Stented Porcine Collagen Matrix to Treat Inadequate Facial Attached Tissue of Dental Implant Supported Fixed Partial Dentures

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INTRODUCTION

When dental clinicians place implants to restore partially or completely edentulous atrophic sites there may be a lack of supporting soft tissue. The optimal time to correct this is prior to implant placement. Nevertheless, it may be necessary to increase the zone of supporting soft tissue after delivery of the prosthetics. This postdelivery situation may be due to patient factors, tissue atrophy, clinical oversight, misjudgment, or slight soft tissue deterioration.[1] Methods to correct this include free gingival or submucosal graft, lateral position graft, apical position graft, dermal allograft, or collagen xenograft. Soft tissue augmentation with collagen xenograft has been studied in the past.[2] Recently available porcine collagen xenograft matrix material (Mucograft, Osteohealth, Shirley, NY) may be used to augment soft tissue support at the facial of natural teeth.[3,4] This material has been applied to augment soft tissue at the facial of dental implant-supported prosthetics and was found to be equal to other graft materials and techniques.[5]

The object of this article is to discuss the use of porcine collagen xenograft to augment supporting soft tissue at the facial of dental implant-supported fixed dentures and crowns using a bis-acryl stent technique.

CASE EXAMPLES

Eleven patients had cement-retained implant-supported fixed partial dentures or splinted crowns (Table). The sites were deemed to have no facial soft tissue support of the partial dentures and splinted crowns (Figures 1 and 2). According to visual examination, periodontal probing compression of the facial soft tissue occlusally against the gingival margin, and measurement of the remaining immovable facial tissue, there was no attached tissue (Figure 2). All patients were treated with an apically positioned partial thickness flap. An incision with a #15 scalpel at the mucomarginal junction was made, leaving the marginal cuff intact (Figure 3). Bleeding was controlled with a saturated (16%) aqueous tranexamic acid tamponade, or blue-violet composite light, to prevent postoperative bleeding from under the stent (Figure 4).[6] The porcine collagen was measured to fit the site and placed on the submucosal tissue. A rectangular segment of porcine collagen (Mucograft, Osteohealth, Shirley, NY) 8- to 10-mm wide was placed with an appropriate length to cover the surgical wound (Figure 5).[7] This was immediately covered with a bis-acryl stent (TempPhase, Kerr, Orange, Calif) before becoming soaked with blood ad modem Flanagan (Figure 6).[6] The bis-acryl mixing gun tip was cut and flattened with a needle holder. A ribbon of mixed bis-acryl was then expressed gingerly onto the surgical site engaging prosthetic and adjacent teeth for mechanical retention. The uncured matrix may be quickly shaped with wet cotton tips before it hardens. The stents were removed after 5–7 days and the site evaluated for healing (Figure7). After 4–12 weeks the sites were measured for soft tissue healing (Figure 8; Table). Figures 9 and 10 show a maxillary left posterior site at 1 postoperative week (Figure 9) and at 12 weeks (Figure 10). Attached tissue or gingiva is the measurement from the base of the peri-implant sulcus to the mucogingival junction. This measurement was not done because of the uncertain nature of the resulting tissue. All facial soft tissue appeared to support the facial implant margin.

RESULTS

All sites healed uneventfully. No tissue appeared to be keratinized attached gingiva but most appeared to be immobile mucosa. The tissue quality was such that it protected the implant prosthetic margin from muscle tension pulling. The average increase in protective tissue was 3.6 mm (Table). Since the preoperative sites had no protective keratinized tissue, the addition of several millimeters of immobile mucosa may be adequate. Most sites resulted in healing into immobile mucosa and not typical appearing attached gingiva. Since this was a retrospective study in a private general dental facility, no tissue biopsies were performed to histologically describe the resulting tissue. Histologic analysis has been done in previously published work.[4]

DISCUSSION

All of the prior published work on this material has been for augmentation of soft tissue at the facial of natural teeth.

The cases described herein were treated after prosthetic delivery. The optimal time to augment soft tissue is before

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DOI: 10.1563/aaid-joi-D-15-00050

Table

Patients treated with porcine collagen graft with an acryl stent at various postoperative measurements; measurements were taken from the crest of the gingival margin to the junction of the immobile mucosa or perceived attached gingiva and the flaccid mucosa

Patient/Sites	Postoperative Time Measured	Postoperative Fixed Tissue (mm)	Assessed Result
JK #13-15	19 months	5.0	Attached gingiva
MS #13-14	9 months	4.0	Attached gingiva
MS	7 months	5.0	Immobile mucosa
DB #18-20	6 months	4.0	Immobile mucosa
JV #3-5	6 months	2.5	Immobile mucosa
TW #19-21	8 months	2.0	Immobile mucosa
GM #30	18 months	3.0	Immobile mucosa
MA #6-7	18 months	3.0	Immobile mucosa
BC #29-31	17 months	1.5	Immobile mucosa
WL #7-8	11 months	2.0	Immobile mucosa
BB	11 months	5.0	Attached gingiva
Average		3.36	

implant placement but an inadequacy can be addressed after prosthetic insertion. Nevertheless, the implant soft tissue margin needs to be protected from muscle tension pull.[8] Protecting the implant percutaneous margin from muscle tension pulling may prevent facial peri-implantitis.[8] There is controversy as to the importance of the attached facial soft tissue.[8] Keratinized attached gingiva or immobile mucosa may be adequate protections.[8] An adequate zone of keratinized tissue is associated with peri-implant tissue health but randomized controlled trials are needed to support this concept.[8]

The porcine type 1and 3 collagen matrix (Mucograft) used in these cases is made by a proprietary processing porcine collagen and gamma radiation sterilizing process.[7] It is provided in a 2-layer matrix, a thin stiff compact outer layer, and a thicker soft inner layer. The compact collagen type 1 and 3 layer purportedly occludes cellular migration. The soft inner type 1 collagen porous layer is placed directly on the surgical site and facilitates clot formation and cell migration. The manufacturer also claims that the product has low antigenicity and excellent biocompatibility but equivocates as to the production of an inflammatory reaction.[7] The collagen matrix is resorbed and does not need to be retrieved. Resulting tissue was biopsied by Schmitt and coworkers[9] and was found to be keratinized multilayered squamous epithelium. The tissue contained differentiation specific markers cytokeratin 5/6, 13, and 14 indicating keratinization.[9] They also found about 30% shrinkage of the graft matrix treatment area. Herford and coworkers[10] found shrinkage to be 14% and an average soft tissue extension of 3.4 mm average.

One study of acellular heterologous porcine collagen matrix grafting compared with split thickness dermal autografts on skin burns found that, histologically, the resulting grafted tissue had a clear and continuous basal membrane, a mature stratum corneum and rete pegs, and uniform dermal collagen fiber structure.[11] Clear desmosomal regions were identified among dermal Merkel cells, which are somatosensory for perception of light touch. The presence of these cells demonstrates a maturity of healing. The porcine matrices showed an improved shape and functional recovery compared with the split-thickness dermal autografts.[11]

Sanz and coworkers[3] used porcine collagen matrix to augment keratinized tissue at fixed natural tooth restorations, and compared this to free connective tissue grafts. At 6 months, the connective tissue graft had attained a mean width of keratinized tissue of 2.6 mm, while the collagen matrix was 2.5 mm. The collagen matrix group had a significantly lower patient morbidity and reduced surgery time. They concluded that the porcine collagen matrix was as effective and predictable as the connective tissue graft for attaining keratinized tissue with significantly lower morbidity.[3]

Cardaropoli and coworkers[12] treated patients with natural tooth gingival recession and compared connective tissue grafts and porcine matrix grafting. They found no significant differences between the 2 methods.

McGuire and coworkers[4] compared submucosal grafts with porcine collagen matrix to treat gingival recession defects and found the results to be very similar. They found that the porcine graft does not have the morbidity of a palatal donor site.

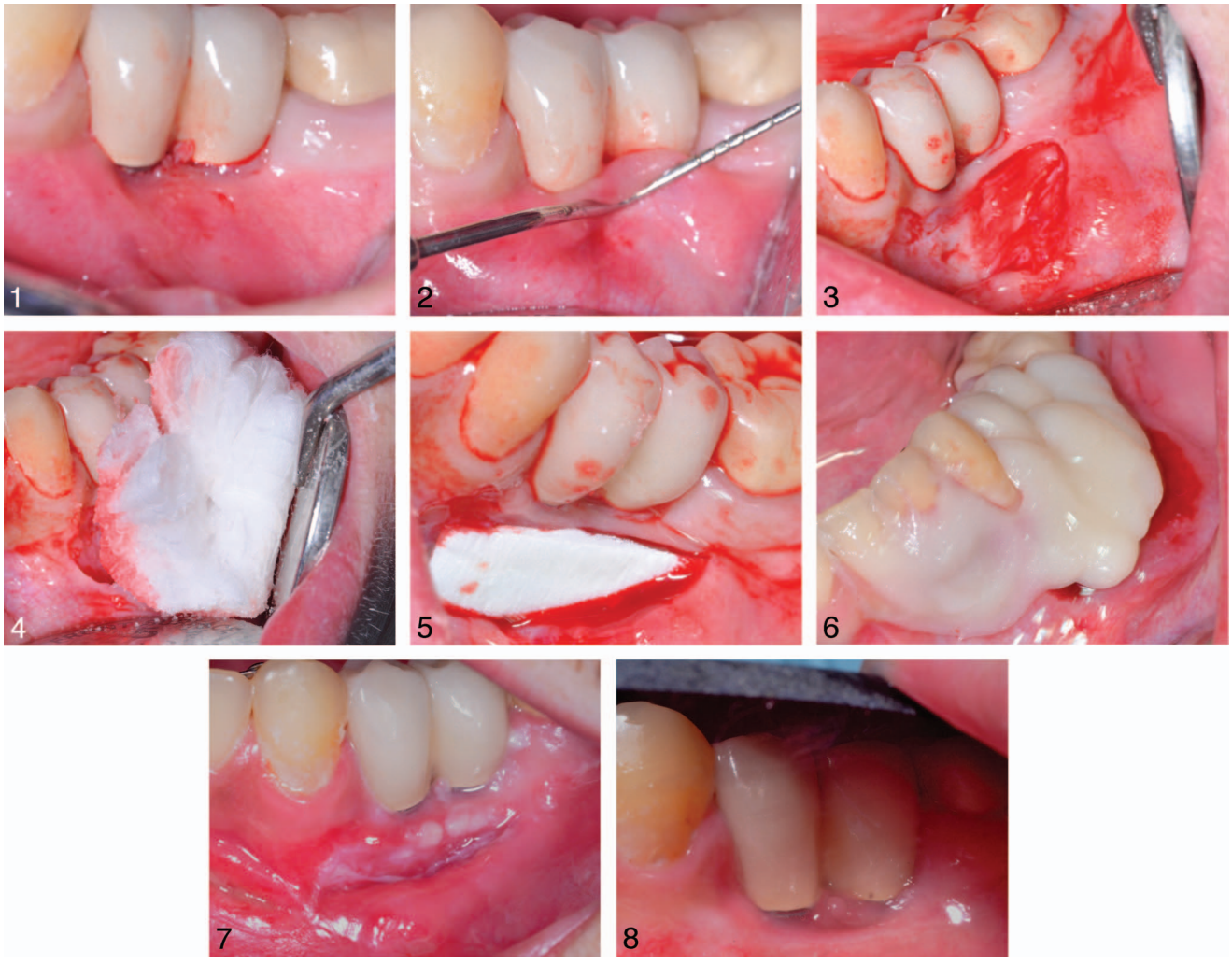
Herford and coworkers[10] treated patients with porcine collagen matrix for soft tissue defects from 50 to 900 mm^2. Most defects were related to preprosthetic issues. The other defects were a result of tumor surgery, trauma, and buccal tissue ankylosis release. They found porcine collagen matrix to provide a biocompatible surgical alternative to autogenous tissue. [10]

Schmitt and coworkers[9] compared free gingival grafts and porcine collagen matrix to augment keratinized tissue at dental implant fixed restorations. There was similar healing and increased keratinized mucosa. They found shrinkage to be 33% with the collagen matrix and 28% with the free gingival grafting. Both free gingival grafts and matrix grafts had multilayered, keratinized, squamous epithelium. Keratinization was found in the tissue basal and suprabasal layers. They concluded that the clinical and histologic results were comparable.[9]

It is important to control bleeding before the stent is applied. A saturate aqueous solution (16%) of tranexamic acid tamponade applied to the surgical wound may quickly accomplish this.[13] Tranexamic acid is antifibrinolytic and stabilizes clot formation. After the stent hardens, any attempt at direct contact of a coagulating agent to the surgical wound will be difficult or impossible.

Treating the site with a blue-violet composite light can also stop bleeding before placement of the stent by irradiating the site with blue-violet light from a composite light curing unit.[14] A wavelength range of 380–515 nm applied for 30 seconds may quickly induce clot formation before the stent is applied. Control of bleeding is important before stent application in order to prevent bleeding or oozing from under the stent where there would be no direct access to the wound for application of a topical coagulant.

Due to the fragility of the matrix when saturated with blood, it cannot be easily sutured, contained, or fixed with other periodontal barrier materials, such as zinc oxide eugenol or light-cured barriers. The bis-acryl is gently and gingerly laid



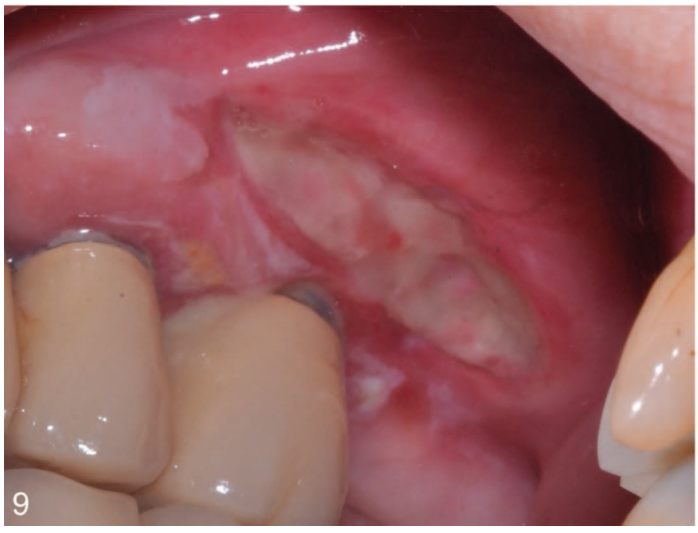
Figures 1–8. Figure 1. Implant-supported crowns with inadequate facial immobile tissue (Patient TW). **Figure 2.** The facial mucosa is demonstrated with compression using a probe. **Figure 3.** A partial-thickness surgical wound is created to accept the porcine collagen. **Figure 4.** Bleeding is controlled with a saturated aqueous tranexamic acid tamponade. **Figure 5.** A festooned segment of porcine collagen fits into the wound and is covered with the bis-acryl before the collagen becomes saturated with blood. **Figure 6.** The bis-acryl is gingerly placed over the site directly from the mixing gun. The tip is cut and flattened to produce a ribbon of material to cover the site without significant creases or surface cavities. **Figure 7.** The site at the first postoperative week. **Figure 8.** The site at 8 postoperative months.

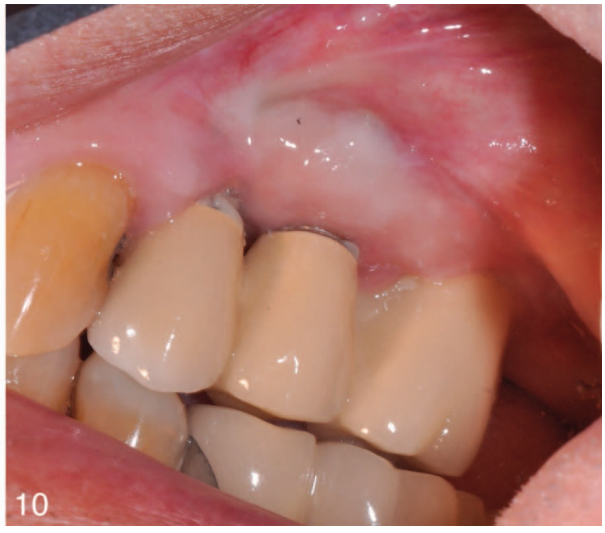
on top of the positioned matrix as a very soft gelatinous-like mass and allowed to polymerize to a hard set over 2 minutes. The hard material protects and fixes the matrix against the wound. The heat of polymerization is not significant, but the stent may be cooled with water spray. After a few days of healing, the epithelium appears to migrate and the soft flaccid tissue is converted to fixed tissue that supports the gingival-implant interface.

One technique for soft tissue augmentation described by the manufacturer is to make an envelope incision and place the matrix under the flap and suture.[7] This author found that more fixed tissue was generated when the matrix was applied on the open wound and not covered with the mucosa. That is, the matrix is placed directly on the exposed submucosa as described earlier. It was this author's experience that covering the matrix with the mucosa resulted in much less or no fixed tissue. Subsequent to the stent placement, blood will soak into the matrix and healing will occur protected by the stent. While tissue biopsy would definitely discern the type of tissue that had formed, this was deemed impractical and costly, so no biopsies of these cases were done. Previous work has histologically examined the resulting tissue.[4] Visual and probing assessments were performed and found that the tissue was immobile.

The porcine allograft technique can be done before, during, or after implant placement, but mechanical retention of the bis-acryl stent is necessary to fix and protect the surgical site. Immediately after placing implants and healing caps may be an opportune time, while the patient has persisting local anesthesia and the healing cap(s) can provide anchor(s) for the stent to gain a purchase.

This author found that narrower matrices did not result in adequate tissue response and that 8–10 mm appears to be an important dimension for an adequate resulting width of





Figures 9 and 10. Figure 9. A maxillary left posterior site at 1 postoperative week (Patient JK). **Figure 10.** The maxillary left posterior site at 19 postoperative months. The tissue appears to be and seems to function as attached gingiva.

supportive tissue. The resulting tissue may be keratinized attached gingiva or immobile mucosa that can indeed protect the marginal tissue of the implant. Most of the previous work has been on natural teeth, but implant-supported fixed prostheses may benefit from this technique for augmentation. Schmitt and coworkers[9] found a 33% shrinkage of the collagen matrix treated area. Sanz et al[3] found a 2.5-mm resulting width for the matrix-treated sites. Thus, to account for this shrinkage the matrix width should be much wider. A 10-mm-wide matrix may result in a 3- to 5-mm width of immobile tissue.

One recent study compared subepithelial connective tissue grafts to acellular dermal allograft. The limited results showed there was an increased "mucosal thickness."[15] These authors did not describe the resulting tissue as attached gingiva.

Even though previous work identified the tissue outcome to be keratinized tissue, in some cases the resulting tissue was visually deemed to be immobile mucosa instead of attached keratinized tissue. No tissue was biopsied because of ethical considerations, and because previous work has been done in this regard.[4,9] This previous work was sponsored by the manufacturer, thus introduces a suspicion of bias. This present work is not a high credibility level research project but rather a retrospective analysis. Nevertheless, the implant tissue interface was deemed to have been successfully protected from muscle tension. This may provide sufficient long-term protection. However, long-term blinded studies are needed to truly examine this modality and specifically define the tissue-type outcome.

Conclusions

Inadequate facial immobile or attached tissue at fixed dental implant-supported prosthetics may be augmented with porcine collagen matrix xenograft to achieve an apparent adequate supportive soft tissue outcome. Importantly, the collagen piece should be 8–10 mm wide and as long as required to fill the surgical wound. A bis-acryl stent should be used before the matrix becomes blood soaked in order to fix and protect the matrix for appropriate healing. Bleeding control should be accomplished before the stent is placed. This can be done with a tranexamic acid tamponade or blue violet composite curing light. A gingerly placed bis-acryl stent is used due to the difficult handling properties of the blood-moistened porcine collagen matrix material. The bis-acryl stent may be safely removed after 4–7 days. Even though the initial results appeared to have supportive tissue, long-term outcomes need to be evaluated.

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