

# Horizontal Ridge Augmentation Using PDLA Fixing Screw in Combination with a Block Graft in a Tunnel Technique to Replace Amaxillary Anterior Missing Tooth - A Case Report

## Abstract

An important aspect of the success criteria for dental implants in the maxillary anterior area involves the establishment of soft tissue contours with an intact inter-implant papilla and a gingival outline that is harmonious with the gingival levels of the adjacent healthy dentition. Recently, the tunnel technique was introduced to maintain the integrity of the soft tissue as an alternative approach for horizontal augmentation, ideally used in sites with 2-wall defects or a prominent C-shaped curvature of the alveolar ridge. The purpose of the present case report is to describe step by step a ridge augmentation procedure utilizing the tunnel technique in combination with an allograft block graft for horizontal ridge augmentation, performed in anterior maxilla.

## Introduction

The anterior maxilla has traditionally been seen as a challenge when it comes to successfully placing dental implants. An important aspect of the success criteria for dental implants in the maxillary Anterior area involves the establishment of soft tissue contours with an intact inter-implant papilla and a gingival outline that is harmonious with the gingival levels of the adjacent healthy dentition [1,2]. This is especially true in patients with a high smile line. The clinician must also be aware of the patient's desires and expectations regarding esthetics when restoring an implant to provide the best treatment options.

Following an uncomplicated extraction, the width of the alveolar ridge has shown to be reduced by approximately 50% after 12 months, with two thirds of this reduction occurring in the first 3 months [3]. Restoring horizontal hard tissue to the alveolar ridge for implantation is one of the most common challenges for correct 3-dimensional implant placement. Various techniques have been suggested in the literature to increase atrophic horizontal bone [4-11]. Successful bone grafting is a multifactorial process that requires the following osteogenic cells including osteoblasts and/or mesenchymal stem cells which originate from the existing bone [5-7], enough blood supply from the adjacent periosteum or cancellous bone to nourish the graft, an appropriate volume of resorbable graft that does not exceed the



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diffusion distance of oxygen and nutrients to the graft site [8-10], tension-free primary closure of the incision that protects the graft from the oral environment, and a sufficient quantity of cancellous bone at the recipient site providing stability, nourishment, and cells to transform the graft into vital bone [10]. Both non-resorbable and bioresorbable barrier membranes have been used to contain the graft materials and allow osteoblast cells to repopulate the defect and prevent ingrowth or migration of undesired soft tissue [11].

However, the use of membrane barriers may have some potential complications. The most commonly encountered complication is wound dehiscence and early membrane exposure, which can lead to bacterial colonization and infection, necessitating early removal of the membrane and materials. A percentage between 22% and 32% of early membrane exposure has been reported for collagen membrane by several authors [12-15], and it has been shown that bone gain is considerably decreased when it happens in an early stage [16,17].

Recently, the tunnel technique was introduced to prevent these undesirable exposures by maintaining the integrity of the soft tissue and in consequence, it's blood supply. It is an alternative approach for horizontal augmentation, ideally used in sites with 2-wall defects or a prominent C-shaped curvature of the alveolar ridge [18]. The purpose of the present case report is to describe step by step a ridge augmentation procedure utilizing the Tunnel technique in combination with an allograft block graft for horizontal ridge augmentation, performed in anterior maxilla.

## Report of a Case

A 26 years-old African-American male patient presented to the New York University College of Dentistry Ashman Department of Periodontology and Implant Dentistry with a chief complaint of wanting to replace a missing maxillary anterior tooth. The right maxillary central incisor was avulsed following a traumatic injury in a football game at the age of 22. He had undergone orthodontic treatment for two years in a private clinic and was referred to implant clinic for the evaluation of an Implant-supported restoration to replace this tooth. The patient did not have any medical conditions and was not taking any medications.



Figure 1: Pre-operative clinical frontal view showing a severely atrophic anterior maxillary edentulous ridge.



Figure 2: Pre-operative clinical occlusal view showing a severely atrophic anterior maxillary edentulous ridge.

Clinical intra-oral pictures revealed a severely horizontally atrophic ridge in its labial-palatal dimension, which presented limited space for placement of a standard diameter implant (Figures 1 and 2). A Cone Beam Computed Tomographic (CBCT) scan was taken and evaluated, showing a 2 mm ridge width 2 mm apical to the crest of bone (Figure 3).

The treatment options for replacing the missing tooth were discussed with the patient, including a removable partial denture, a fixed partial denture, and an Implant-supported crown. The patient opted for the implant option, being aware that bone augmentation would be necessary to complete the implant supported restoration. He agreed to the procedure and the subsequent placement of an implant supported crown.

#### Ridge augmentation procedure

The patient took 2 grams of oral amoxicillin 1 hour prior to surgery and was instructed to continue amoxicillin 500mg tablets three times a day for 7 days post-surgery. Anesthesia was achieved by local infiltration of Xylocaine (Lidocaine HCl, Henry Schein, CA) 2% containing epinephrine at a concentration of 1:100,000. Two vertical incisions were made on labial side mesial and distal of area #8the maxillary right central incisor, from the interproximal mucogingival junction and apically, followed by periosteum elevation to create the subperiosteal tunnel (Figure 4). Decortication was done

over the recipient site, and a hole was made for the Poly-D-L-Lactic Acid (PLDLLA) pin (SonicPin) insertion (Figure 5). The allograft The patient was prescribed took 2 grams of oral amoxicillin 1 hour prior to surgery and was instructed to continue amoxicillin 500 mg tablets three times a day for 7 days post-surgery. Anesthesia was achieved by local infiltration anesthesia of Xylocaine (Lidocaine HCl, Henry Schein, CA) 2% containing epinephrine at a concentration of 1:100,000 was used. Two vertical incisions were made on labial side mesial and distal of area #8the maxillary right central incisor, from the interproximal mucogingival junction and apically, followed by periosteum elevation to create the subperiosteal tunnel (Figure 4). Decortication was done over the recipient site, and a hole was made for the Poly-D-L-Lactic Acid (PLDLLA) pin (SonicPin) insertion (Figure 5). The allograft block (Zimmer-Biomet, Florida) was adjusted using a high speed diamond bur to the ideal shape and volume (Figure 6). The block was inserted underneath the mucosa and adapted to the recipient site (Figure 7). A 2.1x13 mm SonicPin was used to fix the block to the bone (Figure 8). After fixation was completed, the SonicPin went through the middle of the block into the labial bone (Figure 9). Tension-free soft tissue closure was achieved using 4/0 Chromic Gut resorbable material (635-CG, Henry Schein, CA) (Figure 10).

#### Implant placement procedure

After 4 months of healing, a new Cone Beam Computed



Figure 3: Pre-operative CBCT scan image of Anterior maxillary edentulous area. Note the 2mm thick alveolar ridge.



Figure 4: Two vertical incisions were made, followed by the periosteum elevation to create the subperiosteal tunnel.



Figure 5: Decortication was done over the recipient site, and a hole was made for the SonicPin insertion.



Figure 7: The block was inserted underneath the mucosa and adapted to the recipient site.



Figure 6: The allograft block was adjusted using a high speed diamond bur to the ideal shape and volume.



Figure 8: A 2.1x13mm PDLLA SonicPin was used to fix the block to the bone.

Tomography (CBCT) scan was taken prior to implant placement, presenting an increase of 6mm in width of the alveolar ridge (Figures 11 and 12). A full thickness flap was reflected, and a bone level implant (4.1x12 mm; Straumann, Switzerland) was installed into the prepared site with an insertion torque of 35 N/cm (Figure 13). Following cover screw placement, the surgical site was sutured with 4-0 Chromic Gut and allowed to heal.

#### Restorative procedure

The implant was allowed to integrate for 4 months. The second stage procedure was done to expose the implant platform, and a chairside-made, screw-retained acrylic provisional crown was placed (Figures 14 and 15). Three weeks later, when soft tissue shaping was achieved with the provisional restoration, a customized impression coping was fabricated according to the emergence profile of the provisional crown, and a final implant impression was made. After 6 months, a screw-retained porcelain fused to metal crown was delivered and torqued to 35 N/cm. No abnormality of the implant area was noted, and the patient was satisfied with the result and did not report any pain or inconvenience (Figures 16 and 17).

#### Maintenance procedure

After the initial surgery treatment, the patient was followed up every 6 months for 3 years on appropriate oral hygiene and maintenance programs, which are crucial for long-term success.

#### Discussion

The availability of adequate bone volume for dental implant placement is often diminished by trauma, pathology, periodontal disease, and tooth loss. Bone resorption in the maxillary ridge frequently results in a knife-edged deformity, which complicates implant placement and stabilization. The end goal of implant therapy is to provide a functional restoration that is in harmony with the adjacent dentition [19]. These horizontal hard tissue defects are the most common challenge encountered. Many options for management of these defects exist, assuming that an implant of appropriate diameter is to be placed and grafting at the time of implant placement is not an option. One of the most common methods for treating horizontal bone deficiency is the use of barrier membranes for guided bone regeneration. Many variations of this approach have proved to be successful, but are not exempt of complications, being the most common of them wound dehiscence and early membrane exposure, which can compromise the final amount of gained bone. The tunnel technique shows less wound dehiscence or membrane exposure as well as fewer required courses of antibiotics and postoperative visits. In fact, it has been reported by some authors as a more cost effective and time-efficient option with similar success and fewer complications, thus being considered as minimally invasive [20-22]. It is been shown to provide a conservative approach to accessing oral bone grafting sites while minimally compromising the blood supply



Figure 9: After fixation was completed, the SonicPin went through the middle of the block into the labial bone.



Figure 11: 3-month post-op occlusal view showing the augmented ridge.



Figure 10: Tension-free soft tissue closure was achieved with 4-0 Chromic Gut.



Figure 12: A CBCT scan was taken after 8 months of healing.

and reducing trauma to the soft tissue, allowing to maintain primary closure uneventfully, which is vital for any grafting procedure. In contrast to the open-flap techniques, the tunnel technique allows better soft tissue closure, and thus helps in reducing the chances of soft tissue dehiscence, as well as secures bone graft healing. In tunneling techniques, the periosteum is detached during the preparation, but stretched without horizontally cutting it, and thus, the bone graft remains directly in contact with it [23].

Autogenous bone harvested from either extraoral or intraoral sites was reported as a gold standard in post-trauma cases [24]. The graft must possess strength and rigidity to allow its fixation in the recipient site and 3-dimensional stability to withstand muscular forces. Consequently, an autogenous block graft is often recommended in the post-traumatic anterior maxilla. Recent studies suggest that a block allograft in conjunction with a resorbable membrane may be an acceptable alternative to the autogenous block graft in the treatment of compromised alveolar ridges. The incentive for using an allograft block in post-traumatic cases in young patients is to avoid donor-site morbidity. Functional and esthetic post-traumatic demands are provided by the use of cancellous allograft blocks without donor site morbidity and discomfort to the patient [25].

The contouring of the block by the surgeon demands considerable surgical time and it's considered one of the major requirements for the



Figure 13: One Straumann bone level implant (4.1x12 mm) was placed.

success of the tunnel technique in grafts [26], since a good adjustment of the graft into the recipient bed promotes greater stability to it. Currently, most of the appositional bone block grafts are stabilized to the receptor through rigid fixation with medical grade stainless steel screws. However, the use of this type of screw requires its removal in a second surgical procedure before the placement of dental implants, causing a more morbid and time-consuming experience for the patient due to this additional surgery. Another drawback associated with the removal of the screws is that it takes a long releasing incision to access them, often in a high-demand aesthetic region [27]. During



Figure 14: Clinical facial and occlusal view of the provisional restoration.



Figure 16: Delivery of the final PFM restoration showing the desirable result.



Figure 15: Clinical facial and occlusal view of the provisional restoration.



Figure 17: Delivery of the final PFM restoration showing the desirable result.

this procedure, it is necessary to detach the periosteum covering the bone graft, which preservation is believed to be a key factor contributing to the successful integration of the graft to the receptor bed. Moreover, despite the fact that fixing screws are generally made of a poorer titanium alloy, it is possible that these screws osseointegrate to the graft, which can hinder their removal and even cause damages that compromise the overall outcome of the procedure [28]. PDLLA screws do not interfere in the incorporation of the grafts and on bone viability and/or quality; also they do not need to be removed. The PDLLA screws, whose contours are reported to be clearly visible in all biopsies, are encapsulated by a thin and immature fibrous tissue capsule containing many giant cells in direct contact with the PDLLA material as well as infiltrating in areas with fragmented PDLLA. PDLLA particles are observed within the giant cells. Furthermore, the adaptation of the biodegradable screws for fixation of the bone grafts results as uncomplicated as with metal screws, with the advantage that they do not need to be removed, thus avoiding a second surgery to do so and creating less morbidity to the patient. A part from that, the fact that they remain partially in the bone and thus connecting it to the block graft prevents separation of it in the moment of implant osteotomy, as can happen in conventional cases after the titanium screws are removed, due to incomplete graft incorporation in the recipient site and drilling vibration. In the present study, only one PDLLA fixing screw was placed instead of two conventional metal screws, there was no second surgery to remove it, and neither an undesirable separation of the graft at the time of implant placement. The tunnel technique and PDLLA allowed the surgery to be performed

in a shorter time and with less complications.

## Conclusion

Utilizing implant-supported fixed prosthesis to solve single-missing edentulous ridge in the anterior maxilla area has been achieved predictably. However, an ideal aesthetic result may be hard to achieve given certain initial conditions. The result of this case report clearly demonstrates how to successfully manage single-tooth replacement in a considerable complex initial situation with step by step surgical and prosthetic procedure. The tunnel technique for bone augmentation in combination with the use of an allograft block graft stabilized with biodegradable PDLLA fixing screws is a simple and easy to perform technique, which is completed with less surgical time, less appointments and less morbidity to the patient, and has presented a high predictable results with high success rate in the present case. To validate this results, multi-centered randomized controlled studies about these techniques should be performed.

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