

A Three-Point-Translation Technique for Root Coverage With 4-Year Follow-up



Before



After

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Localized and generalized gingival recession frequently occurs in patients with incipient as well as advanced periodontal disease, a pathologic process that affects the supporting soft tissue and bone of the tooth. Recent epidemiological surveys have revealed that gingival recession accounts for a significant amount of attachment loss in industrialized populations with a high standard of oral hygiene.¹ Dentally aware patients are concerned, and ask for periodontal treatment for this visible sign of aging and increased sensitivity of exposed root surfaces.

Miller's report of a thick free gingival graft technique ushered in the era of predictable root coverage grafting.²⁻⁴ Langer and Langer reported a technique of subepithelial connective tissue grafting, which led to a plethora of reports on different connective tissue techniques as root coverage surgery evolved into a primarily connective tissue procedure.⁵ Raetzke⁶ described the envelope technique; Nelson,⁷ the subpedicle; Harris,⁸ the double pedicle; Allen,^{9,10} the tunnel procedure; and Bernimoulin et al,¹¹ a coronally positioned flap (CPF) technique, published in 1975, which is now often underlaid by connective tissue. Clearly, a disadvantage of the technique is the second surgical site to harvest the connective tissue graft and the unavailability of a large supply of donor connective tissue.

Guided tissue regeneration (GTR) for root coverage of human recession sites was introduced by Tinti and colleagues in 1992.¹² The authors used expanded polytetrafluoroethylene (e-PTFE) membranes in combination with a bipediced flap, similar to the double lateral bridging flap. While nonresorbable membranes avoid the need for a palatal donor site, a secondary surgery for membrane retrieval is still required. Resorbable membranes, therefore, are preferred if an equivalent result can be achieved. Genon and associates¹³ were the first to report results using polylactide resorbable membranes.

Root coverage procedures—free grafts of palatal flaps—are successful if the grafted tissues survive on the exposed surface. The survival of grafted tissues is critical on the avascular root surface. Vascularization of grafted tissues plays an important role in the healing process of these surgical procedures. The main blood supply of the gingiva is directed caudo-cranially from the vestibule to the gingival margin. It is mainly derived from the suprapariosteal blood vessels that, in the free gingiva, anastomose with blood vessels from the alveolar bone and the periodontal ligament. Blood supply of the alveolar mucosa mainly derives from suprapariosteal vessels.

The surgical execution of a CPF procedure for root coverage requires an intrasulcular incision and two vertical releasing incisions to raise a full-thickness gingival flap up to the mucogingival junction; a partial-thickness flap apical to the mucogingival junction, obtained by a horizontal incision to separate the flap from the underlying periosteum in a mesio-distal motion; and apical dissection under the alveolar mucosa to facilitate mobility and the coronal displacement of the flap. These surgical incisions could impair blood supply to the flap, and the coronal displacement of the flap and sutures could stretch the residual vessels. Also, histologic findings obtained from specimens regenerated with GTR procedures reveal there is often an artificial defect between regenerated cementum and root dentin. Therefore, the new attachment may not be as strong as that between the original cementum and root dentin.^{14,15}

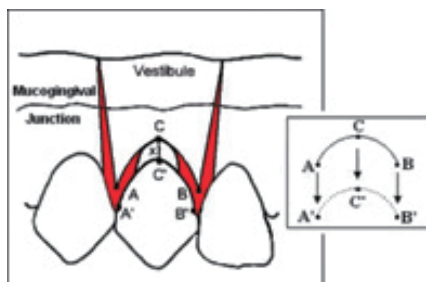


Figure 1. Clinical measurements on the recession-involved tooth: $AA' = BB' = CC' = X =$ recession depth; area of de-epithelization is colored in red.

The aim of this article is to propose a new, predictable, and less traumatic root coverage technique. The complete surgical protocol described in the next section involves a three-point-translation incision design; releasing of the flap; scaling and root planing; application of an enamel matrix-derived (EMD) protein (Emdogain, Biora AB); and securing the flap. Results demonstrating the clinical efficacy for the proposed procedure are presented based on a case study with a 4-year follow-up. The implementation of the proposed three-point-translation root coverage technique is further discussed in the last section (Figure 1).

TECHNIQUE

A 36-year-old woman presented with root recession and sensitivity to cold on the buccal aspect of tooth No. 12. Periodontal evaluation showed localized attachment loss. Gingival recession at tooth No. 12 was 6 mm in length, with a 4-mm width (Figure 2).

Before surgery, two points located at the alveolar crest and mid-buccal CEJ of the involved tooth were marked as points C and C', respectively, as shown in Figure 1. The recession depth was recorded as the distance between point C and C', and was denoted as CC'. Furthermore, without loss of generality, we assumed that CC' is X mm (Figure 1) for further development of the incision design. Additional points, A and B (Figure 1), at the gingival margin and exactly X mm above the adjacent papillae of the tooth (marked as A' and B' in Figure 1), respectively, were also located. During the surgery, two vertical bevel incisions were performed with a surgical blade on the buccal aspect of the targeted tooth. Each incision was made, starting at point A (or B), and was extended all the way to the vestibule (Figure 1) to release muscle tension and facilitate the passive coronal displacement of the trapezoidal flap raised with full thickness, then partial thickness at vestibule. De-epithelialization (see red area in Figure 1) of the existing papillae then followed.



Figure 2. Pretreatment view of surgery site on tooth No. 12 with 6 mm of recession.



Figure 3. Incision design: Recreation of papilla and de-epithelialization of the current papilla.

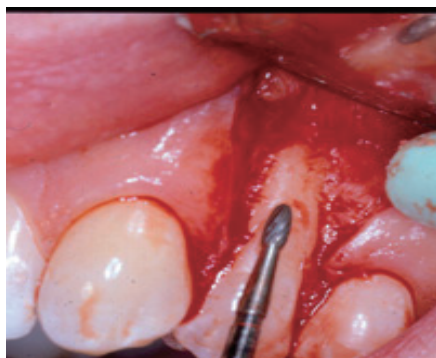


Figure 4. Releasing of the flap: full thickness then partial thickness at the vestibule; no tension.



Figure 5. Scaling and root planning: odontoplasty if necessary; remove any composite if present.

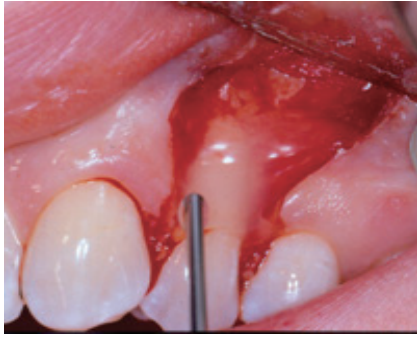


Figure 6. Application of EMD: root conditioning; dry and apply EMD.

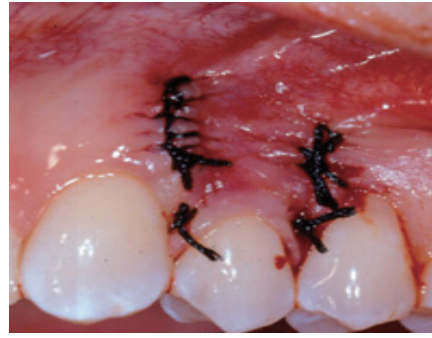


Figure 7. Securing the flap: coronally position the flap without tension and match the newly created papilla to the existing papilla.



Figure 8. Result at 1 week following surgery.



Figure 9. Result at 6 months following surgery.



Figure 10. Result at 4 years following surgery.

The thickness of the flap dictated the depth of this procedure. The surface was root planed, and odontoplasty was accomplished with a rotary instrument. The surgical site was rinsed with sterile saline, and the exposed root surface was conditioned for 2 minutes with 24% EDTA (PrefGel, Biora AB). After the root was conditioned, it was thoroughly rinsed with saline, with extreme care taken to keep the area dry. The EMD was immediately applied to the exposed root surface, starting at the most apical portion of the intrabony defect and covering the entire root surface. At this point the flap was secured by matching points A, B, and C on the flap to A', B', and C' as defined previously. The postsurgical case included (a) suture removal at 1 week, and (b) chlorhexidine solution rinse for 2 weeks (Figures 2 through 10).

RESULTS

Figures 3 through 7 document the surgical phase of therapy including incision design, releasing of the flap, scaling and root planing, application of EMD, and securing the flap. After the surgery, the results at the following intervals are demonstrated in Figures 8 through 10: 1 week, 6 months, and 4 years. No clinical complications or delayed healing were evident. We obtained 100% root coverage on No. 12 at 6 months with excellent color match, and no recurrence of recession was observed after 4 years. In the meantime, we noticed that the attachment on tooth No. 13 had begun to recede. However, tooth No. 12 held.

DISCUSSION

The concept of the incision design is remarkably simple. The technique, in principle, is a straightforward mathematical translation of a set of three points A, B, and C to a second set of points A', B', and C' (Figure 1). The distance between each matched set of points AA', BB', and CC' is designed to be equal ($AA' = BB' = CC' = X$ as marked in Figure 1). This warrants no tension displacement of the flap, which keeps the main blood supply directed caudocranially from the vestibule, flowing throughout the entire flap. A statistical analysis performed by Pini-Prato et al¹⁶ concluded that the higher the flap tension, the lower the recession reduction when shallow recessions were treated by means of the CPF procedures.

Another significant predictor of the clinical outcome of root coverage and recession reduction treated with the CPF procedure is the flap thickness. There was a direct relationship between flap thickness and recession reduction.¹⁷ For the proposed three-point-translation technique, a trapezoidal flap was raised with full thickness then partial thickness at vestibule to fulfill the objective of creating a flap having maximum possible thickness, but no tension. The precision of the dimension and reposition of the flap was enhanced by a simple point-matching process.

Having demonstrated that the incision design makes clinical sense, we were interested in pointing out the role played by the EMD, the solo agent used to promote regeneration of periodontal tissue in the present study. EMD, composed principally of amelogenin and related proteins that are derived from porcine tooth buds, is available as a commercial formulation, and has recently been introduced as a new modality in regenerative periodontal treatment.^{18,19} Histological data from animal and human studies have shown promising results in the formation of a new layer of acellular cementum with inserting collagen fibers, and the formation of new alveolar bone, if treated with EMD.²⁰ In particular, Hakki and colleagues²¹ suggested that EMD influences cell activities, where a fundamental activity of EMD is to promote cell proliferation. Thus, the time EMD remains at a site, coupled with the cells that have been triggered by EMD, most likely determine the clinical outcome. In an ideal situation, EMD may

provide the critical cell mass for promoting bone and cementum formation, while regulating crystal cell growth, allowing formation of a periodontal ligament.

In recent years, new imaging methods have been developed that are aimed at revealing even small bone density changes. The radiographic imaging system employed in a study conducted by Okuda et al²² used imaging plates to produce direct digital images by a process known as photo stimulable phosphor luminescence (PSPL). The PSPL technology has a number of advantages over conventional films for subtraction radiography. Images can be acquired rapidly using low x-ray doses, without the need for chemical processing and the subsequent digitalization of radiographic films. Furthermore, once read, the PSPL is immediately available for further use, representing a recyclable resource. Okuda et al²² reported that the mean radiographical bone gain in EMD-treated sites at 12 months showed a marked increase compared with the placebo-treated sites. In fact, at the placebo-treated sites, there was further loss of radiographic bone. Also, 44% (8/18) of the EMD sites regained more than 20% of the initial bone defect, while 5% (1/18) of the placebo sites reached a gain of more than 20% of the initial bone defect. These differences in radiographic outcome between EMD- and placebo-treated sites are clearly in favor of EMD treatment.

CONCLUSION

Studies suggest a positive role for EMD in promoting cell activities as required during periodontal wound healing.^{8,22} A major rationale indicated for using EMD clinically is based on the hypothesis that epithelial-mesenchymal interactions are required for maturation of the developing periodontium, and hence for regeneration of periodontal tissues. However, further research is required to clinically demonstrate that EMD results in “true periodontal regeneration,” a favorable response on diseased root surfaces associated with intrabony osseous defects.

We conclude that, within the limits of this preliminary case study, this three-point-translation technique might be potentially useful in achieving the goals of periodontal tissue regeneration, including increased width and thickness of keratinized tissue, root coverage, improved aesthetics, clinical safety, and efficiency. Clearly, further clinical and histological studies are required before this technique can be recommended for routine use.

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