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Open Sinus Lift Healing Comparison between a Non-Perforated Schneiderian Membrane and a Perforated Schneiderian Membrane Repaired with Amnion-Chorion Allograft Barrier: A Controlled, Split Mouth Case Report

Dan Holtzclaw, DDS, MS

Abstract

**Background:** Schneiderian membrane perforation is the most common complication of maxillary sinus augmentation and has been associated with a variety of post-surgical problems including infections, failed grafts, and grafts of inadequate magnitude to facilitate the placement of dental implants. The effects of perforated Schneiderian membranes can be somewhat mitigated through repair with a variety of different membrane materials. A number of studies have presented data comparing dental implant success with repaired Schneiderian membranes to non-perforated membranes, but no studies have shown a direct split-mouth comparison within a single subject. The following Case Report shows a single patient who received bilateral maxillary sinus lifts in which one side was unintentionally perforated and repaired with amnion-chorion barrier while the other side was non-perforated. Complications, implant survival, clinical, and radiographic healing comparisons are presented and discussed.

**Methods:** In a single patient, bilateral maxillary sinus lifts were performed via the lateral window method. Both sinuses were treated in the same exact fashion. During instrumentation for sinus membrane elevation, the right sinus membrane was unintentionally perforated and repaired with an amnion-chorion barrier while the left sinus membrane was not perforated. Both sinuses were then grafted with a combination of bone xenograft/allograft and the lateral windows were covered with amnion-chorion membranes. After four months of healing, a cone beam computed tomography scan was utilized to assess the results of healing and plan a guided dental implant surgery. Following placement of dental implants, the case was immediately loaded with a transitional prosthesis for four months and ultimately restored with a zirconia restoration.

**Results:** The non-perforated sinus lift healed with more bone height and a denser, more uniform fill compared to the sinus lift repaired with amnion-chorion barrier. Both sides, however, had adequate healing to permit placement of multiple dental implants to support an immediately loaded restoration. After two years of function, implants in both sinuses have demonstrated zero complications and the prosthesis is functioning well.

**Conclusions:** This is the first known study to document direct healing comparisons between a repaired perforated maxillary sinus membrane versus a non-perforated sinus membrane when sinus augmentations were performed in the same person at the same time. Amnion-chorion barriers have unique properties that make them ideal for repair of perforated maxillary sinus membranes. This direct split mouth comparison Case Report demonstrates that these barriers can produce healing results that allow for long term functioning of dental implants without complication.

**KEY WORDS:** Maxillary sinus, sinus floor augmentation, nasal mucosa, dental implants, amnion, chorion

1. Consultant Faculty, Department of Periodontics, US Naval Post-Graduate Dental School, Bethesda, Maryland, USA.
   Private Practice, Austin, Texas, USA
INTRODUCTION

Pneumatization of the maxillary sinus is a common finding with edentulism of the posterior maxilla and often requires augmentation to facilitate the placement of dental implants.1 Perforation of the Schneiderian membrane is the most common complication associated with maxillary sinus augmentation procedures2 with rates ranging from 11% to 56%.3,4 Multiple techniques have been presented in dental literature for repair of perforated sinus membranes including the use of palatal flaps,5 buccal fat pads,6 Lambone,7 specialized suturing techniques,8 and fixed membrane pouches.9,10 With excessively large perforations, however, reparative techniques are sometimes not feasibly and the procedure must be aborted. When sinus membrane repair is achievable, these studies, and multiple other conformational studies,11-13 show that perforation and subsequent repair of the Schneiderian membrane does not compromise the final success of dental implant survival. None of these studies5-13 however, show any cases with direct split-mouth intrapatient healing comparisons of repaired perforated sinus membranes versus non-perforated sinus membranes. This Case Report presents a situation in which a patient receiving bilateral maxillary sinus lifts had perforation and repair of one sinus membrane while the other side remained intact. With these sinus lifts being performed in the same patient at the exact same time, a unique opportunity presented itself for direct observation and comparison of healing results for a repaired versus a non-perforated sinus lift and the dental implant survival that followed.

METHODS

A 52 year old Caucasian female was referred to our periodontal specialty clinic for evaluation and treatment of long standing chronic periodontal disease. Over the past fifteen years, the patient had undergone a variety of procedures to treat her

Figure 1: Presurgical CBCT scan of patient showing bilateral pneumatized maxillary sinuses and severe bone loss secondary to periodontal disease.

Figure 2: Presurgical CBCT scan showing minimal bone thickness in the maxillary anterior sextant.
condition including non-surgical scaling and root planing, open flap debridement, bone grafting with guided tissue regeneration, and three month periodontal maintenance. In spite of these efforts and the patient’s meticulous home oral hygiene measures, she continued to have pocket depths ranging from 2-8mm with excessive mobility in many of her teeth, particularly in the maxilla. Although the mandible demonstrated moderate to severe horizontal bone loss from her past history of periodontal disease and surgical procedures, probing depths in this arch only ranged from 2-5mm and tooth mobility, although present, was not as significant as that seen in the maxilla. The patient was frustrated with the continued deterioration of her periodontal condition, the esthetics of her maxillary teeth, and her inability to eat many foods due to the excessive mobility of her maxillary teeth. After discussing multiple treatment options with the patient, she requested to have dental implant restoration of her maxillary arch. While it would have been more ideal to treat both the maxillary and mandibular arches simultaneously, the patient elected for treatment of only the maxillary arch. The patient did express that she would like to have the mandibular arch treated in a similar fashion to the maxilla in the future when her finances permitted.

To accommodate the patient’s desires for a dental implant supported fixed restoration of the maxilla, the patient’s significant bone deficiencies had to be addressed. A cone beam computed tomography (CBCT) scan revealed that the patient not only had significantly pneumatized maxillary sinuses bilaterally (Figure 1), she also had minimal bone height and width in the anterior maxillary sextant (Figures 2, 3). Because of these findings, it was decided that bilateral maxillary open sinus lifts would be performed to gain as much bone height as possible in the posterior and mid maxilla. Once these bone augmentations healed, the patient would receive an additional CBCT scan and a guided dental implant surgery would be planned with at least 3-4 dental implants being placed into each augmented sinus.

The first procedure involved extraction/site preservation of teeth 2, 3, 4, 13, 14, and 15 with simultaneous bilateral maxillary sinus lifts. Because these sinus augmentations were going to heal for at least 4-5 months prior to the second surgical phase, teeth 5-12 were left in place at the patient’s request to “give me something to smile and chew with while everything is healing.” Although the option of a temporary complete denture was offered to the patient, she declined noting that she did not want to wear any removable prostheses at any time during her treatment. Following the administration of local anesthesia.
and intravenous conscious sedation, full thickness mucoperiosteal flaps were elevated bilaterally and teeth 2, 3, 4, 13, 14, and 15 were elevated/extracted. Following removal of these teeth, all sockets were degranulated with hand instruments and sharp bony spurs were recontoured with a rotary bur. For the sinus lift procedures, a piezoelectric hand piece (DoWell Dental, California, USA) was utilized to create a lateral window into both the left and right maxillary sinuses. Next, piezoelectric sinus elevation tips were utilized to begin elevation of the Schneiderian membranes. After initial mobility of the Schneiderian membranes were achieved, hand instrumentation was used to perform the remainder of the sinus membrane elevation. While the left Schneiderian

Figure 4: Large perforation of Schneiderian membrane in the right maxillary sinus.

Figure 5: Amnion-Chorion barrier placed onto sinus membrane perforation. Note that no stabilizing sutures are required as the barrier self-adheres to the Schneiderian membrane.

Figure 6: Placement of bone xenograft/allograft combination into the maxillary sinus and extraction sockets.

Figure 7: Amnion-Chorion barrier used to cover the lateral access window and grafted sockets.
membrane was elevated without complication, a large perforation occurred (Figure 4) during elevation of the right sinus membrane. To repair the sinus membrane perforation, a large piece of amnion-chorion barrier (BioXclude, Snoasis Medical, Denver, Colorado, USA) was placed directly onto the Schneiderian membrane (Figure 5). Care was taken to make sure that the amnion-chorion barrier completely covered the sinus membrane perforation with extension of the barrier at least 3mm beyond the lateral borders of the defect. The amnion-chorion barrier was initially placed into the maxillary sinus dry (non-hydrated) which allowed for easy manipulation and movement of the barrier. Once placed into the desired position, the patient’s own blood was utilized to hydrate
Figure 12: Presurgical CBCT scan prior to maxillary sinus augmentations (coronal view).

Figure 13: Postsurgical CBCT scan after maxillary sinus augmentations (coronal view).

Figure 14: Presurgical CBCT scan prior to maxillary sinus augmentations (transverse view).

Figure 15: Postsurgical CBCT scan after maxillary sinus augmentations (transverse view).
the amnion-chorion barrier. Upon hydration, the amnion-chorion barrier became very tacky and self-adhered to the Schneiderian membrane, thus eliminating any need for stabilizing sutures. Following repair of the perforated sinus membrane, a mixture of bone xenograft (Bio-Oss, Geistlich Pharma North America, Princeton, New Jersey, USA) and bone allograft (Maxxeus, Dallas, Texas, USA) was placed into the sinus cavity (Figure 6) and the lateral windows were covered (Figure 7) with amnion-chorion barriers (BioXclude, Snoasis Medical, Denver, Colorado, USA). The mucoperiosteal flaps were then reapproximated with 4-0 polytetrafluoroethylene sutures. Post-surgically,
the patient was prescribed pain medications, antibiotics, and steroids. The patient was seen for follow-up visits at 10, 21, 42, 90, and 120 days. After 120 days of uneventful healing, the patient was sent for a CBCT scan. The CBCT scan was evaluated for healing of the bilateral sinus augmentations and a guided surgical stent was planned (NobelGuide™, Nobel Biocare, Yorba Linda, California, USA). The second surgi-
cal procedure was carried out 150 days after the original surgical procedure. Following the administration of local anesthesia and intravenous conscious sedation, all remaining maxillary teeth were extracted and the surgical guide was affixed with three strategically placed pins. A total of 8 dental implants (NobelActive, Nobel Biocare, Yorba Linda, California, USA) were placed utilizing the surgical guide. Following removal of the guide, multi-unit healing abutments were placed on all implants with 15 Ncm of torque and white healing caps were screwed into the abutments (Figure 8). The patient was then released to the prosthodontist who adjusted and delivered an immediately loaded full-arch transitional prosthesis (Figure 9). The patient wore the transitional prosthesis for four months and then received a zirconia final restoration (Figures 10, 11).

**RESULTS**

The patient healed uneventfully and reported no differences in pain or other symptoms between the two sinuses. The CBCT scan taken at 120 days was compared to the pre-surgical CBCT scan for healing evaluation and comparison of the non-perforated augmented sinus versus the perforated repaired augmented sinus. In general, the non-perforated sinus showed a more dense bone fill compared to the repaired perforated side (Figures 12-15). When the area of the repaired sinus membrane perforation was examined in a transverse view via the CBCT scan, a well-defined radiolucent area was clearly visible (Figure 16). The non-perforated sinus had more bone fill vertically than the repaired perforated side (Figures 17-20). Although the repaired sinus did not achieve bone fill as robust or dense as the non-perforated side, adequate bone was still present for the placement of dental implants which were 11.5mm in length (Figure 21). All dental implants achieved at least 35 Ncm of torque at placement and allowed for immediate loading of a transitional prosthesis. The transitional prosthesis was placed in function for a total of four months without complication prior to the fabrication and delivery of a zirconia final restoration. After two years in function with the zirconia restoration, the patient has experienced no complications (Figures 22, 23). Comparisons of bone levels around the dental implants after two years in function revealed no difference in bone loss between the repaired perforated side versus the non-perforated side (Figure 24).

**DISCUSSION**

Multiple studies have demonstrated that it is possible to repair perforated maxillary sinus membranes and still achieve later success with dental implants. These studies base their conclusions on success comparing perforated versus
non-perforated cases in different individuals. While these studies demonstrate that repaired perforated sinus membranes do allow for dental implant success in augmented sinuses, they do not show direct healing comparisons to non-perforated membranes. Do non-perforated sinuses heal with more bone than repaired perforated sinuses? Do non-perforated sinuses heal with denser bone fills than repaired perforated sinuses? The present case report is unique because it shows direct split mouth healing comparisons in the same person with procedures performed at the exact same time. Additionally, this study is unique in the fact that it shows repair of a perforated Schneiderian membrane with an amnion-chorion barrier. To the author’s knowledge, this is the first study to demonstrate repair of a sinus membrane with such a material.

Amnion-chorion barriers inherently possess a number of unique properties that make them suitable candidates for repair of sinus membrane perforations. First and foremost, amnion-chorion barriers are extremely thin averaging approximately 300 µm in cross sectional thickness compared to Schneiderian membranes that can average as little as 800µm in thickness. The thin nature of amnion-chorion barriers makes them easy to place into tight maxillary sinuses and their self-adherent properties upon hydration eliminates the need for stabilization with sutures or tacks as is required with previously published methods. Additionally, the translucency of amnion-chorion barriers makes it easy to see if the sinus membrane perforation has been completely covered (Figure 5). Amnion-chorion barriers also contain a variety of proteins including collagen types I, III, IV, V, and VI, laminin-5, platelet-derived growth factor-a (PDGF-a), PDGF-b, fibroblast growth factor; and transforming growth factor-b that help to facilitate wound healing. A recently published study utilizing amnion-chorion barriers for guided tissue regeneration of periodontal defects noted rapid epithelial granulation coverage of exposed graft material while an additional study in which amnion-chorion barriers were intentionally left exposed to the oral cavity showed similar findings of rapid epithelial granulation formation over graft material. Both of these studies suggest that the various proteins found in amnion-chorion barriers, Laminin-5 in particular, may be responsible for this rapid epithelial granulation formation. Laminin-5 is an extracellular matrix component prominent in basement membranes and has been shown to stimulate epithelial cell migration. Immunohistochemical analysis of amnion-chorion barriers used for dental applications such as those published for guided tissue regeneration and extraction site preservation have shown extremely high concentrations of Laminin-5. It is possible that the high concentration of Laminin-5 found in amnion-chorion barriers is contributing factor to the rapid epithelial granulation formation seen with the previously published guided tissue regeneration and extraction site preservation studies. As the Schneiderian membrane is epithelial in nature, repair of perforations in this membrane via amnion-chorion barriers provides a bioactive matrix substrate across which epithelial cells of the host sinus membrane may rapidly migrate across.

CONCLUSIONS

While repaired perforated Schneiderian membranes do allow for successful placement and ultimate survival of dental implants, bone fill and bone density in these augmented sinuses do not appear to be as robust as that which is seen in non-perfo-
rated maxillary sinuses. Although the quantity and quality of bone in non-perforated augmented maxillary sinuses appears to be superior to that which is seen in repaired perforated augmented maxillary sinuses, implant success does not appear to differ between the two. In the end, dental implant survival is the true measure of success as the goal of the surgery is long-term surviving dental implants.

Finally, this case report demonstrates that amnion-chorion barriers are uniquely suited for the repair of perforated maxillary sinus membranes.

Disclosure
Dr. Holtzclaw is on the Clinical Advisory Board of Snoasis Medical and has a financial interest in the company.

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Achieving excellent esthetic outcomes after extraction and implant replacement in the esthetic zone is one of the biggest challenges for the cosmetic dentist. The problem is amplified in cases where immediate implant placement is indicated after extraction of the failing tooth as the resorption of the bundle bone can result in mucosal recession after immediate implant placement. The margin of error has to be decreased by meticulous planning. Accurate diagnosis and treatment planning with 3D implant placement and close communication with the ceramist are keys to a successful outcome. In this article implant placement and immediate provisionalization as well as laboratory communication and final restoration are discussed.

**KEYWORDS:** Dental implant, immediate placement, esthetics, prosthetics, case report

1. Private practice, Hong Kong
INTRODUCTION

Extraction and implant placement has proven to be a predictable treatment with regards to surgical success but the esthetic outcome of implants in the esthetic zone continues to be a challenge.\textsuperscript{1,2} Staging of implant placement was proposed and classified by Hammerle in 2004\textsuperscript{3} as immediate implant placement, early and delayed implant placement depending on the days of implant placement. Immediate implant placement was first presented by Schulte et al in 1978\textsuperscript{4} and recommended by Lazzara in 1989\textsuperscript{5} and others.\textsuperscript{6,7} This procedure is can be used in esthetic zone but some studies question it is a suitable method for esthetic success. From a patient’s point of view immediate placement procedures reduce treatment time, number of surgeries required and add psychological value as the patient receives a provisional immediately. Some authors have also claimed that immediate implant placement provides numerous advantages: Reduction of post extrac-
tion ridge resorption, better maintenance of the buccal plate, and as a consequence improved tissue esthetics and papilla preservation by preventing unfavorable soft tissue changes resulting from changes of crestal bone (Lazzara 1989)\textsuperscript{5}

Kan et al 2007\textsuperscript{8} and Chen et al 2007\textsuperscript{9} disagreed and opined that immediate implant will result in mucosal recession. In an animal study in dogs, Araujo et al 2005,2006\textsuperscript{10,11} have shown that immediate implant placement failed to preserve the hard tissue dimension of the ridge following extraction. The buccal as well as the lingual bone walls resorbed. On the buccal aspect this phenomenon even resulted in slight loss of bony osseointegration. The paper concluded that the ridge alteration progressed following extraction as bundle bone structure resorbs irrespective of therapy and results in mucosal recession which affects the esthetic outcome.\textsuperscript{12-15}

Delayed implant placement and various ridge preservation techniques have been suggested to minimize ridge resorption before implant place-
Clinical studies and experimental animal studies have shown that the dimension of the alveolar process as well as the profile of the ridge could be better preserved this way. In order to minimize buccal tissue recession, immediate bone grafting is proposed by some authors to fill the gap between the implant and the labial bone plate. Bio-oss particles (Geistlich Pharma AG) is a bovine bone material with slow resorption rate. It has been shown to be the best option and can significantly reduce horizontal resorption of buccal bone and preserve 70% of the labial bone. The platform switching concept adds further advantage to preserve crestal bone and achieving more predictable long-term soft tissue levels.

In this article, the author describes a case utilizing immediate implant placement in combination with a platform switched...
implant and various preservation techniques for an optimized esthetic outcome.

**CASE REPORT**
A 45 years old male patient with an unremarkable medical history presented in the office with a cosmetic chief concern complaining about a protruded upper left central incisor with spacing (Fig 1a&b). The tooth #9 had fractured due to an accident 20 years ago and had been root canal treated and crowned.

**CLINICAL EXAMINATION AND DIAGNOSTIC FINDINGS**
The patient presented with very mild generalized horizontal bone loss and was classified as an AAP Type II patient. The gingival margin of tooth #9 was incisal to the contralateral tooth.
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#8 which is favorable for the option of immediate implant placement and treatment outcome. He had a Class1 canine and molar relationship with 50% overbite and normal overjet. Static and dynamic occlusion was checked and no signs of parafunctional habits were noted. The biomechanical part of the examination noted an insufficient crown at upper left central incisor an. A bur mark was detected at the incisal third of the existing crown and the crown margin was noted to be defective (Fig 2). A dark triangle was very noticeable on the distal of tooth #9 (Fig 3). Viewing the #9 from the occlusal it was too labially placed.
**Figure 20:** Black and white photo with shade tab.

**Figure 21:** Under-exposure photo shown more detail of the natural tooth.

**Figure 22a:** Digital shade matching with detail shade mapping

**Figure 22b:** Digital shade matching with detail shade mapping.
and a size discrepancy was noted when compared to #8. Furthermore 6 mm pocket was detected at the palatal side (Fig 4) and Grade II mobility was noted. Radiographic examination (Fig 5) revealed that #9 was root canal treated and had been fitted with a post crown. Bone defects were noted at both mesial and distal area of the #9 and the lamina dura was widened especially on the mesial surface of the root. The tooth was diagnosed with a horizontal fracture. Prognosis was considered hopeless and extraction and implant placement was proposed to the patient. The patient had high esthetic expectations and medium lip mobility revealing all papillae in a full smile.
Implant replacement of tooth #9 was planned as opposed to a bridge or resin bonded bridge based on the success rates suggested by Pjetursson. The gingival margin of tooth #9 was placed in a favorable position coronal to #8. Bone sounding was carried out and the position of the osseous crest was found to be 3mm from the free gingival margin on the facial and considered favorable. The triangular crown shape and high gingival scallop of the #’s 8 and 9 and the lateral angulation of #10 contributing to the lack of distal papilla on #8 were considered unfavorable factors. Thin biotype further increased the risk of facial recession and interproximal loss of papilla. Immediate
implant placement was chosen in this case on account of the favorable labial gingival margin of tooth #9 and as it can preserve the papilla and thus enhance the esthetic outcome.

**TREATMENT**

Immediate implant placement in conjunction with bone grafting and placement of an “Immediate Provisional Seal” had been planned for the #9 site. Tooth #9 was extracted atraumatically using a periotome so as to not damage the labial plate (Figs 6 & 7). The socket was curetted and disinfected with an Er Cr: YSGG laser. The extraction socket was then examined (Fig 8) and the labial bone was measured again with a periodontal probe and make sure that the labial bone was intact and favorable for immediate implant placement.
A platform switched implant (Ankylos plus, Dentsply Friadent, German) with 14mm length and 3.5 diameter was placed. Positioning of the implant is tremendously important and usually placed in a palatal position (Fig 9), that leaves a gap between the labial bone and the dental implant. After an appropriate temporary abutment had been chosen and fitted on the implant, bovine filler particle (Bio-Oss, Geistlich Pharma AG) was placed to fill this gap\textsuperscript{33,34} and the sulcus area above the socket (Fig 10). Many authors have shown that this technique aids to maintain the buccal bone and labial soft tissue profile.\textsuperscript{26,27}

An immediate provisional crown was then fitted onto the top of the implant and fitted into the surrounding extraction socket preventing tissue collapse during healing and used as an immediate seal to hold the bovine particle inside the extraction socket and protect the blood clot (Fig 11). The provisional crown was modified after connected it to the temporary abutment to replicate the cervical anatomy of the extracted tooth. It was extended about 3mm into the extraction socket and relined with Luxatemp (DMG American) and connected to the temporary abutment (Fig 12). The subgingival emergence profile was then further modified by adding flowable composite careful not to over contour the provisional as this would result in gingival recession. Under-contouring would have been equally undesirable, as it will affect the provisional seal and the support of the peri-implant tissues, which in turn will cause collapse of the papilla and gingival contour. The author suggests observing blanching of the soft tissues when adding to the provisional restoration. A ‘bottle-neck’ suture was then placed with minimal tension to hold the gingiva to the provisional and ‘seal’ the bone graft and blood clot (Figs 13 & 14). A periapical radiograph was taken showing the bovine bone particle filler in the socket and over the implant shoulder (Fig 15).

A fiber-reinforced wing had been designed for the provisional crown to bond the adjacent tooth (Fig 16). The rationale for using this wing design was to splint the provisional to the adjacent #10 and thus minimize the load to the implant. The wing was then bonded with Rely-X (3M ESPE, Seefeld, Germany) and the implant crown was fitted to the temporary abutment without cement. The occlusion of the immediate implant crown was then checked with thick articulating paper in static and dynamic occlusion and relieved. The patient was instructed to extremely carefully brush the area for 1 week. Suture removal was scheduled one week after surgery. One month and three month follow-ups were performed.

Three months after immediate implant placement and provisionalization (Fig 17), an Er,Cr:YSGG laser\textsuperscript{35} was used to recontour the gingiva (Fig 18) and the provisional crown was modified by adding flowable composite to the subgingival part in order to shape the gingival architecture.

After 6 weeks of gingival maturation additional procedures improve the overall smile esthetics were scheduled. First Laser bleaching (Ezylase, Biolase) was used for tooth whitening to lift the overall shade. In a subsequent appointment 2 weeks later to allow for shade settling and to avoid adhesion problems.\textsuperscript{36,37} Composite (Miris, Coltene, Whaledent Switzerland) was used in a layering technique to modify the
mesial surface of tooth #8 before the impression taking. The reasons for adding composite to #8 were to widen the #8 to better balance it with #9, to minimize the canted midline, and to close the black triangle between #8 and #9.

The fabrication of a single ceramic restoration in the anterior esthetic zone is extremely challenging for both dentist and ceramist. The artistic skill of the ceramist plays an important role for the esthetic outcome and the dentist needs to be able to communicate the individual patient factors to his ceramist.

After the ideal tissue contours had been developed and matured with the provisional crown, the provisional crown was removed and the gingival third of the crown was duplicated by taking an impression of the provisional crown’s gingival third to replicate a custom impression coping. This custom impression coping was used for the impression taking of the final restoration. This method can replicate the true soft tissue contour into the working cast and to give the ceramist detailed information to fabricate the emergence profile.

To fabricate a single restoration that blends harmoniously with the adjacent dentition the shade matching procedure is of utmost importance. Shade matching is recommended at the start of the appointment, as dehydrating teeth will change their color. Appropriate documentation and photography is critical. Photos must neither over nor underexposed. The camera must be angled in the correct position towards the tooth perpendicular to the long axis, as ring and even dual flashes will otherwise produce undesirable highlights. The correct placement of shade tabs in the same plane as the tooth to be matched must also be observed. Correct room lighting color temperature is recommended as it influences the perception of color. An the ideal light color temperature of 5500-6000K is recommended. The author uses the DIAL-ITE with two 5500k bulbs that provides a correct environmental light for the shade matching.

The Vita 3-D Master Linearguide was used in this case. It consist of two steps: First the right value from five value tabs is chosen, then the proper mix of chroma and hue is selected within the chosen value range. Once the gingival, body and incisal shade tabs were selected, photographs of each of the tabs were taken next to the tooth to be matched. Additionally one photograph of all three tabs was taken (Fig 19). Black and white photographs with shade tabs were also taken to allow for accurate evaluation of value (Fig 20). One deliberately under-exposed photograph was taken in order to show maximum detail of the natural tooth (Fig 21). Finally a spectrophotometer (SpectroShade system, Clon 3D) was used for final shade matching. With the help of a digital shade analysis, a more accurate shade match and detail shade mapping prescription was produced for the ceramist (Fig 22 a&b). Photographs and study models of the patient approved provisional were all sent to laboratory.

The technician had customized a CERCON ceramic abutment (Dentsply, Friadent Germany) to fit the gum contour obtained by the custom impression coping. A zirconia coping (3M, Lava) was designed to fit onto the abutment and built up with VM 9 porcelain (Vita, Germany).

At the try-in appointment the abutment was fitted and hand tightened. Then the crown was tried in and photos with and without shade tabs were taken. Numerous pho-
tographs and comments on form where communicated to the ceramist. As it is often the case with single anterior units the first crown was used as a custom shade guide for the final restoration by the ceramist (Fig 23).

The cercon abutment was torqued with 15 Ncm (Fig 24) and the final crown (Fig 25) was cemented with Temporary cement (Temp-Bond NE, Kerr Dental). As the crown margin was placed 2mm subgingivally, removal of excess cement after final cementation is difficult and the risk of peri-implantitis due to residual cement left in the implant gingival sulcus is high. It is beneficial to prepare a duplicate cementing die replica that will remove excess cement before the crown is seated. The internal surface of the crown was isolated by brushing it with petroleum jelly and injected with bis-acryl material (LussiaTemp, DMG America) into which a plastic pin was inserted. The ‘LussiaTemp replica’ was removed from the crown after full set of the bis-acryl material. The crown was then filled with the temporary implant cement and seated on the die replica prior to intra oral seating of the crown (Fig 26).

Static and dynamic occlusion was checked and the required adjustments were carried out. Photographs were taken and a slightly low value and size discrepancy of the implant crown was noted, this was due to the patient having started bleaching again against the advice of the dentist (Figs 27-29). Although there was a slight size discrepancy between 8 and 9 the patient and the dentist felt the restoration blended harmoniously with existing dentition. The patient was happy and insistent on cementation. The photos taken two weeks after the fitting appointment show excellent color integration after slight bleaching relapse. (Fig 30) The extra oral and smile photo shown that the crown harmonized the natural dentition (Figs 31a&b). The radiograph was taken 3 months after crown cementation showing bone growth over the implant shoulder and the stability of the gum tissue (Fig 32).

**CONCLUSION**

Replacement of a single tooth in the esthetic zone is one of the biggest challenges the esthetic dentists face, but can also offer the biggest rewards. This case demonstrates how meticulous diagnosis and treatment planning in conjunction with excellent laboratory support can produce a beautiful white and pink result. This patient was extremely pleased with the outcome and appreciated the dentists’ hard work contributing a beautiful tissue result that continues to be stable 18 month after implant placement (Fig 33).

**Correspondence:**
Dr. Tak On Tse Ryan  
Rm 818, Leighton Centre, 77 Leighton Road,  
Causeway Bay HK  
Tel:+852 2881 6929  
Fax: +852 2881 6619  
tsetakon@hotmail.com
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Disclosure
The author reports no conflicts of interest with anything mentioned in this article.

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SimpleLine II
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**BioXclude™**

**Case Courtesy of Dan Holtzclaw, DDS, MS, Austin, TX**

- BioXclude over grafted socket
- 2 weeks postoperative
- 5 months postoperative

**Case Courtesy of Paul S. Rosen, DMD, MS, Yardley, PA**

- Intrabony defect
- BioXclude placement
- 6 month postoperative radiograph

- Composed of immunoprivileged tissue
- Reduces inflammation at the wound site
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- Tightly adapts over bone graft and proximal walls
- Does not need to be secured with sutures or tacks

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Patients with a somatic malady usually seek care from a health professional. Treatment often includes a written or computer-generated prescription for medication(s). Most of the time, a medication prescribed is for an antibiotic, often one from the Penicillin family (e.g., Penicillin V, Ampicillin, Amoxicillin) or from the Macrolide/mycin family (e.g., Clindamycin, Azithromycin, Clarithromycin). However, the antibiotic prescription may itself be a placebo, especially when prescribed for a viral or fungal infection (e.g., treatment of upper respiratory infections which are usually viral in origin). It is generally a patient expectation (and part of the satisfaction with healthcare treatment) to receive an antibiotic prescription when presenting with most illnesses. The health care professional, practicing in this person-to-person and treatment environment of the doctor-patient relationship, will often accede to this expectation by the patient for an antibiotic prescription (i.e., even though the doctor deems it unnecessary).

KEY WORDS: Antibiotics, placebo, psychology

1. Florida Institute for Advanced Dental Education, Miami, Florida, USA
2. Biomedical Science Faculty, Keiser University, Fort Myers, Florida, USA
INTRODUCTION
Antibiotics are employed by health care practitioners as necessities for the treatment of many infections. However, antibiotic treatment is sometimes the vehicle of risky misuse or harm to the individual and general population. What are the ethics and medico-legal ramifications of such misuse of these medications? What are the psychological expectations of patients being prescribed antibiotics? Are antibiotics commonly prescribed as “placebos” instead of required treatment by physicians and dentists? From an epidemiological standpoint, is there an overuse or misuse of antibiotics in the United States? In practice, patients expect a cure for their illness when receiving and filling prescriptions for antibiotics, whether they were deemed necessary or not. Expectations to receive prescriptions exceed healthcare practitioners’ perceptions of the wants of patients and influences actual decisions to provide needed medications.1

DEVELOPMENT OF RESISTANT BACTERIAL STRAINS
Patients obtain antibiotics and contribute to misuse in several ways2: they may exaggerate their symptoms when describing their conditions to healthcare workers, visit multiple healthcare sites for the same ailments, actually pressure their doctors for drugs, under-dose during the course of therapy and hoard the remaining doses, or obtain the medications illegally (i.e., mostly “under-the-table” from pharmacists or via the Internet). In the conduct of healthcare in the U.S., an unwritten rule of practice is “antibiotics on demand”—denying this axiom often leads to low satisfaction ratings from patients.3 Although meeting patient expectations and maintaining satisfaction are necessary in practice, over-prescribing antibiotics by healthcare practitioners and misuse by patients fosters the development of resistant strains of microorganisms in both the individual and in the general population.4

An active, interacting microflora of bacteria, viruses, and fungi exist in the bodies of each given population of patients. With an overuse of antibiotics, infections by these competing microorganisms proliferate that normally are in held in check by balanced interactions with other microorganisms or bodily tissues. In the condition thrush (oral candidiasis) disruption of the interrelationships of the normal flora of microorganisms in the oral cavity leads to the overgrowth of the opportunistic fungi Candida albicans. Unfortunately, the development of new antibiotics by the pharmaceutical industry has been outpaced by the development of drug resistance.5 Penicillin in long-time and common use for many infections has lead to the proliferation of penicillin resistant bacteria—thereby impacting the activity, metabolism, and detoxication of the antibiotic in the general population.6 The sensitivity of resistant bacterial strains to antibiotics is a function of both genetics and epidemiology.7 According to these authors, resistance of certain bacteria to antibiotics may be chromosomal bound. Furthermore, lowered antibacterial or antifungal action of antibiotics and subsequent resistance can be attributed to chronicity of use and the over-use of these medications in the general population.8

ANTIBIOTICS AS PLACEBOS
Most healthcare practitioners likely would agree that use of a placebo is better than denying the patients’ expectations of receiving a prescription.9 Studied widely under the realm of psychosomatic medicine, the placebo can be a significant force in the healing arts.10 However, the appropriateness of the use of placebos (including antibiotics) in patient
Figure 1: Flow Diagram of Antibiotic Use and Misuse

Medical/Dental Malady

Patient with Infection -> Patient in Pain

Visit to Physician/Dentist or Hospital ER

REFERRAL:
  a) Primary Care
  b) "Urgent" Care
  c) Outpatient Clinic
  d) Specialty Practice

CONSULTATION

TREATMENT (Re: Presenting Health Problem)

VALUES/Ethics

PROVISIONAL Treatment

TELEPHONE Consultation

WRITING PRESCRIPTION(S)

Antibiotic Prescription
  Given to Patient
  Necessary
  Not Necessary (Placebo Effect)

No Antibiotic Prescription
  Given to Patient

Pain Medication
  Given
  Not Given
### Table 1: Medical/Dental Therapeutics: Antibiotics for Somatic Infections

<table>
<thead>
<tr>
<th><strong>Penicillin Family</strong></th>
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<tbody>
<tr>
<td>Penicillin VK (choice as initial anti-infective)</td>
<td></td>
</tr>
<tr>
<td>Ampicillin (choice in treatment of infections caused by Enterococci)</td>
<td></td>
</tr>
<tr>
<td>Amoxicillin (choice as initial anti-infective; drug of choice for prophylaxis for prevention of bacterial endocarditis)</td>
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<tr>
<td>Amoxicillin/clavulanic acid (Augmentin)</td>
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<tr>
<th><strong>Macrolide (mycin) Family</strong></th>
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<tbody>
<tr>
<td>Clindamycin (Cleocin) (Drug of choice with Penicillin allergy: 1- for infections 2- for prophylaxis in the prevention of bacterial endocarditis)</td>
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<tr>
<td>Erythromycin (obsolete due to wide presence of resistant organisms in oral infections)</td>
<td></td>
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<tr>
<td>Clarithromycin (Biaxin) (alternative for prevention of bacterial endocarditis)</td>
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<tr>
<td>Azithromycin (alternative for prevention of bacterial endocarditis)</td>
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<tr>
<th><strong>Tetracycline Family</strong></th>
<th>(orally active--secreted through the salivary glands)</th>
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<tbody>
<tr>
<td>Tetracycline (Broad-spectrum antibiotic)</td>
<td></td>
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<tr>
<td>Doxycycline (Treatment of periodontal disease)</td>
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</tr>
<tr>
<td>Minocycline/Minocin: (Arestin) (Treatment of periodontal disease)</td>
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<th><strong>Cephalosporin Family (Bactericidal)</strong></th>
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<tr>
<td>Keflex (Cephalexin) (most active against Gram-positive cocci; used in the prevention of bacterial endocarditis)</td>
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<tr>
<td>Duricef (treatment of strep throat &amp; urinary tract infections)</td>
<td></td>
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<tr>
<td>Velosef (useful in prolonged antibiotic therapy; prevention of Rheumatic fever)</td>
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<tr>
<td>Ceclor (treatment of a wide variety of bacterial infections)</td>
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<th><strong>Antimetabolites</strong></th>
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<tbody>
<tr>
<td>Metronidazole (Flagyl) (active against anaerobic bacteria proven susceptible)</td>
<td></td>
</tr>
<tr>
<td>Chlorhexidine (Peridex) (Oral antibiotic &amp; anti-viral rinse)</td>
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treatment remains an ethical question.\textsuperscript{10} According to a 2007 policy statement by the American Medical Association about the ethics of prescribing placebos\textsuperscript{11}: “In the clinical setting, the use of a placebo without the patient’s knowledge may undermine trust, compromise the patient-physician relationship and result in medical harm to the patient.”

**HOSPITAL-BASED INFECTIONS**

Lower socioeconomic status (SES) groups often use hospital emergency rooms by “default” (or maybe cultural preference?) for medical and dental care.\textsuperscript{12} Higher hospital utilization by SES patients as compared to obtaining healthcare in ambulatory venues is often associated with poor healthcare outcomes.\textsuperscript{13} A formidable presence in the hospital environment is the propensity for development and subsequent transmission of resistant microorganisms.\textsuperscript{14} Subsequently, many hospitals have a high morbidity and mortality of infections.\textsuperscript{15} For example, the highly contagious and lethally infective \textit{Carbapenem-resistant Enterobacteriaceae} (CRE) bacteria present in some hospitals are resistant to most antibiotics.\textsuperscript{16} According to the CDC in 2014, patterns of antibiotic resistance should be determined and tracked locally at every area hospital (a program that is entitled “antibiotic stewardship”).\textsuperscript{17} Undoubtedly, the development of hospital-based “super” infections (via resistant “super bugs”) constitutes a clear danger to the nation’s public health.\textsuperscript{18}

**DISCUSSION**

Upper respiratory infections (including the common cold and sinusitis), viral pneumonia, influenza, and bronchitis have a non-bacterial etiology and are usually self-limiting or self-resolving.\textsuperscript{19} Antibiotics should not be used to treat viral or allergic infections except those with a secondary bacterial etiology.\textsuperscript{20} In a 2012 controlled and randomized study, Garbutt, Banister, Spitznagel, and Piccirillo found Amoxicillin, a widely prescribed member of the Penicillin group of antibiotics, to have no effect on acute sinus infection.\textsuperscript{21} Antiviral medicines have recently been developed and are sometimes prescribed alternatively to antibiotics; for example, use of the drug Virazole in respiratory infections.\textsuperscript{22} Besides the viral etiology, causes of upper respiratory infections include airborne pollution, allergies, a compromised immune system, or fungal mycosis.\textsuperscript{19}

Bacterial pneumonia (also known as community-acquired pneumonia) is as prevalent as its viral counterpart although the bacterial-caused variety is generally more virulent.\textsuperscript{23} However, antibiotic treatment of bacterial pneumonia may be unresponsive if the infection is metastatic from empyema (exudate in the pleural space), bacterial meningitis, acute endocarditis, or arthritis.\textsuperscript{24,25} Pneumonia transmitted within the hospital is often the cause of morbidity and mortality from infectious disease in those patients admitted for other causes.\textsuperscript{26}

According to Rao in 1998, prescribing of antibiotics should be based upon local patterns of the presence of resistant microorganisms in a given population (termed “genomic mapping”).\textsuperscript{27} Conservative prescribing in general should favor the use of narrow spectrum rather than broad spectrum antibiotics to reduce the development of resistant strains of microorganisms.\textsuperscript{28} However, extensive research evidence and subsequent information dissemination concerning antibiotic inaction in upper respiratory or other viral infections usually does not deter patients from asking for (or often demanding) them from healthcare workers.\textsuperscript{3} Pharmaceutical prescribing and subsequent usage in our society may be
suffering from a cultural problem—we expect a prescription (i.e., often an antibiotic) almost every time that we go to the doctor and often get one.

CONCLUSIONS

Programs that counter negative attitudes and inform the public about the crisis in antibiotic therapy in the United States should engage the following organizations including:

- Healthcare professions
- Mass media (e.g., articles/advertisements in print and broadcast)
- Educational systems (e.g., K-12 and colleges/universities)
- Government at all levels
- Community groups (e.g., Medical and Dental societies; Kiwanis)
- Insurance companies
- Pharmaceutical industries

Healthcare organizations must confront the prescribing problems with antibiotics and promote their judicious use. Research to promote the development of new antibiotics and therapy modes to counter drug resistance should be conducted and adequately funded. Regulation of antibiotic usage is best achieved through interventions and information dissemination to change expectations of patients about what constitutes appropriate antibiotic therapy.

Disclosure
The authors report no conflicts of interest with anything mentioned in this article.

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Treatment with dental implants in the esthetic zone can be complicated especially when there is a deficiency in the normal anatomic hard and soft tissue contours as a result of a history of periodontal disease or trauma. When a patient presents with severe vertical bone loss with subsequent soft tissue recession and shrinkage, it is necessary to perform multiple procedures to augment the hard and soft tissue contours to recreate natural anatomy and provide a framework for subsequent rehabilitation and an esthetically pleasing result.

The following case report demonstrates the treatment of such a complicated case where an extensive amount of vertical bone loss as well as a significant soft tissue deficiency was present in the esthetic zone prior to treatment.

**KEY WORDS:** Dental implants, bone graft, esthetics

1. Private practice, Fairfax, Virginia, USA
2. Private practice, Plantation, Florida, USA
3. Resident, Department of Periodontology, Nova Southeastern University, Fort Lauderdale, Florida, USA
INTRODUCTION

Alveolar ridge defects are a result of tooth loss that leads to dimensional reduction of bone and soft tissue surrounding the alveolus. Alveolar ridge defects often present as unaesthetic depressions, clefts or creases in the gingiva, which frequently trap food. A deficient edentulous ridge in the esthetic zone can be a challenge for the dental practitioner, both in restoring the anatomic contours surgically as well as meeting the patient’s esthetic demands restoratively.

Patients, who don’t wish to have their missing teeth and soft tissue to be replaced with removable prosthesis, have the option of fixed partial dentures or implant supported restorations. However, without re-establishing anatomic hard and soft tissue contours, these prosthetic restorations have a tendency to appear too long in inciso-occlusal and/or too wide and bulky in bucco-lingual dimensions giving an unnatural and frequently unappealing appearance. Attempts have been made to compensate for the collapsed ridge by applying either pink acrylic or pink porcelain to restorations, which often pose a challenge for oral hygiene measures and can lead to esthetically unsatisfactory outcomes because of the presence of a noticeable interface between the tissue-colored restoration and the gingiva.

There have been several surgical techniques described in literature to restore missing soft and hard tissues. Guided bone regeneration is commonly applied, which uses either resorbable or nonresorbable barrier membranes, bone graft materials or tenting screws and has been proven successful in repairing bone defects.1-4 Soft tissue deficiencies of the alveolar ridge have been reconstructed with autogenous graft or allograft materials. Ridge augmentation with a thick free epithelialized graft was first published by Meltzer (1979) to correct an esthetic anterior vertical ridge defect5 and later in 1980, the roll-technique was described by Abrams using a de-epithelialized pedicle graft taken from the palate and placed on the edentulous ridge.6 Seibert confirmed the predictability of free gingival grafts and described his technique and application of the soft tissue onlay graft in a series of articles to rebuild edentulous ridge deformities.7,8 Langer and Calagna introduced the subepithelial connective tissue graft and rationalized the addition of the graft beneath a partial thickness flaps for ridge augmentation9. Advantages of connective tissue grafts compared to free gingival grafts are less postoperative discomfort at the donor site, more predictable revascularization and improved esthetics.10 Besides Abrams, Wang also described a technique that utilized a pedicle graft, in his case a connective tissue pedicle graft, which was taken from an adjacent surgical site and rolled into the anterior edentulous ridge to restore the ridge defect.11 Pedicle grafts have the same donor and recipient site thereby leading to less patient discomfort and morbidity compared to free soft tissue grafts. Also, with the additional blood supply through the pedicle, graft survival and vascularization is more predictable as opposed to free soft tissue graft procedures.

The following case report demonstrates a surgical technique to simultaneously augment both hard and soft tissues, using a double palatal pedicle graft and bone augmentation with particulate grafting material to...
restore normal anatomical contours prior to implant placement. These procedures were indicated to minimize the severe soft and hard tissue defects present and rehabilitate anatomical contours to achieve an esthetically pleasing outcome in the anterior maxilla.

**CASE REPORT**

A 35-year-old male patient presented to the faculty practice at Nova Southeastern University in 2010 with a chief complaint that he didn’t want to smile because of the unaesthetic appearance of his front teeth. He had a history of trauma and extensive dental treatment of the anterior max-
illary teeth which included previous endodontic treatment of teeth Nos. 8, 9 and 10 as well as severe horizontal bone loss of these teeth. Crowns had been placed on teeth Nos. 8, 9 and 10 more than 10 years prior to our evaluation. Due to the patient’s high smile line, the previous restorative dentist attempted to mask the severe vertical hard and soft tissue deficiency with restorations (pink porcelain) (Figure 1). The patient’s medical history was noncontributory.

Intraoral examination revealed severe, asymmetrical soft tissue recession of the gingiva of teeth Nos. 8, 9 and 10. Recession of greater than 7 mm was noted on teeth Nos. 8 and 9 and recession of 3 mm was noted on tooth No. 10. In addition, soft tissue recession on teeth Nos. 8 and 9 extended past the mucogingival junction, leaving 0 mm of attached, keratinized tissue apical to the recession defects of these teeth. Marginal soft tissue presented red, rolled and edematous and there was an obvious loss of stipple and normal anatomy of the gingiva around teeth Nos. 8 and 9 (Figure 2). Periodontal evaluation revealed that teeth Nos. 8-10 presented with severe periodontal probing depths ranging from 9-11 mm and suppuration was noted upon palpitation of the marginal gingiva associated with these teeth. Significant mobility (Grade II and III) was detected on teeth Nos. 8, 9 and 10 and mild mobility (Grade I) was noted on tooth No. 7. Radiographic examination revealed severe horizontal bone loss of teeth Nos. 8-10 and periapical pathology consistent with chronic apical periodontitis as well as internal and external root resorption of the apices of these teeth (Figure 3).

A diagnosis of localized severe chronic periodontitis and chronic apical periodontitis was made for teeth Nos. 8-10. Tooth No. 7 was diagnosed with localized mild chronic periodontitis. Prognosis of tooth No. 7 was poor at the time of initial evaluation while teeth Nos. 8-10 were deemed hopeless.

**Treatment sequence**

- Treatment planning for the anterior maxilla was completed and the following treatment sequence was developed.
- Extraction of hopeless teeth (Nos. 8-10) and soft tissue augmentation
- Guided bone regeneration for site development in preparation for future implant placement
- Re-evaluation of tooth No. 7
- Implant placement at sites 7 and 10 following extraction of tooth No. 7 with additional bone grafting
- Apically positioned flap and placement of extracellular matrix membrane to increase keratinized gingiva
- Uncovering of implants Nos. 7 and 10
- Final restoration

**SURGICAL PROTOCOL**

Following administration of local anesthesia, teeth Nos. 8-10 were extracted with forceps only. Due to long-standing inflammation, infection and tooth mobility, the sockets of teeth Nos. 8-10 were epithelialized internally (Figure 4). Following extraction, the sockets were de-epithelialized prior to flap elevation. Bone sounding and evaluation of the position of the buccal plate of bone was performed and confirmed the radiographic findings of severe horizontal bone loss of teeth Nos. 8-10. Due to the severe soft tissue defects present at this time, soft tissue grafting was initiated following the protocol listed above.

A 15c blade was used to place a beveled ver-
tical incision in a curved fashion mesial to teeth Nos. 7 and 11 followed by full thickness flap reflection. All remaining granulomatous tissue and foreign materials were then carefully and meticulously debrided from the site with curettes and bone files. Irrigation with copious saline solution was also performed. A bilateral palatal pedicle graft was harvested using previously described techniques to provide as much soft tissue augmentation as possible.\textsuperscript{11,14-16} Prior to fixation of the palatal pedicle grafts, bone augmentation with particulate grafting material such as Regeneross

**Figure 5:** Placement of double palatal pedicle graft and bone augmentation with particulate grafting material (FDBA and bovine bone xenograft).

**Figure 6:** Healing after soft tissue augmentation.

**Figure 7:** Placement of implants 7 and 10, 6 weeks after soft and hard tissue augmentation.

**Figure 8:** 4 months healing after implant placement with bone grafting.
freeze dried bone allograft (BIOMET 3i, Palm Beach Gardens, FL) and Bio-Oss bovine bone xenograft (Geistlich, Princeton, NJ) was completed by packing the graft material into the sockets and the residual buccal plate of teeth Nos. 8, 9 and 10 (Figure 5). It should be noted that no membrane was used at this time, as the authors did not expect to obtain primary closure over graft due to the severe soft tissue deficiency, which was present at the surgical site. Suturing of the palatal pedicle grafts was completed with resorbable sutures to the buccal defects of the newly edentate sites of teeth Nos. 8 and 9, which presented with the most severe soft tissue deficiencies. A periosteal releasing incision was completed and the overlying buccal flap was coronally positioned to obtain tension free closure over the bone graft material and overlying palatal pedicle grafts.

Healing following this initial treatment protocol was uneventful. It should be noted that while soft tissue closure was obtained, the coronal flap repositioning that was employed led to a significant coronal migration of the mucogingival junction at sites 8, 9 and 10 (Figure 6).

Following 6 weeks of healing, a second procedure was initiated with the primary objective of augmenting the underlying bone in preparation for implant placement. Following local anesthesia, a 15c blade was used again to place a beveled vertical incision mesial to teeth Nos. 6 and 11 and a full thickness flap was elevated. At this time, tooth No. 7 was re-evaluated in terms of long term prognosis and the decision was made to extract this tooth due to its history of mild to moderate horizontal bone and mobility. Evaluation of the alveolar ridge at sites 7 and 10 revealed adequate ridge width to support implant placement at this time. Therefore, implant placement was completed using bone level endosseous implants (Figure 7). Following implant placement, guided bone regeneration was performed with particulate graft material and placement of a resorbable cross-linked collagen barrier membrane. Tension free primary closure was achieved.

Following another 4 months of uneventful healing, intraoral examination revealed that the mucogingival junction was significantly more coronal as a result of the previous surgical protocol that was employed. Therefore an additional procedure was planned to correct this deformity (Figure 8). Following adequate local anesthesia, a split thickness flap was elevated and apically positioned in the area of teeth Nos. 7-10. To minimize potential shrinkage of the remaining soft tissue covering the underlying alveolar bone, a Dynamatrix extracellular matrix membrane (Keystone, Burlington, MA) was utilized to cover the exposed partial thickness reflection. This dermal matrix was sutured in place with single interrupted sutures (Figure 9). Healing of this procedure revealed a steady, gradual migration of keratinized tissue to the surgical site. Six weeks following this procedure implants were uncovered with standard techniques and a final impression was taken 2 months later.

**RESULTS**

Following surgical treatment, the patient received an implant retained fixed porcelain fused to metal bridge fabricated from sites 7-10 (Figures 10, 11 and 12). Final crown dimensions were symmetrical and offered a significant improvement when compared to the patient’s pre-treatment presentation. The associated gingiva was firm and keratinized and the mucogingival junction was more than 4-8 mm apical to the margin of the crowns of implants Nos. 7 and 10 (Figure
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Figure 8: 4 months healing after implant placement with bone grafting.

Figure 9: Placement of an extracellular matrix membrane combined with apically positioned flap.

Figure 10: Buccal view of the final restoration.

Figure 11: Final periapical radiographs.

10). The crowns Nos. 7-10 were fabricated with long contacts and rectangular forms to minimize the appearance of black triangles (Figure 12).

DISCUSSION
Treatment of cases in the esthetic zone that present with a severe history of disease or trauma often require multiple procedure to augment the
hard and soft tissue contours.\textsuperscript{16} Prior to guided bone regeneration, it is often necessary to augment the soft tissue volume in order to satisfy the prerequisites for successful bone regeneration and healing.\textsuperscript{17,18} In this case a bilateral palatal pedicle graft was employed at the time of extraction to increase the shear bulk of tissue available and to obtain tension free primary closure during subsequent implant placement and bone grafting procedures. Furthermore, the palatal pedicle grafts were used to provide as much of an improvement in soft tissue anatomy as possible to mimic normal anatomical contours. While particulate bone grafting material was adapted to the residual sockets and buccal plate prior to fixation of the palatal pedicle grafts, no membrane was employed because the author originally planned to re-enter the site 6 weeks after extraction and soft tissue augmentation, following soft tissue healing, to perform guided bone regeneration.

It should be noted that prior to flap elevation of the second procedure (implant placement and guided bone regeneration), the authors were uncertain as to whether implants would be able to be placed at the time of guided bone regeneration. Once adequate alveolar bone width was visualized, implant placement with simultaneous guided bone regeneration was employed to minimize the number of procedures the patient would have to endure.

Following 4 months of healing of the implants and the guided bone regeneration, an additional procedure was performed to correct the position of the mucogingival junction for long term stability and color matching of the adjacent gingiva as this patient presented with a very high smile line. A free gingival graft may have accomplished the same functional result but with a poor color match.\textsuperscript{19} Treatment with an apical positioned flap alone may also have been successful but would have risked substantial shrinkage of the valuable buccal hard and soft tissue. It is the author’s opinion that treatment with an apical positioned flap and use of an extracellular matrix membrane, a natural gingival appearance by way of exposing the desired keratinized area can be promoted and provide a matrix to allow for migration of keratinized tissue to the surface.

**CONCLUSION**

Rehabilitation of a previously diseased alveolar ridge segment in the anterior maxilla can be very complex and complicated. While regeneration of lost bone height is the ultimate goal, vertical bone regeneration is often unpredictable and difficult to achieve. Therefore, it is often necessary to plan for substantial soft tissue augmentation to help provide contours that mimic normal anatomy. Also, soft tissue augmentation prior to guided bone regeneration is often indicated to allow for tension free closure over future bone grafted sites.\textsuperscript{20} Fur-
thermore, it is not only important to provide an increase in volume of soft tissue; it is of equal importance that the texture, tone, and color of this tissue mimic normal anatomical parameters to achieve an esthetically pleasing outcome.

Correspondence:
Dr. Nina Cunningham
Email: ne117@nova.edu

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