

The Use of DynaMatrix Extracellular Membrane for Gingival Augmentation and Root Coverage: A Case Series

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Abstract



Over the years, mucogingival surgery has developed into an integral part of periodontal therapy. Mucogingival defects and deformities are conditions that deviate from the normal anatomic relationship between the gingival margin and mucogingival junction. Some of the most common conditions are gingival recession, an absence or insufficient amount of keratinized tissue, and the presence of probing depths extending past the mucogingival junction. A common factor is, often, the existence of alveolar bone loss. However, in

spite of the many advances made in surgical techniques and materials, the coverage of denuded root surface has primarily focused on the soft tissue and not on the underlying bone loss. This article presents a series of cases illustrating techniques that have yielded favorable surgical outcomes in challenging circumstances involving the incorporation of allogeneic bone putty and an extracellular matrix scaffold into the process of repair and reconstruction.

KEY WORDS: Gingival augmentation, root coverage, periodontal plastic surgery, guided tissue regeneration

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INTRODUCTION

The goal of mucogingival surgery has been to create, conserve, and preserve a functionally adequate band of gingival tissue. Lang and Loe previously established that a minimal zone of 2mm of keratinized tissue was essential to maintain gingival health.¹ From studies by Kennedy and Dorfman, this band may be much narrower than originally purported and is often predisposed to inflammation and recession.² The surgical techniques developed and used in the past have essentially been grounded in manipulation and use of only soft tissue. Traditionally, a lateral positioned pedicle graft was first introduced by Grupe and Warren³ and subsequently outlined by Wilderman and Wentz.⁴

For years the primary means of augmenting gingiva and covering roots was the free palatal tissue autograft. Bjorn,⁵ Pennel and King,^{6,7} Cowan,⁸ and Nabers^{9,10} were all pioneers in reporting the use of this procedure. Later in 1968 Sullivan and Atkins¹¹ refined the technique and outlined the wound healing associated with the procedure. Over the years many additional investigators explored enhancements and alterations to existing techniques in order to refine and improve outcomes. In 1977 Maynard¹² and Bernimoulin¹³ published on coronally positioning of a previously placed autogenous gingival graft.

Tissue grafting procedures that increase the amount and quality of attached keratinized gingival tissue, and cover exposed and denuded root surfaces accomplish a number of objectives: the prevention of additional root exposure, decreased or eliminated sensitivity to thermal and other stimuli, decreased susceptibility to root caries, and improved esthetics. As a result, various surgical techniques were developed to

augment the zone of attached keratinized gingiva. Clinicians have utilized autogenous gingival or connective tissue grafts, freeze-dried skin allografts, and acellular dermal matrix. Each method yielded a variety of results, and each technique presented clinical compromises.¹⁴⁻¹⁸

While autogenous soft tissue grafts have demonstrated clinical efficacy, they require a donor site. Harvesting the tissue adds to patient discomfort and can increase the likelihood of complications. The use of an allogeneic soft tissue grafts like Alloderm[®] (Lifecell Corp, Branchburg, NJ, USA) an acellular dermal graft, was an attempt to offset many of the negative aspects associated with harvesting donor tissue. However, the acellular dermal matrix presented certain clinical limitations in handling characteristics, surgical technique, and in enhancing the quality and quantity of keratinized tissue.

It is generally accepted that attached keratinized tissue is an integral part of the periodontium, and serves to function as an effective barrier by facilitating resistance to tissue damage from traumatic insults. This observation was amplified in a recent study conducted at Harvard University by Nevins et al.¹⁹ and published in 2010. Their investigation was conducted to assess the efficacy of an extracellular membrane (DynaMatrix[®], Keystone Dental, Burlington, MA, USA) in augmenting keratinized tissue. The results suggested that the "membrane may present a viable substitute for the autogenous gingival graft" when the objective is to increase the dimension of the keratinized attached gingival.

The study by Nevins et al.¹⁹ compared treatment utilizing a free gingival graft versus an extracellular matrix (DynaMatrix[®]) and determined that both techniques produced a significant increase

in the amount of keratinized gingival tissue. In addition, the matrix-generated tissue was comparable histologically to the tissue derived from the autograft. The study concluded that the DynaMatrix® extracellular matrix blended well with surrounding tissue, and it produced superior esthetic outcomes when compared to the autogenous graft. Finally, the report suggested that the extracellular matrix be considered in the treatment for patients with gingival recession.

This particular current investigation and case series builds on the study by Nevins and co-workers. Seven case studies were documented during 2009 and 2010 in Richmond, Virginia, and involved a variety of periodontal issues and defects. A critical difference from previous studies involved the treatment of gingival recession and root denudation. This investigation was not a controlled study. However, based on the clinical outcomes, perhaps a new paradigm may be developing with respect to treating significant cases of gingival recession. The author believes it is vital to explore the causality associated with gingival recession. Certainly a common denominator in all cases of gingival recession and denudation is bone loss. However, when one reviews the literature on treatment of gingival recession, seldom is there any mention of the role or treatment of lost alveolar bone.

Some of the techniques outlined in this article add another dimension. The motivation was to determine if it were feasible to treat some of the underlying bone loss, which contributes to the recession along with obtaining root coverage. With that objective in mind a surgical methodology was adopted for the majority of patients in this case study.

METHODS

Seven patients were selected for the study. Each patient had varying degrees of gingival recession and osseous destruction. Selection was based on a moderate to severe level of pathology with obvious clinically relevant defects, and with an interest in regenerating, reconstructing, and repairing the damage to the periodontium.

In essence, this series of cases was intended to evaluate the efficacy of the DynaMatrix® extracellular matrix membrane in a variety of treatment modalities. Many of the articles written about this membrane have outlined the fundamental qualities of the matrix.²⁰ The membrane is obtained from the small intestine submucosa of the pig and has been dubbed SIS technology by the producer Cook Biotech Incorporated. The matrix is utilized as the structure to retain a construct of collagen (types I, III, IV, and VI), proteoglycans, glycosaminoglycans, glycoproteins, and additional growth factors such as fibronectin.

Investigation into the formulation and fabrication of the matrix-membrane warrants additional explanation. Hodde and co-workers²⁰ investigated the effects of sterilization on the matrix scaffold and determined that a “biologic scaffold can be prepared for human use and still retain significant bioactivity.”

DynaMatrix® has been successfully used in the treatment of a variety of damaged and or diseased tissues in humans. The biologic scaffold stimulates the repair of compromised tissues and organs with tissue similar in form and function to that which it replaced. It is not within the purview of this case study series to explore in depth the biology and biochemistry of



Figure 1: Localized gingival recession on tooth #25.



Figure 2: Flap design to allow for access to denuded root and bone.



Figure 3: DynaBlast bone putty packed around exposed roots



Figure 4: Extracellular membrane (DynaMatrix) placed and hydrated with blood.



Figure 5: Coverage of site with a laterally positioned flap (pedicle); DynaMatrix is left exposed on donor site.



Figure 6: 9 day post-op with tissue development.



Figure 7: 6 week post-op with significant tissue development and normal healing.



Figure 8: 6 month post-op with developed keratinized tissue and successfully covered exposed root.

the matrix. However, it is accepted that using a cell-free wound dressing derived from the extracellular matrix of the small intestine of the pig can facilitate the repair of damaged and diseased tissues. With these fundamental constructs in place acting as a theoretical foundation, a series of cases was undertaken to assess the efficacy of the DynaMatrix® membrane.

A five step surgical process was adopted for the majority of the patients in this case study:

1. Exposure of the defect with thorough debridement
2. Placement of bone putty (DynaBlast®)
3. Placement of DynaMatrix® membrane over bone graft
4. Ligation of the matrix to surrounding tissue
5. Soft tissue coverage of the surgical site

Healing was evaluated and assessed several times over the following months. The initial postoperative evaluation took place 9-10 days following the surgical procedure. In addition, follow-up visits were scheduled over the next six months. Clinical images were obtained and reproduced with the patients' consent.

RESULTS

Case 1:

The patient presented with localized gingival recession and severe bone loss on the facial of tooth #25 (figure 1). The gingival margin around the exposed tooth was resected (No. 15 Bard-Parker blade) to the depth of the pocket using a v-shaped incision. A gingival flap was developed which was somewhat larger than the recipient site (figure 2). After the flap was elevated and reflected, the root surface was thoroughly scaled and planed. The bone putty (DynaBlast®) was then placed around the exposed root and extended coronally to the cemento-enamel junction (figure 3). Complete coverage of the denuded root was obtained with the bone putty. The extracellular matrix membrane (DynaMatrix®) was placed on the bone graft and completely covered the exposed roots (figure 4). The matrix was then hydrated with the patient's blood and secured with sutures (5-0 resorbable). In this particular case, a laterally positioned flap (pedicle) was used to cover the surgical site (figure 5). The patient was seen for follow-up



Figure 9: Tooth #24 demonstrates localized gingival recession and insufficient keratinized tissue along with aberrant frenum.



Figure 10: Mucoperiosteal flap developed to expose roots.



Figure 11: DynaMatrix placed and hydrated with blood.



Figure 12: Laterally positioned pedicle flap positioned over DynaMatrix and sutured.



Figure 13: 9 days post op, epithelial tissue development over DynaMatrix.

care nine days post operatively and healing was progressing uneventfully (figure 6). Six weeks post-operatively there had been favorable tissue development along with normal healing (figure 7). Finally, the six-month follow-up demonstrates significant coverage of the denuded root with well-developed keratinized tissue (figure 8).

Case 2

The patient presented with localized gingival recession and insufficient keratinized tissue along with a concomitant aberrant fre-



Figure 14: Teeth #24 and #25 have localized recession and inconsistent tissue heights due to severe bone loss.



Figure 15: Mucoperiosteal flap developed to expose root surface



Figure 16: DynaMatrix® placed and hydrated with blood.



Figure 17: Adjacent tissue was laterally positioned and DynaMatrix sutured into place.

num associated with tooth #24 (Figure 9). A mucoperiosteal flap was created to expose the root and to permit a frenectomy (figure 10). Debridement of the site was performed and subsequently DynaMatrix® was placed, hydrated with the patient's blood and secured (figure 11). In this particular case bone augmentation was not performed. A pedicle flap was used to gain soft tissue coverage of the site (figure 12). The nine-day postoperative image (figure 13) reveals normal healing and root coverage for this time period.

Case 3:

The patient presented with localized gingival recession on teeth #24 and #25 (figure 14). Significant crowding likely had an impact of the extant facial bone loss. A mucoperiosteal flap was developed to expose the roots and revealed extensive denudation (figure 15). Following debridement of the site along with scaling and root planing, DynaMatrix® was placed, hydrated with the patient's blood, and secured (figure 16). Adjacent tissue was laterally positioned to cover the site (figure 17). In this particular case an area of



Figure 18: 7 days post op, successful healing and epithelialization of DynaMatrix.

matrix was left exposed to evaluate claims that no negative consequences are anticipated with exposure and bone grafting was not performed. However, osseous augmentation would be perfectly justified based on expected outcomes. After one week, uneventful healing was taking place and the area of exposed membrane was epithelializing without complications (figure 18).

Case 4:

The patient presented, following a referral from an orthodontist, with a shallow mandibular anterior vestibule characterized by a limited amount of attached keratinized gingiva (figure 19). An incision was made at the mucogingival junction and reflected to expose the periosteum of the bone (figure 20). Fur-



Figure 19: Shallow vestibule with little keratinized tissue.

ther dissection resulted in removal of attached muscle fibers from the bone. DynaMatrix® was adapted to the site and hydrated with blood (figure 21). The membrane was secured by sutures and then the site dressed. The healing was uneventful and at ten days healthy keratinized tissue was developing (figure 22).

Case 5:

The patient presented with severe gingival recession on teeth #24 and #25 (figure 23). The likely source of the periodontal pathology may well relate to the ongoing orthodontic therapy. Both teeth demonstrated significant loss of facial bone as well as alterations in the color, contour, texture, and consistency of the gingiva. Two independent laterally positioned flaps were used in the treatment of this problem and they were not performed on the same day. As in other instances a v shaped incision was used to remove the affected gingival tissue (figure 24). Debridement of the site as well as scaling and root planing of the teeth



Figure 20: Incision was made at the mucogingival junction.



Figure 21: DynaMatrix® was placed and hydrated with blood.



Figure 22: 10 day post op, expanded vestibule and healthy, keratinized tissue was developing.



Figure 23: Teeth # 24 and #25 demonstrate severe localized gingival recession and bone loss in association with orthodontic treatment.



Figure 24: V-shaped flap was created to expose the root.

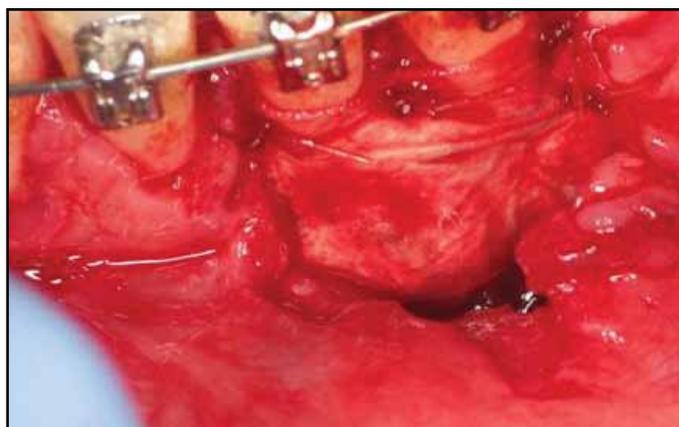


Figure 25: DynaMatrix placed, hydrated with blood and sutured into place with adjacent tissue.



Figure 26: 6 months post op with tissue development over exposed root.

was performed. This was followed by placement of the matrix and ligation of the membrane (figure 25). Closure was obtained by creating a laterally positioned pedicle graft. Figures 26 and 27 demonstrate favorable healing and improved root coverage after 24 and 26 weeks.

Case 6:

The patient presented with an insufficient zone of attached gingiva in the mandibular anterior region (figure 28). A shallow vestibule was present and was noted by the referring orthodontist. An incision was made at the mucogingival junction and after reflection and dissection of muscle fibers, DynaMatrix® was placed, hydrated with blood and sutured into place (figure 29). A six week follow up image revealed healthy tissue development with an esthetic outcome (figure 30).

Case 7:

The patient presented with a thin zone of attached gingiva (figure 31). The referring doctor had requested augmentation of the attached and keratinized tissue. An incision



Figure 27: 6.5 month post op with developed keratinized tissue.

was made at the mucogingival junction and after reflection, dissection of muscle fibers, DynaMatrix® was placed, hydrated with blood and secured with sutures to the adjacent tissue (figure 32). The site was dressed with periodontal pack and a six week follow-up image demonstrates a thicker and broader band of healthy keratinized tissue (figure 33).

CONCLUSION

This case series demonstrates the efficacy of DynaMatrix® extracellular membrane for the treatment of both localized gingival recession as well as for the development of attached keratinized tissue. Post-operative evaluation revealed successful tissue remodeling in the treated areas combined with enhanced root coverage of areas of localized recession. Substantial increases in the volume of keratinized tissue were noted.

In addition to the successful outcomes, DynaMatrix® extracellular membrane offers a number of advantages over traditional methods of soft tissue grafting. This is especially noted as it relates to the procurement of donor tissue.



Figure 28: Insufficient zone of attached gingiva.



Figure 29: Incision made at mucogingival junction, DynaMatrix placed, hydrated with blood and sutured to adjacent tissue.



Figure 30: 6 week post op with healthy tissue development.



Figure 31: Thin zone of attached gingiva.



Figure 32: Incision was made at mucogingival junction. DynaMatrix was placed, hydrated with blood, sutured into place with adjacent tissue and left exposed.



Figure 33: 6 week post op with thicker tissue and healthy keratinized tissue development.

The use of the matrix may reduce the need for a surgical intervention in a secondary or donor site as required in autogenous mucosal grafts including subepithelial connective tissue grafts. For patients, eliminating a donor site reduces the likelihood of post-operative pain, bleeding, and infection. Furthermore, it reduces the treatment time and enhances the patient's overall experience. The extracellular membrane does not require enclosure within the patient's existing tissue and the material may be left exposed in the surgical site. Ultimately, it blends with native tissue and produces a fine esthetic result.

Thus, results outlined here support the use of this extracellular matrix or scaffold. It poses unique attributes for periodontal surgery acting as an alternative to autogenous mucosal grafts. Furthermore, it may well enhance the surgical outcomes of achieving root coverage in the advanced case as well as augmenting the keratinized tissue present. ●

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Disclosure

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

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