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A New Collagen Matrix to Avoid the Reduction of Keratinized Tissue During Guided Bone Regeneration in Postextraction Sites: A Technical Note

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Abstract: For decades, there has been an ongoing controversy regarding the need for an “adequate” width of keratinized gingiva/mucosa to preserve periodontal and implant health. Today, the presence of a certain width of keratinized tissue is recommended for achieving long-term periodontal and implant success, and therefore, a new collagen matrix has been developed to enhance the width of keratinized gingiva/mucosa. During postextraction socket preservation, guided bone regeneration techniques require complete coverage of the barrier membrane to reduce the risk of infection, occasionally causing a reduction of the width of keratinized tissue. Using the new collagen matrix, it is possible to leave the membrane intentionally uncovered, without suturing the surgical flap above it, to avoid the reduction of such tissue.

Key Words: Collagen matrix, postextraction socket, keratinized mucosa, guided bone regeneration

Recently, a new collagen matrix (CM) has been developed and produced by Geistlich Pharma AG (Wolhusen, Switzerland). It offers a promising option for increasing keratinized gingiva/mucosa, because it provides an ideal matrix for blood vessel and soft-tissue ingrowth.

This CM (CG-10286) is made of collagen solely obtained by a standardized controlled manufacturing process. The collagen is extracted from veterinary-certified pigs and is carefully purified to avoid antigenic reactions.

The matrix is made of collagen types I and III without further cross-linking or chemical treatment and has a bilayer structure with a smooth, nonpermeable outer layer and a porous scaffold inner layer.¹

The outer side has a smooth surface, which is cell occlusive and may act as a barrier, and looks toward the soft tissue. Furthermore, the smooth texture has appropriate elastic properties to accommodate suturing to the host mucosal margins and to protect the graft material from oral trauma during biodegradation and healing. The

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porous inner layer consists of collagen fibers in a loose, permeable arrangement to enable cell invasion. This side is turned toward the bone defect and/or soft tissue to encourage cells to grow into it and to stabilize the blood clot.¹

The final product has been approved by the Food and Drug Administration on May 30, 2008. Even though its qualitative properties and safety have been evaluated according to the procedures established in ISO 14971 and ISO 10993-1, only 2 studies have been published to date in the scientific literature on this CM graft material. The first is a randomized prospective clinical trial about the ability of this device to enhance the width of keratinized tissue in patients with fixed prosthetic restoration²; the second is a single-masked, randomized, controlled, split-mouth study that evaluates the use of this device as substitute of the connective tissue graft (CTG) in the treatment of recession defects.³

The aim of this case report was to show a potential indication of this CM. After tooth extraction and cyst removal/enucleation, the residual bone defect was filled with heterologous bone and covered with the bilayer membrane, without suturing the surgical flap above it. It was left intentionally uncovered, to avoid further reduction of the keratinized gingiva/mucosa. One of the fundamental principles of guided bone regeneration (GBR) is that first-intention healing must be always achieved by means of a sealing suture. Using the CM, this principle might be open to discussion.

CLINICAL REPORT

A 30-year-old nonsmoking female patient was referred in January 2005 by a private practitioner to the Section of Dentistry and Maxillofacial Surgery, Department of Morphological and Biomedical Sciences, University of Verona. The patient needed the removal of a radicular cyst due to a double root perforation of the mesial root canals of the lower right first molar tooth.

The patient's dental history revealed that a double perforation of the mesial root of the tooth occurred during endodontic retreatment. The perforations prompted the private practitioner to refer the patient to our department.

Clinical and radiographic examinations revealed severe pain during mastication, a large well-defined periapical radiolucency in relation to the root, and complete alteration of the endodontic space. Consequently, a surgical approach including tooth extraction and cyst removal/enucleation was considered inevitable (Figs. 1–4). [F1–F4]AQ1

The patient was operated on under local anesthesia: a full-thickness flap was reflected after an intrasulcular incision; the tooth extraction was accomplished atraumatically, and the cyst was exposed after removing the expanded bone over the lesion; finally, the cyst was carefully enucleated, maintaining its integrity (Fig. 5). [F5]

To favor good healing of the bone defect and to have an adequate bone volume for implant placement, GBR was carried out using heterologous bone (Bio-Oss; Geistlich Pharma AG) and a collagen membrane (Bio-Gaide; Geistlich Pharma AG) (Fig. 6). The new CM [F6] prototype (CG-10286; Geistlich Pharma AG) was placed above the postextraction site to enhance the regenerative power of the GBR technique.

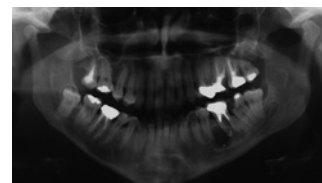


FIGURE 1. Orthopantomography in January 2005.

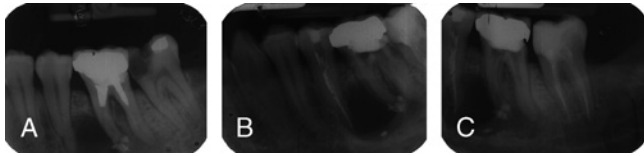


FIGURE 2. A, Periapical radiography after first endodontic treatment and crown restoration. B, Periapical radiography after endodontic retreatment. C, Preoperative periapical radiography, which shows the first molar after endodontic retreatment and inflammatory cyst.



FIGURE 7. A, Repositioning of surgical flap. B, Application of the new collagen membrane. C, Suture of surgical flap.

Fig 7 4/C

Fig 3 4/C



FIGURE 3. A, Incision of surgical flap. B, Elevation of surgical flap. C, Tooth extraction and cortical osteotomy.

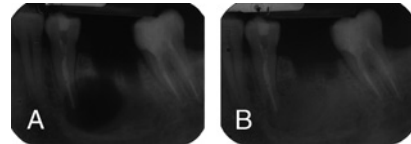


FIGURE 8. A, Intraoperative periapical radiography after tooth extraction and cyst enucleating. B, Postoperative periapical radiography after GBR.

Fig 4 4/C

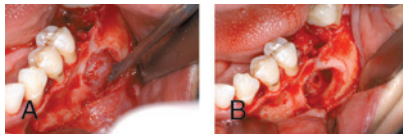


FIGURE 4. A, Enucleation of the inflammatory cyst. B, Bone defect.

Fig 5 4/C

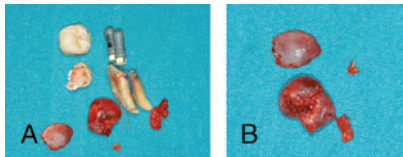


FIGURE 5. A, Extracted tooth with K-files no. 8 that shows root canal perforations. B, Enucleated cyst.

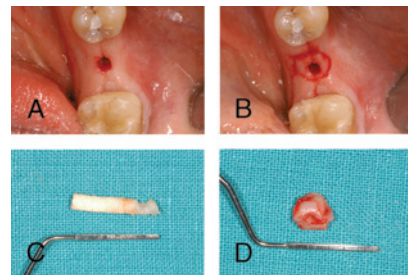


FIGURE 9. A, Biopsy site after bone harvesting. B, Biopsy site after soft-tissue harvesting. C, Biopsy sample of regenerated bone. D, Biopsy sample of healed keratinized mucosa.

Fig 9 4/C

Fig 6 4/C

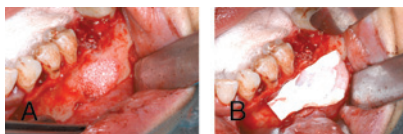


FIGURE 6. A, Application of the heterologous bone. B, Application of the conventional collagen membrane.

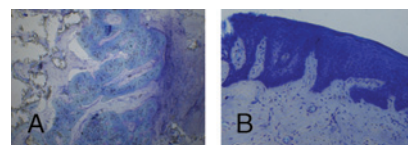


FIGURE 10. A, Histologic analysis of bone tissue, which shows a full healing pattern. B, Histological analysis of soft tissue, which shows a full healing pattern of keratinized mucosa.

Fig 10 4/C

Fig 11 4/C

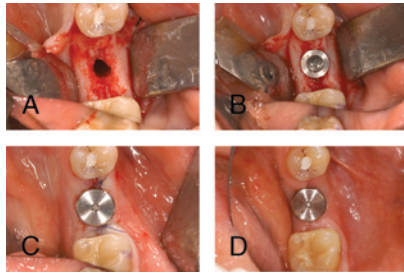


FIGURE 11. A, Implant site after preparation. B, Implant site after implant placement. C, Implant site after healing screw positioning. D, Implant site after 3-month healing.

Because primary closure of the surgical area might have caused a reduction of vestibular depth/loss of fornix depth and a reduction of keratinized gingiva/mucosa, the surgical flap was repositioned at the original level, avoiding complete coverage of the new membrane, which makes it possible to reduce the risk of infection despite partial exposure of the membrane. As a consequence, suturing was performed so that second-intention healing was intentionally achieved.

F7 F8 Sutures were removed after 7 days (Figs. 7 and 8).

During the healing period, no infections or suppurations were recorded; only minimal pain and swelling were noted in the grafted area. The postextraction site was entirely healed without complications in 2 months: a biopsy of the area showed complete regeneration of the epithelium, connective tissue, and bone tissue after 60 days (Fig. 9).

F9

After 6 months, clinical evaluation confirmed an increase in the width of keratinized gingiva/mucosa, and a surgical flap was reflected to confirm the successful results of GBR and to place a 6 × 11-mm implant (Camlog Screw-line; Camlog Biotechnologies AG, Basel, Switzerland).

After another 6 months, the implant was restored with a metal-ceramic crown by a private practitioner.

The patient was included in a maintenance program to achieve optimal hard- and soft-tissue healing, which comprised professional oral hygiene every 6 months, and rinsing twice daily with chlorhexidine digluconate 0.2% during the first 2 weeks (Figs. 10 and 11).

F10 F11

The private dentist performed clinical evaluation monthly during the first 6 months after restoration; further evaluations were performed every year and consisted of analysis of soft-tissue health (plaque index and gingival index), assessment of the probing pocket depth, and measurement of crestal bone loss.

The authors of this case report recalled the patient after 3 years to evaluate the clinical and radiographic outcome of the implant-prosthetic rehabilitation (Figs. 12 and 13).

F12 F13

DISCUSSION

In the scientific literature, there is, to date, only 1 study that evaluates the effectiveness and usefulness of a new CM prototype: Sanz et al² published in 2009 a prospective study aimed at testing a new CM to increase the width of keratinized gingiva/mucosa in com-

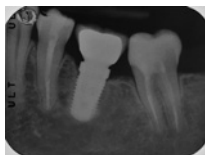


FIGURE 12. Periapical radiography 3 years after implant restoration.

Fig 13 4/C

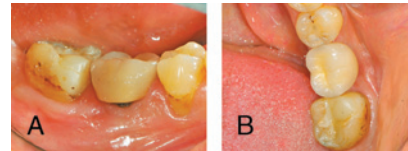


FIGURE 13. Clinical photograph of definitive rehabilitation after 3 years of follow-up. A, Lateral view. B, Occlusal view.

parison with a free CTG. At 6 months, CTG achieved a mean width of keratinized tissue of 2.6 (0.9) mm, whereas with the CM, the width obtained was 2.5 (0.9) mm. No statistically significant differences were reported. However, the CM group had a significantly reduced patient morbidity (pain and medication intake) as well as reduced surgery time. These results showed that this new matrix was as effective and predictable as a CTG for increasing the width of keratinized tissue, but its use was associated with greater patient comfort and greater ease of use for clinicians.

At the American Association of Oral and Maxillofacial Surgeons Annual Meeting in 2009, Lee⁴ described a prospective study regarding the use of a new porcine surgical matrix as a substitute for free mucosal grafts in preprosthetic surgery: 20 patients underwent soft-tissue grafting of various oral defects; the size of the regenerated area and degree of scarring that might reduce the area were determined by leaving half the sutures in place for a period of 4 to 6 weeks. The overall percentage of shrinkage of the graft was 14% (range, 5%–20%), whereas the amount of soft tissue averaged 3.4 mm (range, 2–10 mm). None of the cases reported infections or other complications, but only mild pain and swelling.

Finally, McGuire and Scheyer³ published in 2010 a randomized, controlled, split-mouth study where the authors treated 25 patients with dehiscence-type recession defects in contralateral sites: 1 defect received CTG + coronally advanced flap, and the other defect received CM + coronally advanced flap. At 6 months, recession depth was, on average, 0.52 mm for test sites and 0.10 mm for control sites. Recession depth change from baseline was statistically significant between test and control, with an average of 2.62 mm gained at test sites and 3.10 mm gained at control sites for a difference of 0.4 mm ($P = 0.0062$). At 1 year, test percentage of root coverage averaged 88.5%, and controls averaged 99.3% ($P = 0.0313$). Keratinized tissue width gains were equivalent for both therapies and averaged 1.34 mm for test sites and 1.26 mm for control sites ($P = 0.9061$). There were no statistically significant differences between subject-reported values for aesthetic satisfaction, and subjects' assessments of pain and discomfort were also equivalent. The authors concluded that CM presents a viable alternative to CTG, without the morbidity of soft-tissue graft harvest, in the treatment of recession defects (Fig. 9).

The present case report describes an alternative use of this matrix, which permits an indirect gain in keratinized gingiva/mucosa during GBR and/or during postextraction healing.

The authors of this case report sought to confirm the usefulness of this new CM during GBR to avoid a reduction of vestibular depth/obliteration of the inferior fornix and a reduction of keratinized gingiva/mucosa.

Although all GBR protocols recommended a sealing suture of the surgical flap for obtaining primary closure of soft tissue above the GBR biomaterials, the use of the new CM prototype seems to permit its incomplete coverage, avoiding having to move the surgical flap coronally after mucoperiosteal-releasing incisions.

If a bone defect was filled with heterologous bone and covered with a bilayer membrane, the membrane can be left intentionally uncovered, without suturing the surgical flap above it, to avoid further reduction of keratinized gingiva/mucosa, but it is well known that, left uncovered, non-cross-linked collagen barriers will resorb

extremely fast without achieving sufficient barrier function and stabilization of the augmented area. Thus, the rationale to use the new matrix in an open healing situation could be questionable. The goal of the authors when using the membrane is to show that this kind of membrane permits to have an increase in keratinized mucosa and to enhance bone regeneration.

The authors are well aware that a single case report cannot demonstrate the effectiveness and predictability of the new CM, but it may suggest its possible indication for this material in GBR to avoid vestibuloplasty or similar surgery.

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