rigid fixation was required and there was no need to cover the 1-2mm bony gap between the repositioned window and the intact lateral wall.
A periosteal incision was made to release the flap coronally as needed and was sutured tension-free until the incision was perfectly sealed. Clavulanate-potentiated amoxicillin (Augmentin Glaxosmithkline) twice a day, and a non-steroidal analgesic were prescribed. Chlorhexidine rinses and a nasal decongestant were also prescribed twice a day for 10 days. Nose blowing, sucking liquid through a straw, and smoking cigarettes, all of which create negative pressure, were avoided for at least two weeks after surgery.

Coughing or sneezing had to be done with an open mouth to relieve pressure. Putting pressure at the surgical site, ice, elevation of the head, rest and appropriate oral hygiene were also recommended. Care had to be taken not to pressurize the reconstructed area with any prosthesis. Radiographic control using a panoramic radiograph was performed immediately after surgery to confirm the absence of graft material displacement into the sinus cavity and to insure the adequate location of grafted material intrasinusal and interpositional. The early and late postoperative period was uneventful.

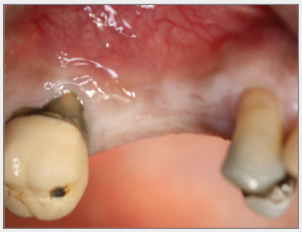
6 months after grafting, a panoramic radiograph was taken to evaluate postsurgical changes of both the osteotomized segment and the augmented sinus. The radiograph showed excellent consolidation with well-defined contours of the fragment and the augmented sinus floor showing more than 20mm of bone height **(Fig 15)**.



15 Panoramic radiograph taken 6 months after sinus floor augmentation and interpositional grafting showing excellent consolidation with well-defined contours of the fragment and the augmented sinus floor showing more than 20mm of bone height.

The 8 mm alveolar defect was corrected by about 6mm which left the site amenable to a more anatomical dental restoration. The clinical appearance of the alveolar crest had improved dramatically.

After a healing period of 6 months, a full thickness flap was reflected as in the grafting surgery and a fairy well-consolidated bone graft was clearly visible **(Fig 16-18)**.



16 Clinical view of healthy soft tissue 6 months after uncomplicated healing.

17 Mid-crestal incision line with mesial and distal vertical releasing incisions.

18 Full-thickness flap was reflected and a fairy well consolidated bone graft is clearly visible.

The alveolar ridge was prepared to receive implants in accordance with a conventional surgical protocol. Initially, the planned implant positions were marked with a pilot bur. In the implant positions a 2mm diameter twist drill was used to attain the desired length **(Fig 19)**.

19 After the planed implant positions were marked with a pilot bur, a 2.0mm diameter twist drill was used to attain the desired length.

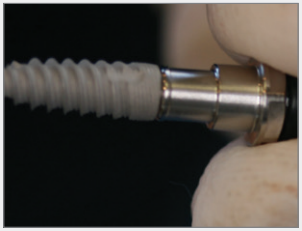
Further preparation was performed using a 2.8mm diameter twist drill for the outer 0.8mm of bone preparation **(Fig 20)**.

20 Further preparation was performed using a 2.8mm diameter twist drill for the outer 0.8mm of bone preparation.

Then, a 3.65mm diameter twist drill was used for the final preparation of the bone **(Fig 21)**.

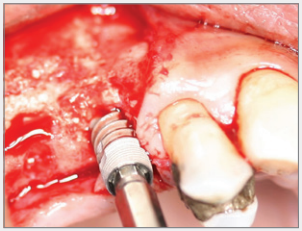
21 A 3.65mm diameter twist drill was used for the final preparation of the bone.

The aim of the selection of the described drill protocol, which is in accordance with the underpreparation concept, was to obtain adequate primary stability for the inserted implants in the case. All the twist drills used for the implant site preparation are manufactured by Alpha-Bio Tec. Implants were placed using the standardized surgical procedure, with the border of the implant neck approximating the alveolar bone crest (bone-level) **(Fig 22).**



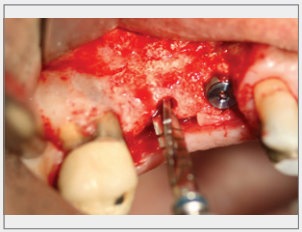
22 4.2 X 13mm NeO implant

Two NeO implants (Alpha-Bio Tec) 4.2mm in diameter and 13mm in length, were inserted into the right augmented area of the sites 15,16 with an insertion torque of 60-70Ncm **(Fig 23-27)**.

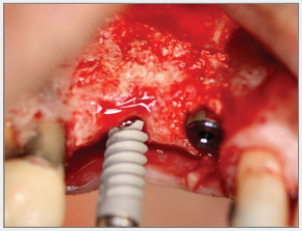


23 A standard implant, 4.2mm diameter, 13mm long, was placed at site 15.

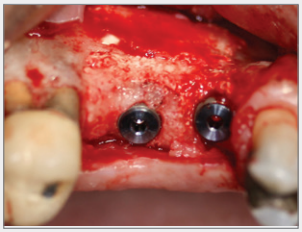
24 Insertion torque values were measured and recorded for implant 15.



25 Implant site preparation at site 16.



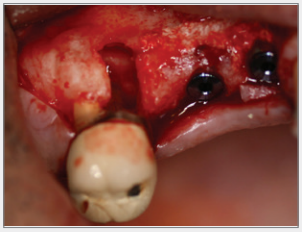
26 Standard implant, 4.2mm diameter, 13mm long, was placed at site 16.



27

Two implants in situ – note the favorable biological inter-implant distances.

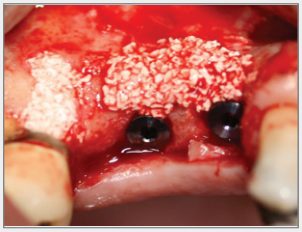
Radictomy of the mesial root of the second molar was done followed by enucleation of the apical lesion **(Fig 28)**.



28

Radictomy of the involved mesial root of the second right molar.

The inserted implants presented no vertical or horizontal mobility at the end of the surgery. DBBM was used for grafting the empty space of the removed mesial root of the second molar and further contour grafting to shape, contour and realign the alveolar ridge after completion of the implant placement **(Fig 29)**.



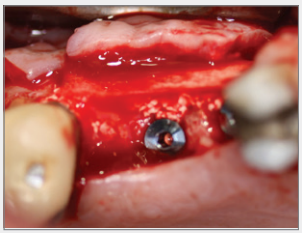
29

Grafting the empty space of the removed mesial root of the second molar and further contour grafting to shape the ridge using DBBM.

A resorbable collagen membrane was placed over the grafted region (Alpha-Bio's GRAFT) **(Fig 30)** and a soft tissue flap was mobilized from the buccal to close the wound primarily **(Figs 31, 32)**.

30

The grafted area was covered using a collagen membrane.



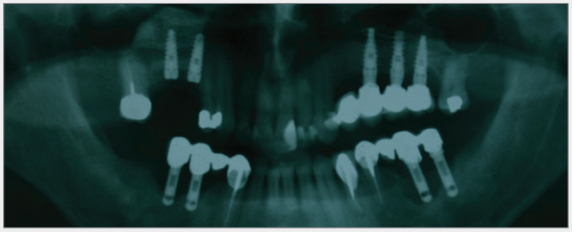
31

Occlusal view showing the grafting material, collagen membrane and repositioned flap prior closure.

32

After surgery was completed, the flap was closed primarily tension-free with interrupted sutures.

The patient was kept on an antibiotic regimen in the form of 1.5g amoxicillin three times a day for 7 days postoperatively. Clinical examinations were carried out one week, one month, and two months after surgery. The soft tissues were examined for signs of inflammation or suture breakdown. The implants were then allowed two months to osseointegrate before temporary restoration. The definitive restoration took place two months later. Radiographic confirmation using panoramic radiography of the desired implants positions into the grafted osteotomy and the sinus was evident one week postoperatively **(Fig 33)**.



33 Panoramic radiograph taken 6 months after implants placement and radictomy of the mesial root of the right maxillary second molar showing well-osteointegrated implants into the grafted osteotomy and the grafted sinus at site 15, 16

Standard transmucosal abutments were attached at the second stage of surgery after two months **(Fig 34)** and provisional crowns were inserted **(Fig 35)**.

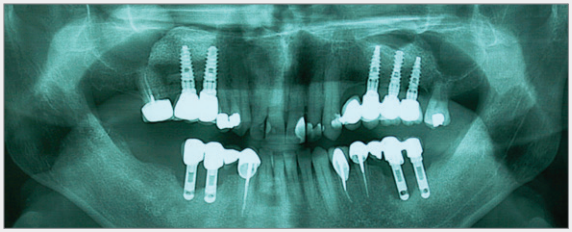
34 Clinical view of prepared solid abutment for temporary prosthesis.

35 Temporary prosthesis in situ; note the crown design at the neck for soft tissue management.

Following a standard prosthetic protocol, final prosthetic restoration proceeded two months after the provisional crown placement **(Fig 36)**.

36 Final prosthesis in situ; note the ingrowth of soft tissue.

The dental restoration featured an improved alveolar plane, equalized crown-to-implant ratios, and a more favorable gingival shape. Six months after implant placement, the crestal bone remained stable and graft consolidation was clearly seen in the taken panoramic radiograph **(Fig 37)**.



37 Panoramic radiograph taken 6 months after loading showing well-defined contours of the osteotomized fragment and the augmented sinus floor besides well-osteointegrated implants.

## Conclusion

This case report assessed the performance of a novel surgical technique to overcome posterior maxillary bone deficiency. It combined interpositional sandwich osteotomy with lateral wall sinus floor augmentation using DBBM alone, and Alpha-Bio Tec's NeO implants which are characterized by their unique design and geometry. It has been well demonstrated that these implants achieve and maintain successful tissue integration due to their design and surface architecture. These features increase the primary and subsequently secondary stability, factors that are prerequisite for the implant's long-term survival.

The main finding emerging from this study is that modified interpositional sandwich osteotomy combined with sinus floor augmentation is effective for patients with posterior maxillary atrophy resulting from severe crestal ridge atrophy accompanied with a pneumatized sinus. The described technique also provides sufficient bone volume to enable implant placement in positions that are optimal from a prosthetic and esthetic standpoint.

The technique appears to be a viable alternative to other vertical augmentation techniques (GBR, onlay graft, distraction osteogenesis, etc.) to enable implant rehabilitation in terms of increasing bone volume, reshaping the alveolar crest and normalizing the interocclusal relationship.

Potential advantages of this technique include avoidance of complications such as flap dehiscence, graft exposure, infections, segment displacement or instability, reduced need for compliance, less operative time, consistent gain of alveolar form and vertical mass along with the lower cost of the procedure.

From a technical and surgical management standpoint, this technique is easily conceptualized, provided the presence of available bone inferior to the sinus floor of at least 6mm. Otherwise, the surgeon will need to modify the surgical technique.

This technique exhibits a high level of result predictability due to the continuous contact between the graft and a four-wall defect, which strongly favors its nutrition and considerably lowers the degree of reabsorption.

However, it appears that some resorption of the fragment cannot be avoided, possibly due to the poor blood supply to the fragment because of buccal flap elevation and the osteotomy of the remaining alveolar bone. Therefore, augmentation should be slightly exaggerated to compensate for resorption.

Since there are only a few such results available in the literature, it is necessary to carry out further research to validate the predictability of this regenerative technique [13,14,45,46].

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