The Use of a Xenogeneic Collagen Matrix as an Interpositional Soft-Tissue Graft to Enhance Peri-Implant Soft-Tissue Outcomes: A Clinical Case Report and Histological Analysis

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Introduction: Keratinized and dense peri-implant soft tissue around implants has been associated with better tissue health, less bone loss, and improved esthetics. The purpose of this case report is to evaluate a new, xenogeneic collagen matrix (CM) as an interpositional soft-tissue graft to enhance peri-implant soft-tissue thickness. To our knowledge, this is the first such case report to include soft-tissue biopsies and histologic analysis.

Case Presentation: After extraction and bone grafting of a mandibular left first molar, the patient received a dental implant, and CM was used as an interpositional soft-tissue graft. Clinical healing was uneventful, and the impression of enhanced soft-tissue volume/thickness was observed. At 10 weeks, biopsies were taken from the operative site and from a contralateral, non-operated site. Histologic assessment of the operative site demonstrated normal squamous epithelium and lamina propria. Tissue growing into the residual CM also appeared normal, with no inflammatory cells seen in the graft area. Vascular blood vessels were observed growing into the matrix. Control and test sites were comparable.

Conclusions: This case report and the first examination of a human biopsy around a dental implant demonstrate that CM holds promise as an effective, time-efficient, and reduced morbidity alternative to autogenous graft harvest for the promotion of peri-implant soft-tissue thickness. CM was easy to handle, place, and suture, and histologic analysis indicated a benign tissue response resulting in an organized and attached connective tissue similar to native, undisturbed periodontal tissue.


Key Words: Case reports; collagen; dental implants; esthetics; transplants.

Background

Around teeth, gingival tissue thickness has been associated with improved root coverage predictability and recession reduction.1 Around implants, keratinized and thick soft tissue has been associated with better indices of tissue health, lower levels of bone loss, and improved esthetics.2-5 Based on the bone loss observed on the facial aspect of implants in a thin buccal plate environment, in which susceptibility to recession is high, the establishment of a keratinized and thick peri-implant soft tissue would appear to be advantageous.

Interpositional soft-tissue grafts can be used to increase peri-implant soft-tissue thickness and keratinization.6 However, for clinicians, autogenous soft-tissue grafting procedures can
be time consuming, and for patients, harvest sites may be uncomfortable and associated with morbidity.7

A new porcine collagen matrix (CM) has been investigated as a connective tissue graft substitute for root coverage and for the generation of keratinized tissue (KT) around teeth and implants.8,9 We decided to investigate and understand the histologic implications for CM when used as an interpositional connective tissue graft substitute simultaneously with one-stage implant placement.

**Case Presentation**

The patient presented herein is a white, non-smoking, 38-year-old female with #19 failing root canal and a coronal fracture with inadequate tooth structure for proper restoration (Fig. 1). The patient was diagnosed with Angle’s Class I malocclusion, associated tooth wear, and compensatory eruption, along with localized, early-to-moderate chronic periodontitis (#5, #9, #12, and #14 probing 4 to 7 mm, with bleeding on probing). The patient was chosen as an interpositional graft candidate because she presented with thin coronal bone width after wide-diameter implant placement and was considered “at risk” for bone resorption, recession, and compromised, long-term soft-tissue/crown apposition esthetics. No IRB approval was necessary for this case study.

**Case Management**

Tooth #19 was extracted and the alveolus was preserved using mineralized freeze-dried bone cortical allograft enhanced with plasma rich in growth factors and covered with a collagen membrane for socket bone grafting (Fig. 2a). An implant was placed 12 months after extraction (Fig. 2b), with CM placed under the buccal flap at the time of implant placement (Fig. 3).

Postoperative management included amoxicillin, 250 mg every 8 hours, and chlorhexidine, 0.12% oral rinse twice per day, applied with a cotton swab after the first 2-week postoperative visit. Ibuprofen was prescribed, 600 mg every 6 hours for the first day then as needed for discomfort.

After obtaining written informed consent, two biopsies were performed 10 weeks after implant placement. Using the operative photo for orientation, a 3 x 3 mm scalpel biopsy down to bone level was removed interproximally over the grafted area. A second biopsy was taken from non-operated tissue on the contralateral side of the mouth. Specimens were stored in 4% paraformaldehyde and sent to the Loma Linda University Department of Oral Maxillofacial Surgery histology laboratory for analysis. Samples were embedded for 4 to 5 hours in an aqueous encapsulating gel, placed into a mega-cassette, and embedded in celloidin–paraffin. Using a microtome, 5-μm sections were cut and stained with hematoxylin and eosin (H&E).

**Clinical Outcomes**

There was a clinical impression of enhanced soft-tissue volume, although what appeared to be a significant gain in tissue thickness at 2 weeks diminished somewhat at the 10-week time point (Fig. 4). Healing was uneventful and benign, much as might be expected for a traditional connective tissue graft. CM was not exposed to the oral environment. Histologic analysis of the native, control tissue specimen revealed a normal-appearing, attached gingiva with stratified...
squamous epithelium and underlying connective tissue, i.e., lamina propria (Fig. 5). In the test CM specimen, squamous epithelium and lamina propria also appeared normal. Tissue growing into the residual collagen matrix of CM appeared normal, with no inflammatory cells (lymphocytes or macrophages) seen in the graft area (Fig. 6). Vascular blood vessels were observed growing into the matrix (Fig. 7). Control and
test site specimens were comparable in terms of connective tissue and vascular organization.

Discussion

The aim of this case report is to understand the histologic implications for CM when used as an interpositional connective tissue graft substitute simultaneously with one-stage implant placement. A secondary goal was to observe whether a thicker soft-tissue “cuff” around implants was achieved that might not only benefit peri-implant tissue health but also provide improved esthetics at the prosthetic interface.

CM was easy to handle, place, and suture and obviated the need and time required for donor graft harvest. Our clinical impression was enhanced soft-tissue volume. Histologic analysis revealed no inflammatory cell infiltrates and a benign response to the CM. Test and control site tissues biopsies were comparable, and the test site biopsy consisted of an organized (as opposed to dense, disorganized scar) tissue with normal, stratified squamous epithelium and normal underlying connective tissue—a positive indication that an attached form of peri-implant soft tissue may have formed at the test site.

In a recent animal study over chronic ridge defects, Thoma et al. demonstrated that a porcine CM was able to create soft-tissue volume enhancement comparable to an autogenous subepithelial connective tissue graft. Similarly, Wehrhan et al. found that mean epithelial thickness generated in pig ear dermal wounds was equivalent, whether CM or split-thickness skin grafts were used. In a controlled clinical study, Sanz et al. compared CM to free connective tissue grafts (FCTG) as onlay soft-tissue augmentations to enhance KT around fixed partial restorations on both teeth and preplaced implants. CM was as effective as FCTG in creating a band of KT but without the morbidity or added time associated with palatal graft harvest. A similar animal study and a clinical case series with more extensive grafting were performed by Herford, Boyne et al. These studies appear to demonstrate the biocompatibility, rapid replacement with normal connective tissue, and epithelialization of CM, along with generation of new mucosa, both keratinized and non-keratinized. Finally, in a randomized, controlled, within-patient, contralateral study of recession defects, McGuire and Scheyer showed that CM was able to provide root coverage and generate an equivalent band of KT compared to autogenous connective tissue grafts. As with the case investigated herein, the authors noted: “...both test and control sites appeared ‘thicker,’ particularly when viewed along the margins (former vertical incision lines) of the treatment sites...”

![Figure 6](image1)

**FIGURE 6** CM test site biopsy with some residual collagen, normal appearing epithelium (SSE), and underlying connective tissue (LP). H&E stain. Original magnification ×10.

![Figure 7](image2)

**FIGURE 7** Normal connective tissue and vascular extension into CM. H&E stain. Original magnification ×20.
Summary

Why is this case new information?
- To our knowledge, this is the first case to include human histologic analysis in the examination of CM as an interpositional graft substitute for the enhancement of peri-implant soft-tissue thickness.
- Histologic assessment indicated a benign tissue response resulting in an organized and attached connective tissue structure similar to native, undisturbed periodontal tissue.

What are the keys to successful management of this case?
- Previous studies indicated that soft-tissue volume and KT may be generated by CM, but only sites with mucosal margins and some pre-existing KT were selected in this evaluation. As a conservative first step, the presence of KT may allow for better flap manipulation and a greater likelihood that CM remains covered, heals uneventfully, and provides optimal soft-tissue augmentation results.

What are the primary limitations to success in this case?
- Although soft-tissue augmentation is simpler and more predictable to perform than bone augmentation, the key to health and esthetics around implants and teeth is bone, so soft-tissue augmentation is secondary to adequate bone architecture. To make a more definitive judgment about the utility of CM as an interpositional graft for peri-implant soft-tissue thickness, a controlled, comparative investigation with longer-term clinical and histologic observations should be undertaken.

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