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Coronally advanced flap with or without enamel matrix derivative for root coverage: a 2-year study

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Abstract

Aim: The purpose of this study was to assess the ability of enamel matrix derivative (EMD) to improve root coverage with a coronally advanced flap (CAF) during a 2-year follow-up.

Methods: Fifteen patients each with two single and similar bilateral Miller Class I or II gingival recessions (30 recessions) were selected. Each recession was randomly assigned to the test group (CAF+EMD) or the control group (CAF only). Clinical parameters recorded at baseline and at 6, 12 and 24 months were recession depth (R), recession width (WR), probing depth (PD), clinical attachment level (CAL) and keratinized tissue (KT).

Results: Reduction of R resulted in a significant CAL gain in both groups, whereas PD was not altered. In the test group, R decreased from 4.07 mm (SD ± 0.59) at baseline to 0.47 mm (SD ± 0.74) at 24 months, corresponding to a mean root coverage (MRC) of 90.67%, whereas in the control group R shrank from 4.13 mm (SD ± 0.74) at baseline to 0.60 mm (SD ± 0.83) at 24 months (MRC = 86.67%). Complete root coverage was achieved at 24 months in 73.33% and 60% of the two groups. A significant KT increase was observed in both groups.

Conclusions: Root coverage outcomes were similar in both groups and no statistically significant differences were found at all between them. Hence, the additional use of EMD to CAF is not justified for clinical benefits of root coverage, but as an attempt of achieving periodontal regeneration rather than repair.

Key words: comparison studies; enamel matrix derivative; gingival recession/surgery; surgical flaps

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One of the main goals of periodontal plastic surgery is to cover gingival recessions in keeping with patient demands in terms of aesthetics and root hypersensitivity. Different surgical approaches are commonly used for this purpose such as coronally, laterally or double papillae sliding flaps either associated or not with connective tissue grafts (CTGs).

However, clinicians aim to achieve both complete root coverage (CRC) and wound healing by periodontal regeneration instead of periodontal repair.

The coronally advanced flap (CAF) is a predictable surgical procedure (Roccuzzo et al. 2002) mainly for the coverage of shallow gingival recessions (Allen & Miller 1989) and has been used in conjunction with membranes (Cortellini et al. 1993, Parma-Benfenati & Tinti 1998) according to the principles of guided tissue regeneration (GTR).

Following a biomimetic approach, the enamel matrix derivative (EMD) in combination with a flap was introduced to treat gingival recession (Modica et al. 2000) with the double objective of enhancing root coverage results and inducing periodontal regeneration.

Histological evidence of periodontal regeneration when using EMD was first described in the treatment of an artificially created buccal dehiscence (Heijl 1997).

Further reports showed that periodontal regeneration could be achieved when EMD was applied to a denuded root surface (Rasperini et al. 2000, McGuire & Cochran 2003). Most studies of the treatment of gingival recessions, however, report a follow-up of only 6–12 months. Clinicians should always bear in mind that one of the major challenges is to enable the patient to attain complete and long-lasting root coverage. So far, all studies of EMD in the treatment of gingival recessions report clinical data for a follow-up of no more than 12 months.

The objective of the present randomized prospective split-mouth study

was to evaluate the clinical results of CAF+EMD compared with CAF alone in the treatment of moderate and deep (recession depth (R) $\geqslant$ 3 mm) gingival recessions over a period of 24 months. Thus, the aim of this study was to assess the ability of EMD to improve root coverage with a CAF during a 2-year follow-up. The hypothesis tested was to evaluate if less recession occurs over time in the CAF+EMD-treated sites thus leading to a higher long-term predictability of root coverage as against the CAF sites alone.

Materials and Methods

Study population

Fifteen non-smoking patients (four males, 11 females) aged 18–56 (mean 39.46 $\pm$ 10.72) with similar bilateral Miller Class I or II gingival recessions (Miller 1985) attending the Departments of Periodontology, University of Turin (seven patients) and Bologna (eight patients), were selected from June 2000 to June 2001. Before any therapy was accomplished, the protocol, in full accordance with the ethical principles of the WMA Declaration of Helsinki, was approved by an Institutional Review Board. All patients agreed to participate in the study and signed a written informed consent according to the above-mentioned principles.

Each patient provided two single symmetrical recessions suitable for a split-mouth design. Patients chosen met the following inclusion criteria:

1. Good general health.
2. No contraindications for periodontal surgery.
3. Buccal gingival R $\geqslant$ 3 mm.
4. Difference of R between the two sites in the same patient $\leqslant$ 1 mm.
5. Difference of clinical attachment level (CAL) between the two sites in the same patient $\leqslant$ 2 mm.
6. Identifiable cemento-enamel junction (CEJ).
7. Vital teeth free from caries or restorations.
8. No previous periodontal surgery in the area.

All patients received oral hygiene instructions associated with full-mouth scaling until they reached FMPS $<$ 20% and FMBS $<$ 20%. Root planing of the root surfaces chosen as test or control sites was performed in order to yield absence of plaque and bleeding in the treatment areas. Randomization between test (CAF+EMD) and control (CAF) was performed by the surgeon by tossing a coin 1 h before surgery.

Clinical assessments

Two clinicians with more than 10 years' of periodontal experience (one in Turin, the other in Bologna) and blinded to the surgical procedure collected the pre- and post-operative data. The investigators met in order to perform a calibration exercise for all clinical data collected. Intra-examiner reproducibility was calculated as standard deviation of the difference of triplicate measurements. Both examiners reached the goal of a Standard deviation lower than 0.5 mm for all parameters. Inter-examiner variability was evaluated as standard deviation of the difference from the gold standard represented by author M. F. The calculated value for all parameters was lower than 0.5 mm for both investigators.

The clinical parameters evaluated with a periodontal probe (XP 23/UNC-15, Hu-Friedy, Chicago, IL, USA) at baseline and after 6, 12 and 24 months were as follows:

- recession depth (R): distance between the CEJ and the gingival margin (GM) measured at the mid-buccal aspect of the tooth.
- recession width (WR): distance between the mesial and distal aspect of the GMs of the tooth measured in a horizontal direction at the level of the mid-buccal point of the CEJ.
- probing depth (PD): distance between the GM and the bottom of the pocket measured at the mid-buccal aspect of the tooth.
- clinical attachment level (CAL): distance between the CEJ and the bottom of the pocket measured at the mid-buccal aspect of the tooth.
- keratinized tissue (KT): distance between the GM and the mucogingival junction.

All data were rounded off to the nearest millimetre.

Surgical procedure

Two surgeons (D P. M. in Turin, Z. G. in Bologna) operated in accordance with the same protocol. Briefly, after local anaesthesia (mepivacain with adrenalin 1:100,000), a trapezoidal flap was created. A # 15 C blade was used to make an intra-sulcular incision on the buccal aspect of the tooth involved and two divergent, oblique releasing incisions were performed from the mesial and distal extremities of the horizontal incision at least 3 mm beyond the MGJ. A split–full-split thickness flap was raised from coronal to apical. It was split thickness from the papillae until the bottom of the dehiscence, then rendered full thickness as far as the depth of the gingival recession by blunt dissection, and lastly restored to partial thickness to minimize any residual tension. The papillae adjacent to the recession area were de-epithelialized to promote adhesion of the CAF. Only the exposed root surface (R+PD) was planed with curettes to maintain the connective fibres of the previous attachment. Following application of 24% EDTA gel (Prefgel, Biora AB, Malmö, Sweden) on the root surface for 2 min. and rinsing with sterile saline, EMD (Emdogain Biora AB) was applied only to the test sites and left on a dried root surface for at least 2 min. Finally, by means of Vicryl 5/0 interrupted sutures were performed to position the flap slightly coronal to the CEJ (Fig. 1).

Post-operative care

- Patients were placed on azithromycin 500 mg/day for 3 days, nimesulide 100 mg 2/day for 3 days and chlorhexidine digluconate 0.12% 3/day for 6 weeks. They were asked not to chew and brush the surgical area for the first 4 weeks post-operative. Sutures were removed after 2 weeks. Patients received oral hygiene instructions and they were shown how to achieve a roll-stroke brushing technique. All patients were monitored for plaque control. Scaling and root planing (in case of no CRC) were performed 1, 3 and 5 weeks after suture removal. Patients were recalled on a monthly basis, and professional hygiene was performed, whenever needed, until the end of the study. This important post-surgical supportive periodontal therapy (scaling and root planing as previously described) was performed on the uncovered root surfaces for two reasons:

1. to avoid gingival inflammation because of plaque accumulation because of an increased post-opera-

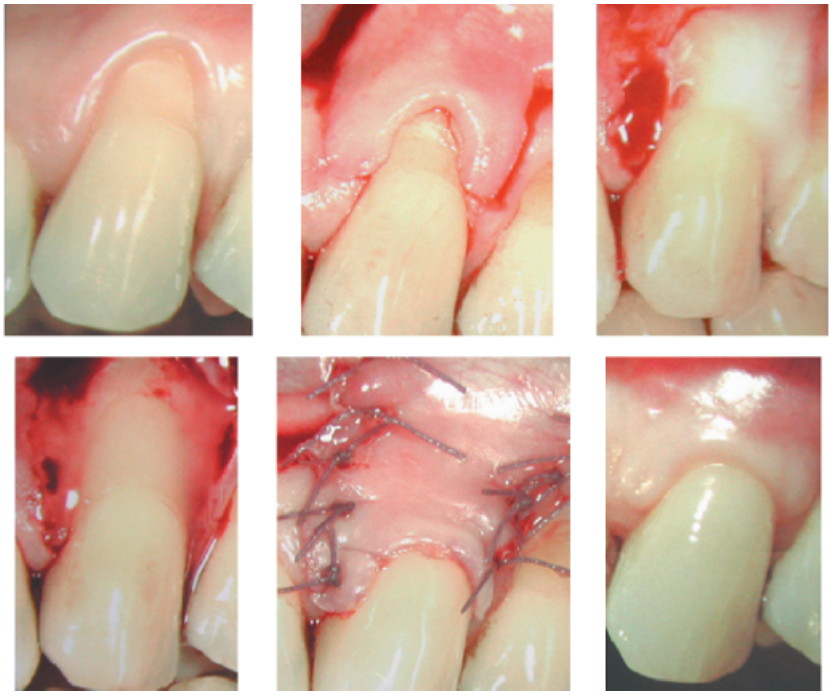

Fig. 1. Surgical procedure test group.

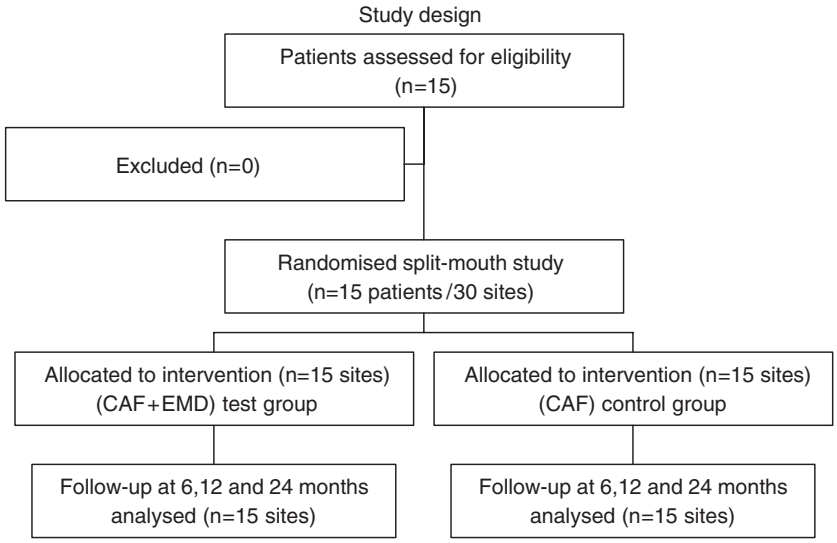

Fig. 2. Diagram of the study design.

tive hypersensitivity for a few months, that could lead to a further reduction of root coverage and

2. to create the right conditions (plaque-free root surfaces) for a possible, even if rare (in our study it occurred only in one site of the test group), coronal re-growth of the GM.

Statistical analysis

The Kolmogorov–Smirnov test ($p = 0.05$) was used to confirm the normal distribution for homogeneous baseline conditions. A comparative statistical inter- and intra-group analysis was made of the data at baseline and after 6, 12 and 24 months. An ANOVA (Bonferroni's) test was used for data with Gaussian distribution and a Dunn test for those with a different distribution. The null hypothesis of the study was declared when the average of the differences among values of the variables under examination in the test and control groups was 0. The alternative hypothesis was considered when the average of the differences among the values of the parameter under examination in the test and control groups was equal to δ (with $\delta = 1$ mm for variables such as R or CAL).

Sample size determination

Of the 15 patients enrolled all completed the study until 2 years post-operative. A statistical power analysis was performed considering that test and control groups were not independent, under hypothesis of normality for the variables examined. Calculations at 5% significance level show that 15 patients were sufficient to detect a difference of 1.0 mm in change in R and CAL, with 70% statistical power. This level of statistical power, even if not high, was assumed to be acceptable to demonstrate differences between test and control groups.

Results

A flow diagram of participants in the study is enclosed (Fig. 2). All data at baseline (Table 1) and after 6, 12 and 24 months are set out in Table 2 (test sites) and Table 3 (control sites). No adverse events were encountered in each intervention group.

Gingival recession

At test sites R decreased from 4.07 ± 0.59 mm at baseline to 0.47 ± 0.74 mm at 24 months post-operative corresponding to a mean root coverage (MRC) of 90.67 ± 16.99% (R gain = 3.60 ± 0.83). At control sites R shrank from 4.13 ± 0.74 mm at baseline to 0.60 ± 0.83 mm at 24 months, corresponding to an MRC of 86.67 ± 18.29% (R gain = 3.53 ± 0.83).

From 12 to 24 months, MRC decreased slightly from 93.67% to 90.67% in the test group and from 88.33% to 86.67% in the control group.

CRC was achieved in 73.33% of patients (11/15) in the test group, and 60% (9/15) in the control group (Figs 3a, b and 4a, b). Reduction of recession was significant ($p < 0.001$) in both groups from baseline to 6, 12 and 24 months, although there was no significant difference between the groups. WR was also significantly reduced in both groups, although with no difference between them.

CAL

In the test group, CAL changed from 5.13 ± 0.64 mm at baseline to 1.47 ± 0.74 mm at 24 months, corresponding to a gain of 3.67 ± 0.82 mm.

In the control group, CAL went from 5.13 ± 0.74 mm at baseline to 1.60 ± 0.83 mm at 24 months, corresponding to a gain of 3.53 ± 0.83 mm. These gains were because of the reduction of recession, whereas PD was unchanged. The changes from baseline to 6, 12 and 24 months were significant ($p < 0.001$) in both groups, although there was no significant difference between them.

KT

KT variations are reported in Fig. 5. In the test group, KT changed from 1.47 ± 0.74 mm at baseline to 2.47 ± 0.52 mm at 24 months, corresponding to a gain of 1.00 ± 0.76 mm. In the control group, KT went from 1.67 ± 0.82 mm at baseline to 2.13 ± 0.52 mm at 24 months, corresponding to a gain of 0.47 ± 0.64 mm. The changes from baseline to 6, 12 and 24 months were significant ($p < 0.001$) in the test group, while in the control group the gain of KT from baseline to 6 months was not statistically significant. However, the gain in the control group became significant at 12 ($p < 0.01$) and 24 months ($p < 0.05$). The comparison between the groups at 6 months showed a significant increase of KT in the test group. The comparison between tests and controls at 12 and 24 months did not show significant differences. However, the amount of KT always increased in the test group over the study period, whereas in the control group KT decreased from 12 to 24 months.

Table 1. Baseline clinical parameters

Patient	Baseline													
	test group							control group						
	Miller Class	tooth #	R	WR	PD	CAL	KT	Miller Class	tooth #	R	WR	PD	CAL	KT
1 C. A.	I	2.3	5	5	1	6	2	I	1.3	4	5	1	5	3
2 B. R.	I	4.3	4	4	1	5	2	I	3.3	3	4	1	4	1
3 N. N.	I	1.4	4	4	1	5	3	I	2.4	4	4	1	5	3
4 N. M.	I	2.3	4	5	1	5	1	I	1.3	5	5	1	6	2
5 M. A.	I	1.3	5	2	1	6	2	I	2.3	5	3	1	6	2
6 Q. F.	II	4.3	4	6	1	5	0	II	3.3	5	5	1	6	0
7 B. G.	I	3.3	4	3	1	5	1	I	4.3	4	4	1	5	2
8 G. L.	I	1.3	4	4	1	5	1	I	2.3	4	5	1	5	2
9 C. C.	I	4.3	4	4	2	6	2	I	3.3	5	4	1	6	1
10 D. G.	I	4.3	3	4	1	4	2	I	3.3	3	3	1	4	2
11 R. P.	I	1.3	4	4	1	5	1	I	2.3	5	5	1	6	1
12 V. A.	I	2.3	4	5	1	5	2	I	1.3	4	4	1	5	1
13 C. M.	I	2.3	4	5	1	5	1	I	1.3	3	5	1	4	2
14 B. G.	I	2.4	3	4	1	4	1	I	1.4	4	4	1	5	1
15 Z. A.	I	1.4	5	4	1	6	1	I	2.4	4	4	1	5	2
		Mean	4.07	4.20	1.07	5.13	1.47		Mean	4.13	4.27	1.00	5.13	1.67
		Standard deviation	0.59	0.94	0.26	0.64	0.74		Standard deviation	0.74	0.70	0.00	0.74	0.82

R, recession depth; WR, recession width; PD, probing depth; CAL, clinical attachment level; KT, keratinized tissue.

PD

PD was virtually unchanged in both groups throughout the study without any statistically significant difference over time and between the groups.

Discussion

The goal of this study was to compare the long-term clinical results of the well-known CAF procedure alone and with EMD in the treatment of moderate or deep Miller Class I or II gingival recessions ($R \geqslant 3$ mm). As described by Allen & Miller (1989) shallow Miller Class I recessions can be successfully treated with high predictability by CAF if the

Table 2. Follow-up clinical parameters

Patient	Test group																						
	6 months post-operative								12 months post-operative							24 months post-operative							
	tooth #	R	WR	PD	CAL	KT	rec-red	%RC	R	WR	PD	CAL	KT	rec-red	%RC.	R	WR	PD	CAL	KT	rec-red	%Ric.	
1 C. A.	2.3	1	4	1	2	2	4	80	1	4	1	2	2	4	80	2	4	1	3	2	3	60	
2 B. R.	4.3	0	0	1	1	1	4	100	0	0	1	1	2	4	100	0	0	1	1	2	4	100	
3 N. N.	1.4	0	0	1	1	3	4	100	0	0	1	1	3	4	100	0	0	1	1	3	4	100	
4 N. M.	2.3	1	3	1	2	2	3	75	2	5	1	3	2	2	50	2	5	1	3	2	2	50	
5 M. A.	1.3	0	0	1	1	3	5	100	0	0	1	1	3	5	100	0	0	1	1	3	5	100	
6 Q. F.	4.3	1	5	1	2	2	3	75	1	5	1	2	2	3	75	1	5	1	2	2	3	75	
7 B. G.	3.3	0	0	1	1	3	4	100	0	0	1	1	3	4	100	0	0	1	1	3	4	100	
8 G. L.	1.3	0	0	1	1	2	4	100	0	0	1	1	2	4	100	0	0	1	1	2	4	100	
9 C. C.	4.3	0	0	1	1	2	4	100	0	0	1	1	2	4	100	1	3	1	2	2	3	75	
10 D. G.	4.3	0	0	1	1	3	3	100	0	0	1	1	3	3	100	0	0	1	1	3	3	100	
11 R. P.	1.3	0	0	1	1	2	4	100	0	0	1	1	2	4	100	0	0	1	1	2	4	100	
12 V. A.	2.3	0	0	1	1	2	4	100	0	0	1	1	3	4	100	0	0	1	1	3	4	100	
13 C. M.	2.3	0	0	1	1	2	4	100	0	0	1	1	2	4	100	0	0	1	1	3	4	100	
14 B. G.	2.4	0	0	1	1	2	3	100	0	0	1	1	2	3	100	0	0	1	1	2	3	100	
15 Z. A.	1.4	1	3	1	2	2	4	80	0	0	1	1	3	5	100	0	0	1	1	3	5	100	
Mean		0.27	1.00	1.00	1.27	2.20	3.80	94.00	0.27	0.93	1.00	1.27	2.40	3.80	93.67	0.40	1.13	1.00	1.40	2.47	3.67	90.67	
Standard deviation		0.46	1.77	0.00	0.46	0.56	0.56	10.39	0.59	1.94	0.00	0.59	0.51	0.77	14.45	0.74	2.00	0.00	0.74	0.52	0.82	16.99	

R, recession depth; WR, recession width; PD, probing depth; CAL, clinical attachment level; KT, keratinized tissue.

Table 3. Follow-up clinical parameters

Patient	Control group																						
	6 months post-operative								12 months post-operative								24 months post-operative						
	tooth #	R	WR	PD	CAL	KT	rec-red	%RC	R	WR	PD	CAL	KT	rec-red	%RC.	R	WR	PD	CAL	KT	rec-red	%Ric.
1 C. A.	1.3	1	3	1	2	3	3	75	2	4	1	3	3	2	50	2	4	1	3	3	2	50
2 B. R.	3.3	0	0	1	1	2	3	100	0	0	1	1	2	3	100	0	0	1	1	2	3	100
3 N. N.	2.4	0	0	1	1	2	4	100	0	0	1	1	3	4	100	0	0	1	1	3	4	100
4 N. M.	1.3	2	3	1	3	2	3	60	2	5	1	3	2	3	60	2	5	1	3	2	3	60
5 M. A.	2.3	0	0	1	1	3	5	100	0	0	1	1	3	5	100	0	0	1	1	3	5	100
6 Q. F.	3.3	1	4	1	2	2	4	80	2	5	1	3	2	3	60	2	5	1	3	2	3	60
7 B. G.	4.3	0	0	1	1	3	4	100	1	3	1	2	2	3	75	1	3	1	2	2	3	75
8 G. L.	2.3	0	0	1	1	2	4	100	0	0	1	1	2	4	100	0	0	1	1	2	4	100
9 C. C.	3.3	1	4	1	2	1	4	80	1	4	1	2	2	4	80	1	4	1	2	2	4	80
10 D. G.	3.3	0	0	1	1	2	4	100	0	0	1	1	2	4	100	0	0	1	1	2	4	100
11 R. P.	2.3	0	0	1	1	2	5	100	0	0	1	1	2	5	100	0	0	1	1	2	5	100
12 V. A.	1.3	0	0	1	1	2	4	100	0	0	1	1	2	4	100	0	0	1	1	2	4	100
13 C. M.	1.3	0	0	1	1	2	3	100	0	0	1	1	2	3	100	0	0	1	1	2	3	100
14 B. G.	1.4	0	0	1	1	1	4	100	0	0	1	1	1	4	100	0	0	1	1	1	4	100
15 Z. A.	2.4	0	0	1	1	2	4	100	0	0	1	1	3	4	100	1	3	1	2	2	3	75
Mean		0.33	0.93	1.00	1.33	2.07	3.87	93.00	0.53	1.40	1.00	1.53	2.20	3.67	88.33	0.60	1.60	1.00	1.60	2.13	3.60	86.67
Standard deviation		0.62	1.62	0.00	0.62	0.59	0.64	12.79	0.83	2.10	0.00	0.83	0.56	0.82	18.29	0.83	2.10	0.00	0.83	0.52	0.83	18.29

R, recession depth; WR, recession width; PD, probing depth; CAL, clinical attachment level; KT, keratinized tissue.

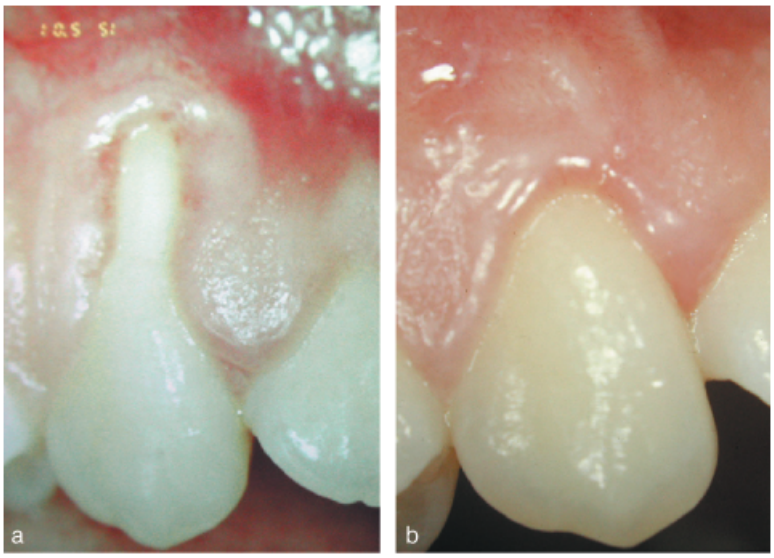

Fig. 3. (a) Baseline recession test group. (b) Two-year outcome.

KT is at least 3 mm wide and not less than 1 mm thick. CAF is a mucogingival technique that produces a MRC ranging from 70% to 99% and CAL gain varies from 2.5 to 3.7 mm (Wennström 1996). Previous studies have compared a CAF with and without EMD. Modica et al. (2000) found that both approaches gave similar results in a split-mouth study, although those of the CAF+EMD group were slightly better in terms of root coverage (MRC 91.2% *versus* 80.9%), mainly when recessions were deeper than 2 mm. CRC was achieved in 64% of patients in the CAF+EMD group compared with only 50% in the CAF group.

In a similar split-mouth study, Hägewald et al. (2002) showed that CAF+EMD and CAF alone resulted in virtually similar MRC (80% and 79%, respectively) and that the KT increase in the CAF+EMD group was statistically significant compared with that in the CAF group. CRC was not reported in this study.

A further split-mouth study (Berlucchi et al. 2002) compared CAF+EMD with CAF+EMD+CTG. The only advantage they found of adding a CTG was a greater KT increase. MRC was almost 94% in both groups and CRC was achieved in 76.9% of the CAF+EMD group and 84.6% of the CAF+EMD+CTG group.

McGuire and Nunn (2003) have compared CAF+EMD with CAF+CTG. MRC was 95.1% in the EMD group and 93.8% in the CTG group, and CRC was 89.5% and 79%, respectively. The significant increase in KT was higher in the CTG group. Even so, the width of KT may rise over time in the EMD group. Our study gave MRC values similar to those in the few previous randomized split-mouth studies of the use of EMD to treat gingival recessions. Our test sites had less recession over time than the control sites from 6 to 24 months after surgery (Fig. 6). CRC was achieved in 73.33% of the EMD group compared with 60% of the CAF only group. These results are consistent with those in the literature. All studies of EMD in the treatment of recession found better root coverage in the EMD compared with the control group. Clinical differences are often encountered, in fact, even in the absence of statistically significant differences. Moreover, CRC achieved with EMD is similar to that provided by a CTG (McGuire & Nunn 2003), with less post-operative discomfort because of the second surgical site used to harvest a graft from the

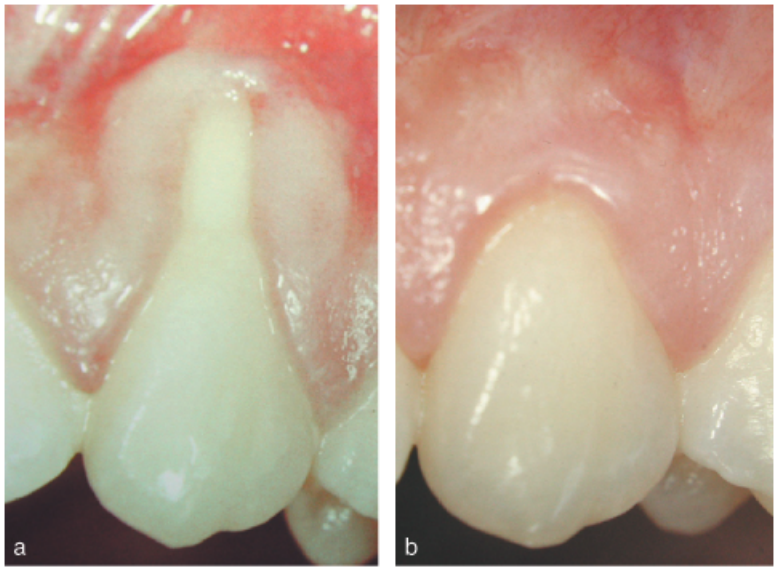

Fig. 4. (a) Baseline recession control group. (b) Two-year outcome.

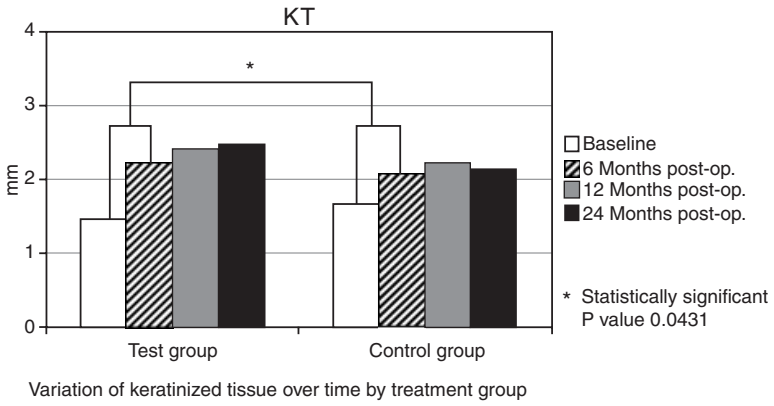

Fig. 5. Variation of keratinized tissue over time by treatment group.

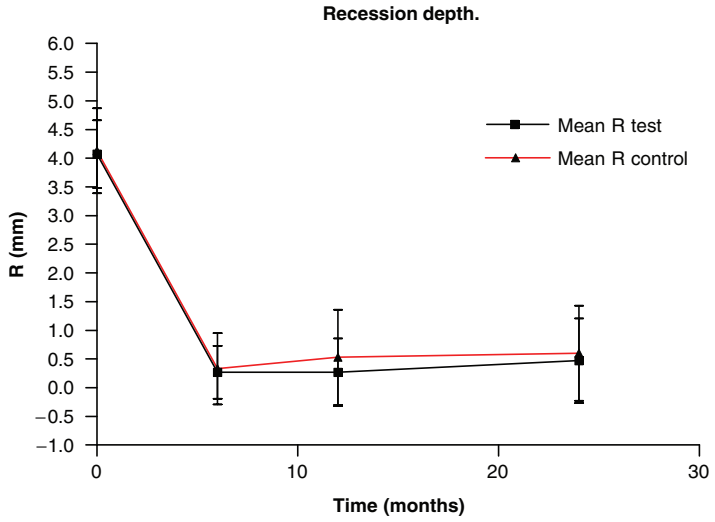

Fig. 6. Root coverage over time by treatment group.

palate. Certainly, a CTG increases the gain of KT. However, it is interesting to note that all studies of EMD combined with a CAF describe a KT gain (Berlucchi et al. 2002, Hägewald et al. 2002, McGuire & Nunn 2003) as we found in this study. Furthermore, in our study the KT gain increased over time in the test group (KT gain = 1 mm at 24 months), whereas in the control group a slight decrease followed the increase found after 6 months (KT gain = 0.46 mm at 24 months). It is controversial in the literature whether a CAF increases (Wennström & Zucchelli 1996) or reduces (Pini Prato et al. 1999) KT. It would be interesting to monitor the changes in this parameter over a long follow-up period. Increases in KT width following a CAF are ascribed to apical repositioning of the mucogingival junction in its pre-operative site (Ainamo et al. 1982), or granulation tissue originating from the periodontal ligament (Lundberg & Wennström 1988). The additional KT gain in CAF+EMD studies 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 (Cattaneo et al. 2003).

By means of EMD periodontal regeneration may be achieved (Hammarström et al. 1997, Heijl 1997, Rasperini et al. 2000, McGuire & Cochran 2003). A CTG or pedicle flaps often result in periodontal repair (Common & McFall 1983, Harris 1999, Majzoub et al. 2001). The alternative to EMD in the promotion of periodontal regeneration is GTR (Cortellini et al. 1993, Parma-Benfenati & Tinti 1998). This is a predictable technique that produces high MRC values. However, CRC occurs on average less than 50% of the time with GTR (Roccuzzo et al. 2002).

CAF+EMD is less technique demanding compared with GTR, associated with one of the highest predictabilities of root coverage and may be justified as a way of achieving periodontal regeneration as opposed to periodontal repair alone. Basically, CAF+EMD is a time-saving procedure that provides root coverage comparable with that offered by a CTG without its possible complications (haemorrhage) and greater discomfort related to the donor surgical area (McGuire & Nunn 2003). Reduction of the number of operations and surgical sites should always be considered both in general and from the patient's point of view. In cosmetic terms, too, it is easier to mimic a natural periodontal appearance if a graft is not used. Hence, on authors' opinion clinical indications for the use of EMD in gingival recessions include both following conditions:

a. high demanding aesthetic sites where it is not useful to increase in a large amount (more than 1 mm) the width or the thickness of KT,
b. high predictability of CRC associated with a possible histological periodontal regeneration.

In conclusion, a combination of CAF with EMD in the treatment of moderate or deep Miller Class I or II gingival recessions produced long-term root coverage similar to that provided by CAF alone, and there were no statistically significant differences between the two groups.

Indeed, only little clinical differences that failed to reach a statistical value in favour of CAF+EMD were encountered, such as a higher percentage of CRC (+13.33%) and a greater KT gain (+0.54 mm). Therefore, within the limits of this study, the additional use of EMD to CAF does not seem to be justified for clinical benefits of root coverage. Thus, the expected periodontal regeneration for EMD cases compared with the periodontal repair attainable in most cases treated with pedicle flaps only does not seem to lead to a better prognosis. Whether much longer studies with higher statistical power and histological evaluations may change these results remains questionable.

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Clinical Relevance

Scientific rationale for study: A few short-term studies have tested EMD in gingival recession therapy recommending EMD for periodontal regeneration. This 2-year follow-up study aims to evaluate the clinical benefits, if any, resulting from the additional use of EMD to a CAF.

Principal findings: A lack of detectable statistically significant differences of root coverage outcomes between the two groups (CAF alone *versus* CAF+EMD) was found.

Practical implications: EMD does not markedly improve the clinical results obtained with a CAF in gingival recession therapy irrespective of the expected histological periodontal regeneration rather than repair.