Healing of Gingival Recessions Using a Collagen Membrane with a Demineralized Xenograft: A Randomized Controlled Clinical Trial

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This study compared the results following treatment of gingival recessions by a coronally advanced flap procedure alone (CAF) or combined with a bioabsorbable membrane and a demineralized xenograft (GTRF). Sixteen nonsmokers with 20 Miller Class I or Class II buccal gingival recessions at canines or premolars were included in the study. Sites were randomly assigned to either CAF treatment (control, n = 10) or GTRF treatment (test, n = 10) and examined at baseline and at 6 months postoperatively. Both treatments resulted in a significant reduction in recession and gain in clinical attachment level; there was no significant difference between treatments. No differences were found in probing depths among or between the groups. The increase in keratinized tissue from baseline to 6 months was slightly greater for the GTRF group than for the CAF group, but without statistical significance. The test group experienced a statistically significant increase in gingival thickness from baseline to the 6-month evaluation, while little gain was detected in the control group; the between-group difference was statistically significant in favor of the test group. Both procedures offer a predictable, simple, and convenient means of root coverage in Miller Class I and II recession defects, but the GTRF-supported procedure resulted in more keratinized tissue and a significant increase in gingival thickness than the CAF-only approach. (Int J Periodontics Restorative Dent 2009;29:59–68.)

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Gingival recession is generally defined as the displacement of the marginal tissue apical to the cementoenamel junction (CEJ) with exposure of the root surface.[1] According to Albandar and Kingman,[2] an estimated 22.5% of the population has one or more tooth surfaces with recession. Problems commonly associated with the presence of gingival recessions are compromised esthetics, root hypersensitivity, higher incidence of root caries, and compromised plaque control.[3] Treatment of gingival recession is performed via so-called mucogingival therapy, which includes surgical and nonsurgical procedures (periodontal plastic surgery, oral hygiene, orthodontic therapy) for correction of soft tissue defects.[1] The treatment of buccal soft tissue defects is mainly concerned with reshaping the gingival architecture, and in some cases concomitant efforts to increase the amount of keratinized tissue is indicated. Thus, the rationale for treating gingival recessions is related to esthetics and root hypersensitivity.

A variety of surgical techniques has been proposed to gain root coverage. Pedicle flaps such as coronally

or laterally advanced flaps, noncontiguous grafts such as free tissue grafts, and combination procedures such as subepithelial connective tissue grafts can produce predictable outcomes. However, healing may result in the formation of a long junctional epithelium with varying amounts of connective tissue attachment.[4] Moreover, the graft procedures may have high morbidity as a result of the need for a second surgical site, postsurgical bleeding, patient discomfort, and limited quantities of donor tissue.

Case reports and clinical trials have indicated that the principles of guided tissue regeneration (GTR) can be used to promote root coverage. A variety of nonresorbable and absorbable barrier membranes has been used with clinical outcomes similar to those achieved by traditional procedures. In addition, GTR can potentially result in new attachment formation.[5,6] The use of nonresorbable membranes necessitates a second surgical step to remove the membrane, potentially increasing the morbidity of the treatment and putting the results at risk. Otherwise, studies comparing nonresorbable and resorbable membranes have shown similar outcomes.[7,8] Among the absorbable barrier devices, collagen membranes have been shown to have good characteristics leading to positive clinical results.[8] The creation of space between the root surface and the overlying GTR barriers is critical to the success of GTR techniques. The space is necessary to promote the migration of cells toward the root surface to regenerate new cementum and new periodontal ligament. In root-coverage procedures, it is very difficult to maintain space under the membranes since the membrane tends to collapse against the root surface. The use of a bone graft under a membrane can prevent its collapse onto the root, enhance clot stability, and potentially stimulate cellular proliferation.[9–11]

The aim of the present study is to compare the efficacy of two surgical techniques (coronally advanced flap [CAF] alone or in combination with the use of an absorbable membrane plus a demineralized xenograft [GTRF]) for the treatment of gingival recession in a prospective randomized controlled clinical trial.

Method and materials

Patients and defect treatment

Sixteen adult patients (nine men and seven women, aged 18 to 54 years [mean 33.06 ± 12.20 years]) were included in this study. The patients, all systemically healthy nonsmokers without contraindication to periodontal surgery, each presented with at least one Miller Class I or II buccal recession[12] that measured at least 2 mm on a maxillary canine or premolar (Fig 1a). A total of 20 recession-type defects were available for treatment. All patients underwent periodontal evaluation before entry into the study, including professional tooth cleaning with scaling and polishing, and received instructions in oral hygiene (the use of a soft toothbrush with a nontraumatizing brushing technique was recommended).

At baseline, probing depth was ≤ 3 mm at all sites with no bleeding on

probing. Ten defects were randomly assigned by coin toss to be treated by a CAF only (control sites), and the remaining 10 defects were treated by the GTRF method (test sites). The barrier device used was a collagen membrane (Evolution, Tecnoss Dental) and the bone substitute used was a demineralized xenograft (Gel 40, Tecnoss Dental).

Clinical measurements and analysis

Clinical measurements were recorded using a calibrated periodontal probe (PCP-15, Hu-Friedy) and were made to the nearest 0.5 mm. At baseline and 6 months postsurgically, the following parameters were recorded at each site: recession depth (REC), probing pocket depth (PPD), clinical attachment level (CAL), and width of keratinized tissue (KG). In addition, the gingival thickness (GT) was measured at a buccal location 1 mm apical to the bottom of the sulcus using a no. 15 reamer endodontic instrument.[9] Means and standard deviations for both groups were calculated for each parameter at the initial and final examinations. The Student *t* test was used to compare presurgical and postsurgical outcomes. Significance was reported at $P < .001$.

Surgical protocol

After local anesthesia was achieved, an initial intrasulcular incision at the buccal aspect of the involved tooth was made. Then, without interfering with the gingival margins of the adjacent teeth, two vertical releasing incisions with a slight divergence were extended beyond the mucogingival junction (Fig 1b). A full-thickness trapezoidal flap was then elevated up to the mucogingival junction where, following incisions of the periosteum, a split-thickness flap was dissected further apically. The periosteum at the base of the flap was excised and the flap was undermined until tension-free coronal positioning was possible. To create a receiving bed for the sliding flap, de-epithelialization of the adjacent papillae was performed. The exposed, affected root surface was scaled and planed with ultrasonic rotary burs and/or hand instruments to produce a decontaminated, smooth, and flattened surface (Fig 1c).[13] At this point, in the test sites the collagen membrane was trimmed such that at least 1 mm of surrounding tissue was covered. The membrane was then positioned at the level of the CEJ and sutured (Fig 1d).

The collagenated xenograft was inserted under the membrane, in contact with the root surface, and layered evenly to a thickness of about 1 mm (Fig 1e). The pedicle flap was then positioned to the CEJ by means of a double-loop sling suture[14] and the releasing incisions were sutured to complete primary closure of the area (Fig 1f). Two weeks after surgery the sutures were removed (Fig 1g). The patients were followed up at 1, 2, and 4 weeks and 3 and 6 months after surgery (Fig 1h).

Treatment of a control site is illustrated in Fig 2.

Fig 1 *Test group site treated with GTR-based root coverage using a collagen membrane plus a collagenated xenograft.*

Fig 1a *Intraoral image at baseline showing buccal gingival recession on the maxillary right canine.*

Fig 1b *Flap design with two divergent vertical incisions.*

Fig 1c *The flap was elevated, the root surface was debrided, and the papillae were deepithelialized.*

Fig 1d *The collagen membrane was trimmed, placed on the root surface, and secured with 5-0 sutures.*

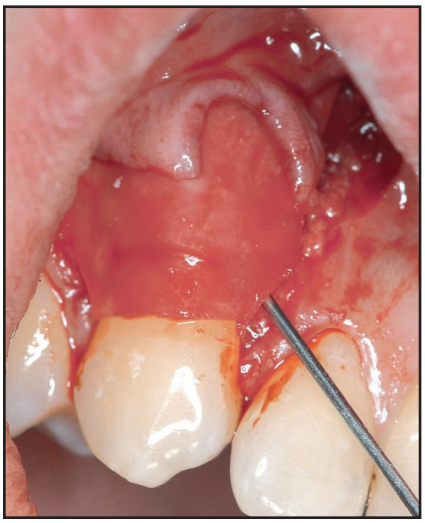

Fig 1e *The collagenated xenograft, in a gel state, was inserted under the membrane by means of a sterile syringe.*

Fig 1f *The flap was advanced coronally and sutured.*

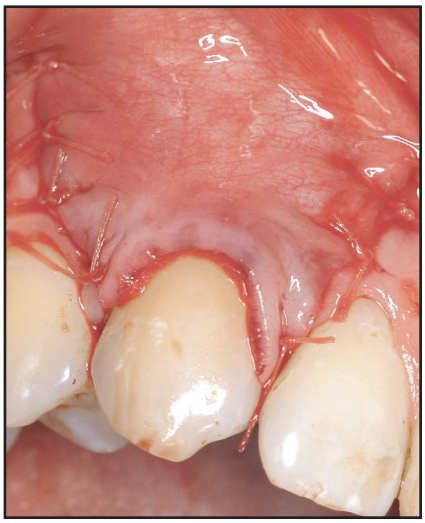

Fig 1g *Site after 2 weeks of healing.*

Fig 1h *Site after 6 months of healing, showing perfect adaptation and complete root coverage.*

Fig 2 *Control group site. Mucogingival surgery-based root coverage was performed using a coronally advanced flap alone.*

Fig 2a *Intraoral image at baseline showing buccal gingival recession on the maxillary left first premolar.*

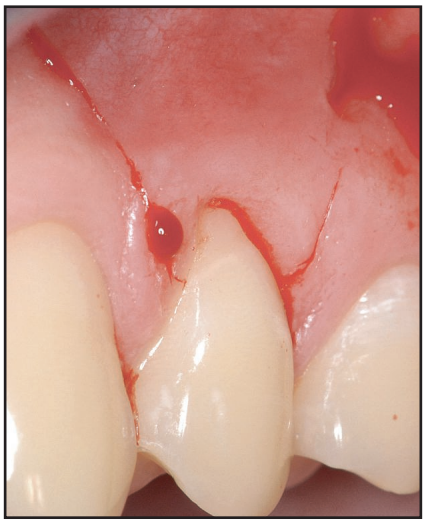

Fig 2b *Flap design with two divergent vertical incisions.*

Fig 2c *A flap was elevated and the root surface was debrided.*

Fig 2d *The flap was advanced coronally and secured with 5-0 sutures.*

Fig 2e *Site after 4 weeks of healing.*

Fig 2f *Site after 6 months of healing, showing perfect adaptation and complete root coverage.*

Table 1 Periodontal parameters at baseline and 6 months postoperatively (means ± SDs, in mm)

Parameter/time	CAF	GTRF	Difference (CAF – GTRF)
Recession			
Baseline	2.70 ± 0.54	2.50 ± 0.71	0.20 ± 0.75
6 mo	0.20 ± 0.26	0.15 ± 0.24	0.05 ± 0.28
Difference (baseline–6 mo)	2.50 ± 0.28*	2.35 ± 0.78*	0.15 ± 0.82
Probing pocket depth			
Baseline	1.25 ± 0.35	1.20 ± 0.35	0.05 ± 0.55
6 mo	1.30 ± 0.35	1.30 ± 0.42	0.00 ± 0.47
Difference (baseline–6 mo)	0.05 ± 0.15	0.10 ± 0.21	–0.05 ± 0.28
Keratinized gingiva			
Baseline	2.60 ± 0.66	2.45 ± 0.72	0.15 ± 0.82
6 mo	3.15 ± 0.91	3.25 ± 0.63	–0.10 ± 0.94
Difference (baseline–6 mo)	0.55 ± 0.55	0.80 ± 0.54	–0.25 ± 0.35
Gingival thickness			
Baseline	0.93 ± 0.21	0.85 ± 0.17	0.07 ± 0.31
6 mo	1.10 ± 0.21	1.73 ± 0.30	–0.63 ± 0.40*
Difference (baseline–6 mo)	0.17 ± 0.12	0.88 ± 0.18*	–0.71 ±

Results

Twenty Miller Class I or II defects were treated in this study. The control group included seven canines, two first premolars, and one second premolar, and the test group included six canines and four first premolars. Sixteen patients were included in the study (seven in the control group and nine in the test group). All patients were able to complete the follow-up evaluation. Table 1 shows the clinical parameters at baseline and after 6 months.

Healing was uneventful for all patients; no membranes were exposed at any time during the healing process. At baseline, no statistically significant differences were found between the study groups. In the test group, REC decreased from 2.50 ± 0.71 mm to 0.15 ± 0.24 mm, for a difference of 2.35 ± 0.78 mm. In the control group, REC decreased from 2.70 ± 0.54 mm to 0.20 ± 0.26 mm, for a difference of 2.50 ± 0.28 mm. No statistically significant difference in REC was found between the groups (0.15 ± 0.82 mm in favor of the control group; $P = .576$); however, both showed a statistically significant reduction in REC from baseline.

The percentage of root coverage was 93.33% ± 10.97% for the test group and 92.49% ± 9.97% for the control group. Seven of the ten test sites (70%) achieved 100% root coverage, one gained 83.33% root coverage, and two showed 75% root coverage. Six of the ten control sites (60%) achieved 100% root coverage, three gained 83.33% root coverage, and one achieved 75% root coverage.

CAL showed a significant gain at 6 months for both groups: 2.25 ± 0.79 mm in the test group and 2.45 ± 0.60 mm in the control group. No changes or differences were reported for PPD values between the two groups at either time point. Both groups had increases (not statistically significant) in KG: a gain of 0.80 ± 0.54 mm in the test group and a gain of 0.55 ± 0.55 mm in the control group. No significant difference was reported for KG values between the two groups.

In the test group, initial GT was 0.85 ± 0.17 mm and the final value was 1.73 ± 0.30 mm. The difference was 0.88 ± 0.18 mm, representing a statistically significant difference ($P < .000$). The control group showed a nonsignificant increase in GT of 0.17 ± 0.12 mm (baseline: 0.93 ± 0.21 mm, 6 months: 1.10 ± 0.21 mm). The comparison of GT gains between the two study groups found a significant difference of 0.71 ± 0.21 mm in favor of the GTRF sites ($P < .000$).

Discussion

The main goal of mucogingival surgery is to treat gingival recessions that jeopardize patient esthetics. In recent years several studies have compared different surgical approaches and reported successful results.[14–18] The purpose of the present randomized controlled clinical trial was to compare the clinical outcomes of the traditional CAF technique with those of a regenerative technique that used a collagen membrane plus a demineralized xenograft (GTRF) for the treatment of buccal recessions of the gingival margin. Findings obtained from this study indicated that both CAF and GTRF procedures can be successfully used for the treatment of recession-type defects, confirming previous findings.[14–19]

REC reduction and CAL gain were significant in both groups, and no difference was found between the test and control sites. Whereas the results for increase in KG values tended to favor the GTRF group, the difference between the two groups was not statistically significant for this parameter.

The overall percent root coverage was above 90% in both groups. This outcome was as favorable as other results reported by several authors.[17,20–24] It could be speculated that the CAL gains accompanied by a lack of change in probing depth might be related to some new attachment to the root. However, histologic analysis should be done to confirm this speculation. Increases in KG are in agreement with the majority of other studies in which GTR-based techniques were used for the treatment of gingival recessions.[16,25,26] The KG gain should be correlated with tissue maturation following healing and with the fact that the mucogingival junction tends to be located at its genetically determined position.[27,28] Another explanation of the KG increase may be the quality of tissue healing beneath the flap, since the inductive properties inherent in the periodontal ligament caused by the regenerative procedure can cause surface keratinization.[27,28] Reentry studies and histologic analysis have verified the presence of new connective tissue attachment with periodontal ligament fibers functionally inserted into new bone and cementum.[29,30] In the present study, it can be speculated that increased surface keratinization was a sign that the healing obtained with membrane-based therapy is tissue regeneration to a certain extent.

The difference between baseline and final GT values in the control group was not statistically relevant, whereas it was significant in the test group. Moreover, the difference in final GT gain between groups was significant in favor of the GTRF-treated sites. This suggests that the use of a collagen membrane supported by a xenograft results in an increase in tissue thickness when associated with a CAF for the treatment of gingival recession. Since stabilization of the fibrin clot is a requirement for proper healing, the use of a membrane can be useful to enhance wound stability and protect the clot from external tensile forces. From a hypothetical point of view, the use of a graft could contribute to the stability of the regenerating tissue and relieve the tension on the maturing clot. Moreover, maintenance of the space between the membrane and root surface is critical for the success of the GTR procedure, since a channel for the migration of pluripotent cells to the root surface must be provided.[31,32]

Mucogingival surgery either alone (with a coronally positioned flap) or combined with a guided tissue regeneration procedure (with an absorbable membrane plus a collagenated xenograft) was useful for the treatment of buccal gingival recessions. The results following both procedures appeared equivalent, providing good root coverage, gain in clinical attachment levels, healthy nonbleeding sulcus, and increases in keratinized tissue. However, the sites treated using the guided tissue regeneration technique showed better results than the control group in terms of gingival tissue thickness.

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