Performance of Alpha-Bio Tec's NeO Implants after Staged Lateral Wall Sinus Floor Augmentation in a Periodontally Compromised Patient

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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

Maxillary sinus floor augmentation is the most common surgical technique for vertical augmentation of the atrophic posterior maxilla caused by increased pneumatization of the maxillary sinus and bone resorption after teeth extraction. It is considered a reliable treatment procedure to restore bone volume deficiency. There is considerable controversy surrounding the desired characteristics of the implants used in augmented sinuses.

This case study evaluates the new Alpha-Bio Tec's NeO implants with their unique design, surface characteristics and geometry inserted in a 65-year old male patient presenting with severe marginal bone loss combined with sinus pneumatization. Alpha-Bio Tec's NeO implants with adequate length and diameter were inserted in a two-stage lateral wall sinus floor augmentation using deproteinized natural bovine bone mineral (DNBM) and a resorbable collagen membrane (Alpha-Bio's GRAFT). Prosthetic restoration was performed using solid abutments following a standard prosthetic protocol. It is well demonstrated that NeO implants can achieve and maintain successful tissue integration. This case study provides insight into the unique features of implant design that may optimize implant stability and improve long term implant survival.

Background

The placement of dental implants in the edentulous posterior maxilla often presents difficulties due to insufficient bone quantity as a result of increase pneumatization of the maxillary sinus and bone resorption after tooth extraction. To overcome this situation, maxillary sinus floor augmentation can be achieved by the lateral window approach or crestal approach [1-11]. The lateral window approach originally described by Geiger and Pesch [12] and Tatum [13] in the 70's, is considered to be the gold standard approach to increase the height and width of the residual bone in the atrophic posterior maxilla. The ultimate goal of this procedure is to restore the resorbed posterior maxilla with dental implants through the dynamic process of osseointegration as originally described by Branemark *et al* [14].

Today, two key techniques of sinus floor augmentation are in use: a one-stage technique with a lateral window approach, were implants can be placed simultaneously with sinus floor grafting, and a two-stage technique with delayed implant placement after a healing period of 4-6 months. The decision depends on the residual bone available and the possibility of achieving primary stability of the inserted implants at the time of surgery. Several studies have reported excellent long term survival rates for implant placed into one and two-stage augmented maxillary sinus using the lateral window approach [6, 7]. The lateral approach is still the most common surgical procedure for sinus floor augmentation.

In addition to the various techniques utilized for sinus floor augmentation, many other variables are important and may affect the outcome of this procedure, including: one-

stage or two-stage, the use of different grafting materials, use of a barrier membrane, and the use of different implants with varying length, width, and surface characteristics.

Various types of grafting materials have been successfully utilized for sinus augmentation particularly when using the lateral approach. The original protocol used autologous 97disadvantages are related to harvesting autologous bone, such as prolonged operation time, surgical complications, and increased morbidity. To overcome these disadvantages, various osteoconductive and osteoinductive bone substitutes have been used for many years in sinus grafting procedures [17]. These materials include allografts, xenografts, alloplasts, and growth factors or composite materials [16, 17].

Two factors are important in clinical decision-making regarding the choice of bone substitutes, the time-dependent new bone formation and the time dependent volumetric stability of the substitute. Implant design refers to the three-dimensional structures of an implant with all its retentive elements and features [18]. Implant design is one of the critical factors to achieve and maintain osseointegration, and consequently, long term implant survival [19]. This phenomenon is closely influenced by chemistry and surface topography [20]. Topography of titanium surfaces is considered one of the most important factors in the success of dental implants [21,22].

In recent years, new innovative implant surface treatments have been proposed to improve the surface quality of titanium dental implants, to obtain a higher rate of bone-to-implant contact (BIC), and to reduce healing periods [23-29]. All methods led to specific microstructure surfaces with a higher performance, due to a greater BIC area, increasing the cellular response, promoting faster healing and consequently, long term clinical implant survival.

Primary stability of dental implants is one of the most important factors associated with long term successful osseointegration [30, 31] and it is even more critical in immediate loading. Primary stability is predicated by implant geometry, insertion torque value, bone density, the amount of BIC, and surgical implant site preparation. Secondary stability (biologic) is depended on implant surface and geometry, bone density, tissue and loading conditions. Implant design also contributes to obtaining secondary stability and plays an important role in load distribution.

Since the highest stress is at the coronal portion of the bone and implant [32], such a load concentration may lead to implant marginal loss. To overcome this situation, micro-thread design can distribute the stress evenly and preserve marginal bone level [33]. Therefore, not only loading conditions but also the surface macro architectures can stimulate bone apposition around the implant neck. Furthermore, thread or groove configuration is the optimal surface macro architecture of screw-shaped implant design related to stress distribution.

Macroscopic grooves provide an excellent environment for cell differentiation, bone formation, and remodeling [34, 35]. Different implant thread designs in different bone densities, large and aggressive thread geometry versus small and less aggressive and classical thread design were compared in different studies [36,37] with controversial conclusions. The data showed that through reduction of thread pitch and thread depth, initial mechanical stability in low-density bone might be improved and consequent healing interval might be decreased [38]. A moderate thread implant design seems to demonstrate a better biomechanical performance than classical or large and aggressive thread design performed in both low-density, cortical and cancellous bone situations [37].

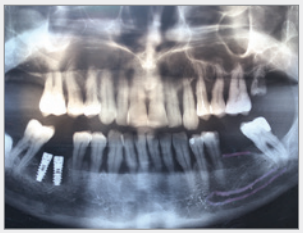
The purpose of this case study was to evaluate the performance of a novel implant system with a unique moderate thread implant design, surface characteristics and geometry inserted in augmented maxillary sinus with DBBM after a healing period of six months. This case study provides insights into the unique features of implant design that may optimize implant stability and improve long term implant survival.

Case Overview

A 65-year old male, referred by his dental practitioner for implant placement in the upper left quadrant, presented in our implant surgery clinic complaining of inadequate chewing ability on the left side. The patient reported that he had undergone implant surgery in the right mandible. He had tried a partial removable denture in the lower jaw but found the discomfort unacceptable. The patient requested an evaluation for the purpose of rehabilitation with an implant-supported prosthesis. The patient was in a good physical health with no contributing medical history including maxillary sinus diseases or allergies. The patient was not on any medications and smoked 10 cigarettes per day.

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

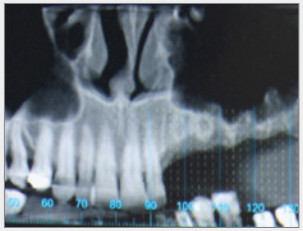
- Maxilla: missing teeth, severe periodontal problems with extensive loss of bone support around almost all existing teeth, pockets of 5-7 mm with bleeding on probing (BOP), and hopeless mobile teeth in the posterior sector.
- Mandible: two missing teeth, almost all teeth are hopeless, spontaneous exposure of two implants in region 46 presented with peri-implantitis and pocket depth of 10 mm.
- Panoramic radiograph showed massive loss of supporting bone of most existing teeth, maxillary sinus pneumatization with low residual bone height (RBH) which is inadequate for implant placement **(Fig. 1)**.



1

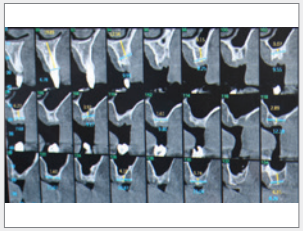
Baseline radiograph showing severe marginal bone loss almost around all existing teeth, particularly in the left posterior maxilla

CT scan showed a healthy maxillary sinus, no preexisting sinus pathology with healthy osteomeatal complex, RBH of 3.0 mm and of 10 mm width, existing maxillary septa, small posterior superior alveolar artery (PSAA) in the lateral wall, and wide latero-medial angle of the sinus **(Figs. 2,3)**.



2

Panoramic view of CT-scan showing pneumatization of maxillary sinus coupled with severe marginal bone loss-note the small septa in the left maxillary sinus



3

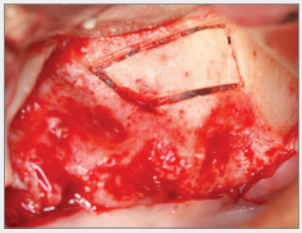
CT scan showing alveolar bone height of 1-3 mm in areas requiring augmentation procedure

Treatment Plan

After evaluation of the patient, it was decided to extract the hopeless teeth in the left posterior maxilla, including the canine, premolars and molars. Based on the radiographic examination and due to the increased maxillary sinus size, consequent decreased alveolar crest and lack of bone mass, a staged lateral wall sinus floor augmentation with delayed four implant placement at sites 23, 24, 25, and 26 for a four-unit fixed implant supported prosthesis was proposed.

Surgical Technique

The surgical procedure was carried out under local anesthesia (Lidocaine 2% including 1:100000 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, a full-thickness mucoperiosteal flap was reflected to expose the sinus lateral wall, with the borders of the maxillary sinus kept in mind. A thin osteotomy line was outlined 3 mm away from the anterior and inferior borders and extended antero-posteriorly and in the vertical dimension to be 10 mm and 5 mm respectively, using a piezoelectric surgical saw (Mectron piezosurgery, via Lorita, Italy) **(Fig. 4)**.

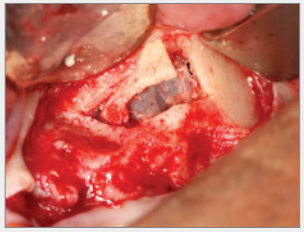


4

Following exposure of the lateral maxillary wall, gentle osteotomy with piezosurgical saw, which is adequate for minimizing bone loss, was performed. A thin osteotomy line is recommended for minimizing bone loss to help repositioning of the bony segment to the original position

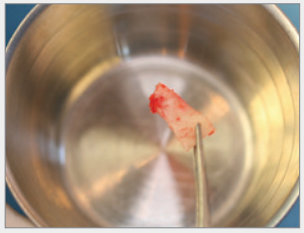
The size of the lateral window was determined by the number of implants to be placed. Repeated outlining of the antrostomy borders with the piezosurgical saw was continued, ensuring that the bony window was completely separated from the surrounding bone and minimizing the risk of an unintentional perforation of the sinus membrane. The piezosurgical saw was tilted to obtain a tapered osteotomy to insure the stability of the bony window when it was replaced. The bluish grey line beneath the osteotomy line indicates the Schneiderian membrane,

a sign to interrupt further bone separation. After the lateral window had been 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 kept in saline **(Figs. 5, 6)**.



5

The entrance to the lateral sinus wall was prepared by complete outward removal of the bony window which was carefully osteotomized using a piezosurgical saw

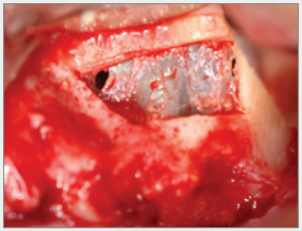


6

The outfractured bone segment is placed in normal saline during sinus grafting

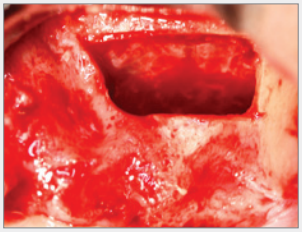
The sinus membrane was carefully elevated in traditional method, inferiorly, anteriorly, and posteriorly until the desired elevation was obtained to permit placement of 13 mm long implants and space was created for the bone graft under the sinus membrane. Care was taken to mobilize the sinus mucosa around the existing partial septa and the inner bone surface. A small sinus membrane perforation approximately 3 mm occurred during the dissection procedure and the elevation was extended in all directions. Alpha-Bio Tec's Collagen Membrane was placed to seal the perforation

before augmenting the sinus **(Figs. 7-9)**.



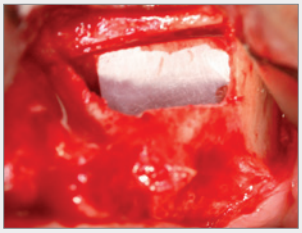
7

After removal of the bony segment, a small perforation of the sinus membrane is clearly visible



8

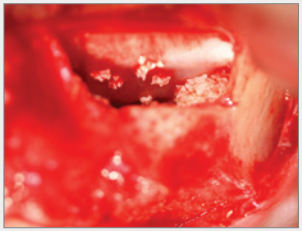
The sinus membrane was elevated inferiorly, anteriorly, and posteriorly until the inner bone surface



9

The perforation of the sinus Membrane was covered using collagen membrane

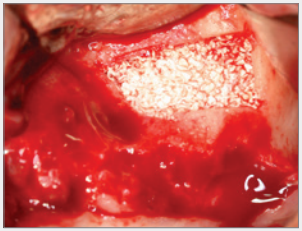
The graft material (NBBM) was mixed with blood from the wound and hydrated with saline, then applied in the created space following elevation of the sinus mucosa. The material was gently packed first at the superior aspect of the sinus and against the medial wall of the created compartment **(Fig. 10)**.



10

Grafting material NBBM was placed gently first at the superior aspect underneath the Collagen Membrane and against the medial wall

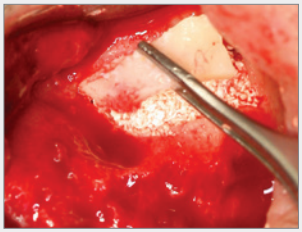
The material was not compressed but lightly placed into the sinus with a small bone condenser and sufficient material was placed until the desired vertical height was achieved **(Fig 11)**.



11

Further grafting of the created compartment in all dimensions was achieved

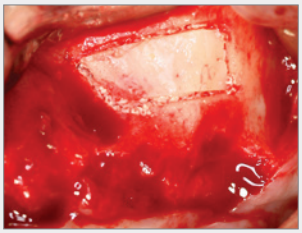
Upon completion of the bone graft, the removed lateral bony window was repositioned and gentle pressure was applied **(Fig .12)**.



12

After completion of the sinus floor augmentation, the outfractured bony window was repositioned

No rigid fixation was required and there was no need to cover the 1-2 mm bony gap between the repositioned window and the intact lateral wall **(Fig. 13)**.

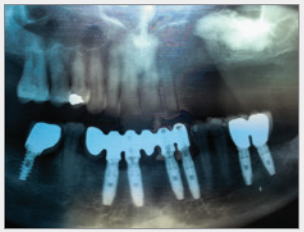


13 Gentle pressure on the repositioned bony window was applied to ensure stabilization; no rigid fixation was required and no need to cover the bony gap

After cleansing and irrigating with saline, tension free suturing was performed.

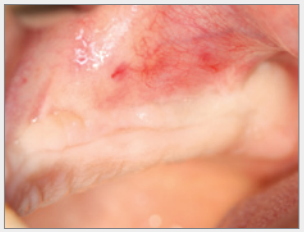
Postoperatively, clavulanate-potentiated amoxicillin (Augmentin, GSK) twice a day, and non-steroidal analgesic was prescribed. Chlorhexidine rinses and nasal decongestant were also prescribed twice a day for 10 days. Blowing the nose, sucking liquid through a straw and smoking cigarettes, all of which create negative pressure, were avoided for at least 2 weeks after surgery. Coughing or sneezing should be done with an open mouth to relieve pressure. Pressure at the surgical site, ice, elevation of the head, and rest besides appropriate oral hygiene were also recommended.

Radiographic control with a panoramic radiograph was performed immediately after the sinus augmentation to confirm the absence of graft material displacement into the sinus cavity and to insure the adequate location of grafted material **(Fig. 14)**. The early and late postoperative period was uneventful. After a healing period of 6 months, implants were placed using the standardized surgical procedure, with the border of the implant neck approximating the alveolar bone crest (tissue-level). A total of four NeO implants (Alpha-Bio Tec.) 4.2 mm diameter and 13 mm in length were inserted in the left augmented maxillary sinus in site 23, 24, 25, and 26 with an insertion torque of 50 Ncm.

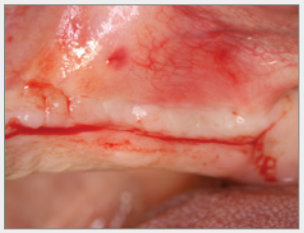


14 Pre-surgical panoramic radiograph taken 6 months after sinus floor augmentation

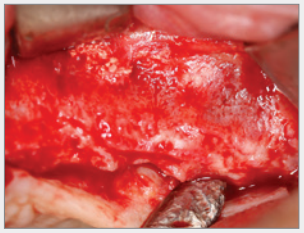
A full thickness flap was reflected as in the grafting surgery. The alveolar ridge was prepared to receive implants according to the conventional surgery protocol **(Figs. 15-17)**.



15 Clinical view after 6 months of uncomplicated healing

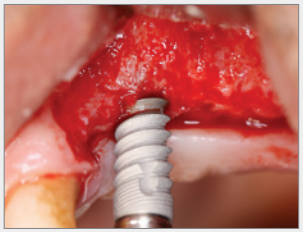


16 Clinical view of a mid-crestal incision line with mesial and distal vertical releasing incisions

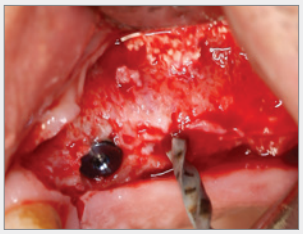


17 Access to the edentulous alveolar ridge was achieved through a full-thickness flap elevation

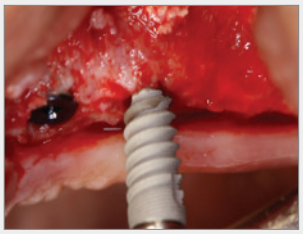
Initially, the planned implant positions were marked with a pilot bur. A 2mm diameter twist drill was used in the implant positions for the desired length. Further preparation was performed using a 2.8 mm diameter twist drill for the outer 0.8 mm of bone preparation. Then, a 3.65 mm diameter drill was used for the final preparation of the bone. The aim of the selection of the described drill protocol, which is in accordance with the under preparation concept, was to obtain adequate primary stability for the inserted implants. All the twist drills used for implant site preparation are manufactured by Alpha-Bio Tec. The inserted implants presented no vertical or horizontal mobility at the end of surgery **(Figs. 18-25)**.



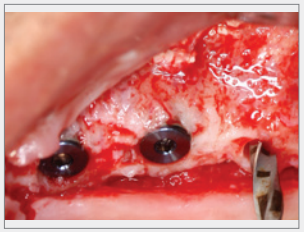
18 After implant site preparation, a NeO implant, Ø4.2 mm, length 13 mm, was placed at site 23



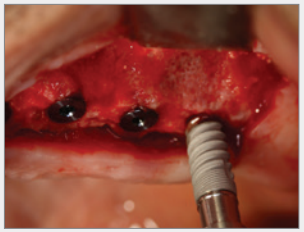
19 Implant site preparation 24



20 NeO implant, Ø4.2 mm, length 13 mm, was placed at site 24

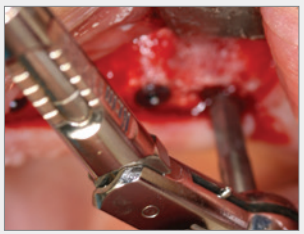


21 Implant site preparation 25

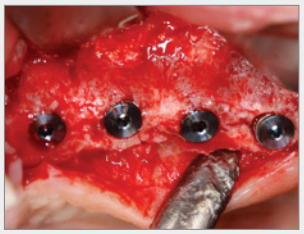


22 Standard implants, Ø4.2 mm, length 13 mm, were placed at sites 25, 26

23 Alpha-Bio Tec. torque ratchet

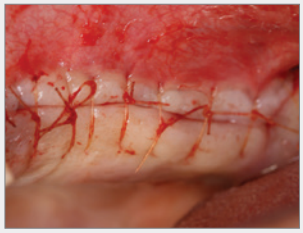


24 Insertion torque values were measured and recorded for each implant site



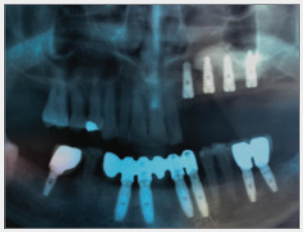
25 Four implants in situ; note the favorable biological inter-implant distances

A submerged technique was used attaching a cover screw and reattaching the mucoperiosteal flap **(Fig. 26)**.



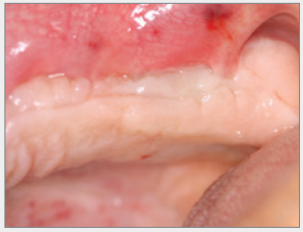
26 After surgery was completed, flap was closed primarily tension-free with resorbable interrupted sutures

The patient was kept on an antibiotic regimen in the form of 1.5g amoxicillin three times a day for 7 days postoperative. The implants were then allowed 2 months to osseointegrate before prosthetic loading. Radiographic confirmation via panoramic radiograph of the absence of implant protrusion into the sinus cavity was evident one week postoperatively **(Fig. 27)**.

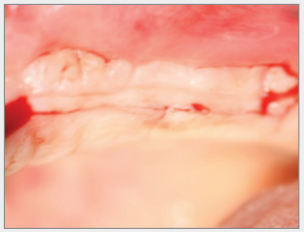


27 Panoramic radiograph obtained two months after implant placement showing well osseointegrated implants at sites 23-26

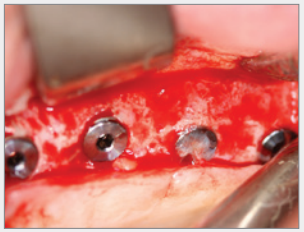
Standard transmucosal abutments were attached at stage-two surgery after two months. Following a standard prosthetic protocol, provisional crowns were inserted **(Figs. 28-35)**.



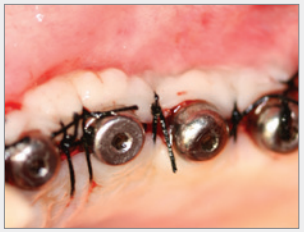
28 Clinical view of good soft tissue healing two months after implant placement



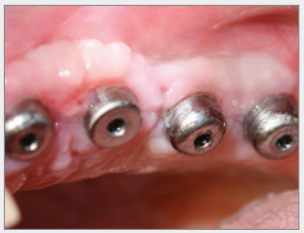
29 Mid-crestal incision with small releasing incisions were made as in implant placement surgery



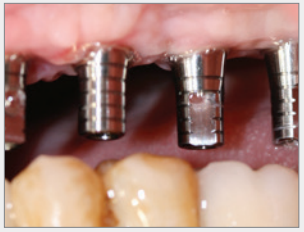
30 Clinical view of second stage surgery to expose the inserted implants at sites 23-26 performed 8 weeks after placement



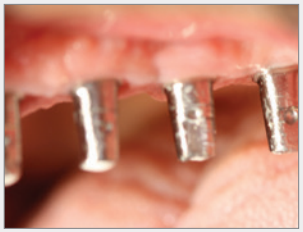
31 After attaching healing abutment to the implants, the flap was sutured



32 Clinical view two weeks after implant exposure, indicating healing of peri-implant soft tissue

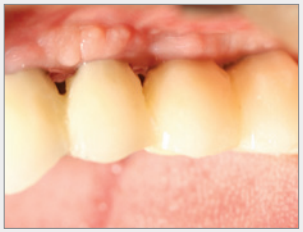


33 Intraoral appearance of connected solid abutments – impression-taking was scheduled three weeks after exposure



34

Clinical view of prepared solid abutment for temporary prosthesis



35

Temporary prosthesis in situ; note the small mesiodistal dimensions of the teeth to be replaced

Conclusion

This case study assessed the performance of a new implant system (Alpha-Bio Tec. NeO implant), characterized by its unique design and geometry. The implants were inserted in a staged lateral wall sinus floor augmentation using DBBM alone mixed with patient's blood. It is well demonstrated that these implants can achieve and maintain successful tissue integration due to their design and surface architecture, which seem to to increase the primary and consequently secondary stability, the prerequisite for implant long term survival.

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