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## A comparative study of the long term results of root coverage with connective tissue graft or enamel matrix protein: 24-month results

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### Abstract

**Background:** The objective of this study was to compare the 24 month results of coronally advanced flap + enamel matrix derivates (EMD+CAF) and CAF+ connective tissue graft (CTG+CAF) in the treatment of Miller Class I recession defects.

**Methods:** Twelve patients with bilateral gingival recessions were treated with EMD+CAF or CTG+CAF. Vertical recession depth (VRD), keratinized tissue width (KTW), clinical attachment level (CAL), and clinical probing depth (CPD) were measured preoperatively, 1 and 2 years post surgery. A paired t-test and independent t-test were used to compare differences for the measured characters within and between groups, respectively.

**Results:** After 24 months a significant decrease in VRD was observed in CAF + EMD ( $3.33 \pm 0.30$  mm) and CAF + CTG ( $4.5 \pm 0.28$  mm) treated sites. There was also a significant increase in KTW ( $0.83 \pm 0.23$  mm versus  $2.08 \pm 0.14$  mm in EMD+CAF and CTG+CAF sites, respectively). The gain in CAL was  $3.54 \pm 0.38$  mm and  $4.45 \pm 0.30$  mm in EMD+CAF and CTG+CAF group, respectively. There were significant differences between the treatments for VRD, CAL, and KTW at the end of study.

**Conclusions:** The CTG+CAF procedure seems to provide better long-term results than the EMD+CAF in obtaining root coverage, increasing the KTW and CAL gain.

**Keywords:** Root coverage; gingival recession, connective tissue grafts, EMD, coronally advanced flap.

## Introduction

Gingival recession can be defined as a shift of the gingival margin to a position apical to the cemento-enamel junction (CEJ) with oral exposure of the root surface (1). It has been clinically related to major functional and esthetic problems, a higher incidence of root caries, attachment loss, and hypersensitivity(2). Among different etiologic factors that have been addressed, traumatic tooth brushing and tooth mal-position have been related most frequently to gingival recession (2,3).

Several mucogingival surgical techniques aiming at successful root coverage have been published which most common of them include free gingival grafts, pedicle flaps, (laterally or coronally displaced) and sub-epithelial connective tissue grafts. Connective tissue grafts with a pedicle flap have been demonstrated to be more successful than free gingival grafts in obtaining root coverage (4,5) and are currently considered the most predictable technique for complete root coverage (6). However, Connective tissue graft require a second surgical site to harvest the tissue and, because of that, are associated with undesirable side effects such as post surgical pain and discomfort and potential postoperative bleeding.

One of the root coverage procedures that does not need to additional surgical site in palate is coronally advanced flap (CAF) in comparison to connective tissue graft, but its success and predictability is lower. Therefore, modifications to the CAF technique which would lead to success and predictability rates similar or superior to the CT graft have the potential to make the CAF the most convenient root coverage technique for patients and clinicians.

Enamel matrix derivatives (EMD) which induces acellular cementum formation during tooth development, and eruption has been developed as a clinical treatment to promote periodontal regeneration. It is derived from embryonal enamel of porcine origin, based on the high degree of homology between porcine and human enamel proteins. Clinical studies have shown the possibility of combining EMD with root coverage procedures, especially coronally advanced flap procedures (7-11) to achieve root coverage, as well as periodontal regeneration on the previously exposed root surface.

McGuire et al. (12) in a short term (12 month) study compared CAF and either EMD or connective tissue graft (CTG) in the treatment of recession defects and concluded that the addition of EMD to CAF resulted in root coverage similar to the CTG+CAF. However, there are only limited data showing the long-term success of these techniques. Therefore, the aim of the present prospective, randomized and controlled study in recession type defects was to compare the clinical efficacy of coronally advanced flap procedure combined with either EMD or CT.

## Material and Method

Twelve systemically healthy and non smoker patients (8 female and 4 male) with bilateral Miller class I buccal recession ( $VRD \geq 3$  mm) and at least 2 mm of keratinized tissue were selected from patients seeking treatment in the author's private practice. Patient population, ranging in age from 28 to 51 (mean age 34.5 years, Standard error of mean S(EM): 2.8) and their major complaints were esthetic detracton and root sensitivity while tooth brushing. All patients agreed to participate in the study and each signed an appropriate form of consent. An inflammation score was recorded according to the criteria of the gingival index (GI) presented by Loe(13) and the plaque score was recorded using the plaque index (PI) of Quigley and Hein as modified by Turesky et al. (14). Complete scaling and root planing were performed and oral hygiene instructions were given 4 weeks prior to surgery.

Subjects were evaluated at baseline and 1, and 2 years after the surgical procedure and the following clinical measurements were recorded with UNC periodontal probe and rounded off to the nearest 0.5 mm:

Vertical recession depth (VRD) measured at the deepest part of the recession as the distance between the cement-enamel junction and the gingival margin, clinical probing depth (CPD) measured at the deepest part of the recession as the distance between the gingival margin and the base of the sulcus, width of keratinized tissue (WKT) measured at the deepest part of the recession as the distance between the gingival margin and the mucogingival junction and the clinical

Attachment level (CAL) calculated by combining CPD and VRD.

The percentage of root coverage (PRC) was calculated according to the following formula:

Root coverage =  $\frac{((\text{preoperative vertical recession depth} - \text{postoperative vertical recession depth})/\text{preoperative vertical recession}) \times 100}{}$

All measurements were carried out by a single blinded examiner. Training and calibration of the examiner were conducted prior to the start of the study to ensure the intra-examiner reproducibility of the clinical measurements and the indices (GI, PI).

In each patient, one of two teeth with gingival recession was randomly assigned to one of the surgical procedures. In the EMD+CAF group a CAF was conducted according to the technique described by Bernimoulin et al (15). Under local anesthesia (2% lidocaine with epinephrine at a concentration of 1; 80,000), the root surface was mechanically planed with ultrasonic and hand instruments. An internally beveled intrasulcular incision was made for proper envelope design. A full-thickness flap was then elevated to the mucogingival junction exposing any underlying bone dehiscence. A split thickness flap was initiated at the mucogingival junction and the

sharp dissection was carried out in apical direction to the point at which the flap could be coronally positioned and would sit passively, without any tension at the level of the CEJ. The remaining portion of papillae coronal to the first horizontal incision was de-epithelialized with a small blade.

Experimental sites were treated with EMD ( Emdogain, Straumann Biologics), as suggested by the manufacturer. Exposed root surfaces was conditioned with a 24% EDTA gel(Prefgel) for about 2 minutes and rinsed abundantly with sterile saline solution.

The flap was displaced coronally, completely covering the recession, and fixed with a non-resorbable suture material and a mattress sling suturing technique .Finally interrupted sutures were placed at the vertical incisions to facilitate tissue stabilization. No periodontal dressing was used. (Fig.1:A-F)

In the CTG+CAF sites the CAF was performed accordingly but instead of EMD a connective tissue graft was used. The connective tissue graft was harvested from the premolar and first molar region of the palate. The

graft was trimmed if necessary, and secured at the level of CEJ by sling suturing in the recipient site with 4/0 non resorbable suture. The flap was displaced coronally, completely covering the connective tissue graft.

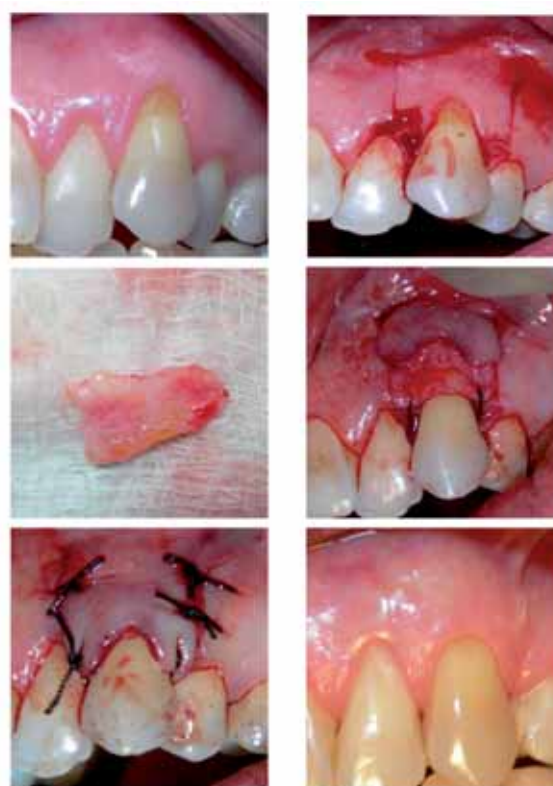
The donor site was covered with periodontal dressing but no periodontal dressing was used in the recipient site( Fig.2:A-F).

Postoperative care included 500 mg amoxicillin (t.i.d) for one week, ibuprofen 400 mg (t.i.d) as needed for pain and swelling control for 7 days and chlorhexidine gluconate 0.2% twice a day for the first 3 weeks. Sutures were removed after 10 days. In general no brushing or flossing was allowed in the operation area for 3 weeks after surgery. Oral hygiene instructions were given at the end of surgery and at each visit. Professional prophylaxis was performed at each follow up visits, if indicated. Clinical measurements and indices (PI, GI) were taken 1 and 2 years postoperatively.

The distribution of data was examined using Kolmogorov-Smirnov test. Mean and standard error of the mean (SEM) were estimated for each clinical parameter



**Fig. 1.** A) preoperative photograph of right maxillary cuspid to receive a EMD+CAF. B) Incisions for CAF preparation. C) The EDTA is applied to the root surface D) The EMD is applied to the root surface E) Mucogingival flap is coronally advanced over the root surface and sutured F) Clinical appearance at 24 months.



**Fig. 2.** A) preoperative photograph of right maxillary cuspid to receive a CTG+CAF. B) Incisions for CAF preparation. C) The connective tissue graft D) The subepithelial connective tissue graft is sutured over the denuded root surface E) Mucogingival flap is coronally advanced over the subepithelial connective tissue graft and sutured F) Clinical appearance at 24 months.

in both groups. Due to normal distribution of all the parameters analyzed, a paired t-test was used to compare differences between baseline and one or two years post surgery clinical measurements in each group. The differences between two groups were assessed using independent t test. The statistical analysis was performed using a software program (SPSS.13).

**Results**

The two groups were homogeneous at baseline for all parameters tested. (Table1) gives the baseline, 12 and 24 months mean data for the various clinical parameters assessed. Plaque and gingival indices were low and remained low over time and showed no significant differences between two groups at any time point (p<0.05).

Treatment with the both modalities significantly improved clinical parameters after 12 and 24 months compared with baseline, except for CPD.

The gingival recession depth in the CAF + EMD group decreased from 4.33±0.39mm to 0.83±0.26 mm and 1.00±0.21 mm at 12 and 24 month follow-ups, respectively. In CTG+CAF group, the gingival recession depth was also significantly decreased after 12 and 24 months compared with baseline. (From 4.83±0.38 to 0.50±0.19mm and 0.33±0.14 at 12 and 24 month follow-ups, respectively). There were significant differences between the two groups with respect to root coverage two years after treatment. The percentage of root coverage after two years was 93.1% and 76.9 % in the CTG+CAF and EMD+CAF groups, respectively. Complete root coverage was observed in 66.6% of CTG+CAF group compared to 25% in EMD+CAF group.

There was statistically significant gain of keratinized gingiva in both groups after 12, and 24 month compared to baseline. CTG+CAF resulted in more gain of keratinized tissue than EMD+CAF after 12 and 24 months (1.83±0.16 mm and 2.08±0.14 mm versus 0.66±0.22 mm and 0.83±0.25 mm, respectively).

The increase in KTW after 12 and 24 months was more significant in the CTG+CAF group compared to the EMD+CAF group.

The CAL in the CAF + EMD group changed from 5.70±0.41mm to 1.91 ±0.28 and 2.16±0.19 after 12 and 24 months, respectively, in comparison to baseline. Treatment with CTG+CAF significantly decreased CAL from 6.04±0.34 to 1.83±0.26 and 1.58±0.18 mm after 12 and 24 months, respectively, compared to baseline.

**Discussion**

The CTG+CAF(Subepithelial connective tissue graft=SCTG) technique is preferred for treating most gingival recession defects and could be considered the gold standard( 11). On the other hand it has been shown that CAF+ EMD is highly effective procedure in obtaining root coverage of isolated type of gingival reces-

	VRD			CAL			CPD			KTW		
	Baseline	12month	24month	Baseline	12month	24month	Baseline	12month	24month	Baseline	12month	24month
EMD+CAF	4.33±0.39	0.83±0.26	1.00±0.21	5.70±0.41	1.91±0.28	2.16±0.19	1.37±0.13	1.08±0.08	1.16±0.15	2.83±0.29	3.49±0.25	3.66±0.30
CTG+CAF	4.83±0.38	0.50±0.19	0.33±0.14	6.04±0.34	1.83±0.26	1.58±0.18	1.2±0.11	1.33±0.14	1.25±0.11	2.66±0.25	4.49±0.25	4.74±0.17
Significance	NS	NS	S	NS	NS	S	NS	NS	NS	NS	S	S

**Table 1.** Clinical parameters (Mean±SEM) at baseline, 1 and 2 years postoperative- Inter group comparison.

VRD: Vertical recession depth  
 CAL: Clinical attachment level  
 CPD : Clinical probing depth  
 KTW: Keratinized tissue width



sion defects. The goal of this split-mouth, randomized controlled clinical study was to evaluate the 12 and 24 months clinical results of the CTG+CAF procedure and CAF with EMD in the treatment of Miller Class I gingival recessions. Considering the study design and group's homogeneity at baseline, differences in clinical outcomes can be attributed to the treatments employed. The long-term evaluation of the results achieved after different root coverage procedures is essential to provide a better idea about the advantages and limitations of each technique. Then in this study we compared 12 and 24 months results.

Present data indicate that both treatments (CTG+CAF and EMD+CAF) can produce significant improvement in the studied clinical parameters at 12 and 24 months follow ups with respect to baseline.

At 12 month, both treatments resulted in similar and significant gain of root coverage ( $p < 0.5$ ), amounting to  $4.25 \pm 0.24$  mm ( or 83.4 %) in the CTG+CAF group and  $3.5 \pm 0.33$  mm or ( 77.7 %) in EMD+CAF group with no significant difference between groups. This finding is in accordance with Mc Guire et al. (12) which compared these two techniques and did not find any significant difference in amount of root coverage after 12 month. Compared with 12 month data, the 24 month observation showed more root coverage (0.17mm) (mean root coverage of 93.1%) for the CTG+CAF group while a reduction in root coverage of 0.17 mm (mean root coverage of 76.9%) for the EMD+CAF group. Changes within groups between 12 and 24 month measurements were statistically non-significant but differences between groups at 24 month follow-up were statistically significant (in the favor of CTG+CAF). In other word some recession occurred with time in EMD+CAF while in CTG+CAF group some creeping happened. This result is in agreement with the observation of Wennström (16). Nemcovsky et al. (17) in a long term study showed that SCTG clinical results tended to improve with time. Del Harris also (18) reported a slight decrease in root coverage (About 3%) between 12 and 24 months after use of EMD+CAF. These findings are in accordance with present study.

In contrast Moses et al in a similar study compare the short and long term results and reported 2.5% decrease in root coverage in CTG+CAF group whereas an increase of 3.7% in EMD+CAF group. These conflicting results are probably related to differences in primary VRD, selection of experimental defects (upper versus lower sites), primary KTW, patients' daily oral hygiene, and postoperative maintenance care.

At 12 month follow complete root coverage (CRC) was achieved in 58.3% of patients in the CTG+CAF group compared with 50% in the EMD+CAF group whereas these reached to 66.6% and 25% in CTG+CAF and EMD+CAF respectively at 24 month records. In 3 of 12

EMD+CAF sites that complete root coverage have been achieved at 12 month, further recession occurred at the end of study. In contrast in CTG+CAF group in 4 sites creeping attachment occurred and this phenomenon improved percentage of root coverage and percent of CRC at 24 month record.

In spite of the reinforcements of these instructions during the maintenance visits, it is not possible to assure that all the patients performed a perfect non-traumatic brushing technique during the entire course of the study. This fact could help to explain the loss of part of the initially achieved root coverage EMD+CAF group (additional loss of 4%, between 12 and 24 months).

KTW in both groups increased significantly between baseline and follow-ups. Comparing the two groups, significant differences in the KTW were observed in all the periods in the favor of CTG+CAF group. In spite of a gradual and little recession that occurred in EMD+CAF sites, KTW increased and this reveals the role of EMD in keratinization process. This finding is in agreement with previous studies (12,16,19). Reasons for those increase in the KGW in EMD+CAF group, are unknown and may be related to the enhanced early healing in these sites and a higher migration and activity of fibroblasts is generally observed on the roots to which EMD was applied (20) or to the ability of EMD's ability to promote expression of keratinized cells (21). The increase in this parameter in the CTG+CAF group could be the result of the tendency of the mucogingival line to regain its original position (22) and exposure of coronal portion of connective tissue graft.

Clinical probing depth remained shallow with no significant changes in the depth of the probing buccal pocket depth. This is in agreement with several root coverage studies (11,18,19).

While CPD remained shallow and stable, then the changes of CAL follows a pattern similar to pattern of VRD changes. In other word both techniques, adopted in the present study, resulted in a clinically and statistically highly significant clinical attachment gain at 12 month records with no significant differences between the groups. This finding is in accordance with Mc Guire et al study (12). But at 24 month follow-up, a statistically greater improvement was seen in the CTG+CAF teeth that were harmonious with significant difference in VRD between groups at this period and may be related to an additional marginal recession that had been occurred in EMD+CAF group.

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