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Treatment of multiple gingival recessions using a coronally advanced flap procedure combined with button application

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Abstract

Aim: The purpose of this randomized controlled clinical trial was to evaluate the effectiveness of a new treatment approach, which consists of coronally advanced flap (CAF) procedure combined with orthodontic button application (CAF+B) for the treatment of multiple recession-type defects in patients with aesthetic demands.

Materials and methods: Forty-one healthy subjects presenting at least three adjacent Miller Class I or II multiple gingival recessions were treated with a CAF technique. Twenty-one patients were randomly assigned to the test group, and the other 20 patients were assigned to the control group. On the test group, orthodontic buttons were used for the stabilization of advanced flaps. Clinical and patient centered parameters were measured at baseline, 7 days and 6 months after the surgery.

Results: A total of 155 recessions were treated. Complete root coverage from baseline to 6 months post-surgery was 61% for the control group and 84% for the test group. There was no difference on visual analog scale-pain measurements among the treatment groups. Patient satisfaction with aesthetics was very high in CAF+B group when compared with CAF group.

Conclusion: Six months results showed that the CAF+B approach was effective for the treatment of multiple gingival recessions in patients with aesthetic demands.

Key words: aesthetics; coronally advanced flap; multiple gingival recession; root coverage

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Gingival recession is a term that designates the oral exposure of the root surface due to a displacement of the gingival margin (GM) apical to the cemento-enamel junction (CEJ). The treatment of gingival recession is needed for reducing root sensitivity and improving aesthetics (Wennström 1994, Wennström & Zucchelli 1996, Camargo et al. 2001, Pagliaro et al. 2003, Chambrone et al. 2008, 2009b, Kerner et al. 2008). Coronally advanced flap (CAF) is the frequently used mucogingival procedure to achieve root coverage (Chambrone et al. 2010). Several authors have utilized CAF by shifting the residual gingiva in a coronal direction alone (Pini-Prato et al. 1999, 2005) or in combination with free gingival or a connective tissue graft (CTG) (Matter 1980, Miller 1985, Raetzke 1985, Nelson 1987, Harris 1992, Wennström & Zucchelli 1996, Cheung & Griffin 2004) or with bioabsorbable or non-resorbable membranes, according to the principles of guided tissue regeneration (Tinti et al. 1993, Pini-Prato et al. 1995, Trombelli et al. 1995, Roccuzzo et al. 1996, Zucchelli et al. 1998).

Recently, some periodontal plastic surgery techniques have been proposed for the surgical treatment of multiple adjacent recession-type defects (MAR TD) such as modified CAF technique (Zucchelli & De Sanctis 2000), modified CAF combined with an subepithelial connective tissue graft (CAF+SCTG) (Allen 1994), CAF with CTG (Da Silva et al. 2004, Cortellini et al. 2009, Pini-Prato et al. 2010), or the tunnel SCTG (Zabalegui et al. 1999, Tözüm & Dini 2003), or CAF with

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enamel matrix derivative (CAF+EMD) (Aroca et al. 2010) and CAF with and without vertical releasing incisions (Zucchelli et al. 2009). Few case reports (Blanes & Allen 1999, Zabalegui et al. 1999), case series (Tinti & Parma-Benfenati 1996, Zucchelli & De Sanctis 2000, Cetiner et al. 2004, Carvalho et al. 2006) and some controlled randomized (Zucchelli et al. 2009, Aroca et al. 2010) and non-randomized (Pini-Prato et al. 2010) clinical trials have specifically addressed multiple adjacent gingival recessions showing complete root coverage (CRC) in 35–90% of defects (Chambrone et al. 2009a, Pini-Prato et al. 2010). Although these rates resemble results that are acquired with single recession defects, the treatment of MARTD shows some differences when compared with the single type of recessions. Some recent studies have suggested that the choice of treatment for MARTD involving two or more adjacent teeth may be based on a variety of factors, such as anatomic structures (size of the defect, width of keratinized tissue adjacent to the defect, amount of connective tissue available from the donor site, depth of the vestibular fornix and mucogingival phenotypes), number of adjacent teeth to be treated, anticipated level of discomfort during healing, cost and need for more than one surgical procedure to treat the entire recession site (Carvalho et al. 2006, Chambrone & Chambrone 2006, Chambrone et al. 2009a). In MARTD, as the area of surgical operation is multiple, it is important that the technique to be used must be easily practical, must not take a long time and should not require second operation area. When multiple recession defects affecting adjacent teeth in aesthetic areas of the mouth are present, patient-related considerations suggest the selection of surgical techniques that allow all gingival defects to be simultaneously corrected with the soft tissue close to the defects themselves (Chambrone et al. 2009a). So the attempt to reduce the number of surgeries and intra-oral surgical sites, together with the need to satisfy the patient's aesthetic demands, must be taken into consideration for success of treatment of the MARTD (Zucchelli & De Sanctis 2000).

Although all mucogingival treatment techniques have shown a consistent potential for root coverage, meta-analyses from several systematic reviews (Roccuzzo et al. 2002, Clauser et al. 2003, Cairo et al. 2008) revealed an ample degree of variability of clinical results. The success and predictability of the therapy depends on such as patient-related, dentist-related, site-related and technique-related factors (Pini-Prato et al. 1999). In a technical manner; flap thickness, flap tension before suturing and the position of the GM at the end of the surgery appeared to be fundamental in achieving CRC (Pini-Prato et al. 2005, Hwang & Wang 2006). Pini-Prato and colleagues showed that the post-operative location of the GM may affect the probability of CRC. In a recent study, Aroca et al. (2010) reported a new technique, which include the composite stops placed at the contact points of the teeth to prevent collapse of the suspended sutures into the interproximal spaces.

As it is important and hard to protect and to achieve the most possible coronal position of the GM during early healing period with routine periodontal plastic surgery techniques, orthodontic buttons were used in this study to maximize the stabilization of the immediate post-operative flap location. The purpose of this randomized, controlled clinical trial is, therefore, to investigate the effectiveness of a new treatment approach, which consists of CAF procedure combined with orthodontic button application (CAF+B) for the treatment of multiple recession-type defects in patients with aesthetic demands.

Material and Methods

Sample size

Sample size was calculated with an expected parameter (percentage of CRC) (Aroca et al. 2010) estimate based on minimum 20% ratio of root coverage differences between control and test group (Julious & Campbell 1998). The minimum sample size thus was required to be approximately 80 recessions in each study group within a 95% confidence and 80% power.

Subject selection

Forty-three systemically and periodontally healthy subjects, 19 males and 24 females, aged 22–48 years (mean age, 38 years), presenting at least three adjacent Miller Class I or II multiple gingival recessions affecting adjacent teeth of the upper jaw were enrolled in the study (Fig. 1a–c). The patients contributed 162 recession-type defects. The participants of this study were chosen among individuals who were referred to the Periodontology Department of Cukurova University between January 2008 and November 2009. The approval of the Local Ethics Committee of Cukurova University, Faculty of Dentistry was obtained. All patients agreed to participate in the study and signed an appropriate consent form in agreement with the Helsinki Declaration on human experimentation.

Inclusion criteria and randomization:

The patients were assigned into two treatment groups (test and control). The test group were treated by CAF+B, while the control group were treated by CAF alone. The randomization was achieved by toss of a coin before the surgery of each patient. The outcome of coin toss was written on a paper, which was put in the opaque envelope contained the treatment information for the specific patient by a blind staff; it was opened at the time of surgery, immediately after completing treatment of the root surfaces to prevent surgeon bias. The number of the patients treated with the test and control procedures were 22 (81 defects; 42 Miller 1 and 39 Miller 2) and 21 (81 defects; 40 Miller 1 and 41 Miller 2), respectively.

All participants met the study inclusion criteria: multiple (at least three) Miller Class I and II recession defects ($\geqslant$2 mm in depth and $\geqslant$2 mm in width) on adjacent anterior (47 incisors in test and 52 incisors in control) or posterior teeth (34 pre-molars in test and 29 pre-molars in control) in the same quadrant of the upper jaw; presence of identifiable CEJ (in case of unidentifiable CEJ a resin stent was used as reference point); presence of a step $\leqslant$2 mm at CEJ level and/or the presence of a root abrasion; presence of $\geqslant$1 mm high keratinized tissue apical to the root exposure; presence of $\geqslant$0.8 mm thick gingival tissue (gingival thickness was measured at the mid-buccal 2 mm apical to the free GM by penetrating a UNC probe into the tissue and recorded to the nearest 0.5 mm) (Huang et al. 2005), a full-mouth plaque score of $<$10% (O'Leary et al. 1972); no occlusal interferences, periodontal and systemic health; no contraindications for periodontal surgery and not taking medications known to interfere with periodontal tissue health or healing; and no previous periodontal

surgery on the involved sites. All subjects were non-smokers. Recession defects associated with demineralization/caries, deep abrasion or restoration and teeth with evidence of pulpal pathology were not included.

Initial therapy and clinic measurements

In both test and control groups, an initial periodontal therapy consisted of oral hygiene instructions, ultrasonic instrumentation and coronal polishing was done 1 month before surgery. The criterion for surgery was optimal plaque control with a full-mouth plaque score (O'Leary et al. 1972) of 10% or less. The gingival index (Löe & Silness 1963) and plaque index (Löe 1967) were used to assess gingival health conditions throughout the study.

One blind-trained examiner performed all the clinical measurements at each selected site using a periodontal probe (MHC). Before surgery (after initial treatment, baseline) and 6 months after surgery, the following clinical parameters were recorded to the nearest millimetre (Carvalho et al. 2006): (1) gingival recession depth (GRD), measured as the distance between the most apical point of the CEJ and the GM; (2) gingival recession width (GRW), measured as the distance between the mesial GM and the distal GM of the tooth (measurement was recorded on a horizontal line tangenital at the CEJ); (3) probing depth (PD), measured as the distance from the GM to the bottom of the gingival sulcus; (4) clinical attachment level (CAL), measured as the distance from the CEJ to the bottom of the sulcus; (5) apico-coronal width of keratinized tissue (KTW), measured as the distance from the mucogingival junction (MGJ) to the GM, with the MGJ location determined using a visual method; (6) the location of the GM after suturing with respect to CEJ is calculated by subtracting the distance between incisal margin and CEJ (IMCEJ) from the distance between incisal margin and GMafter suturing (Pini-Prato et al. 2005); (7) recession depth reduction; (8) mean root coverage; (9) CRC.

GRD, PD, CAL and KTW measurements were performed at the mid-buccal point of the involved teeth. The same blind calibrated examiner undertook all the probing measurements using a Hu–Friedy periodontal probe (UNC-15 periodontal probe, Hu–Friedy, Chicago, IL, USA).

Intra-examiner reproducibility

The examiner evaluated six subjects who has at least three adjacent teeth with Miller I and II multiple-type recession defects and not involved in the study, on two occasions 24 h apart. Calibration was accepted if 90% of the recordings could be reproduced within a difference $\leqslant$0.5 mm (Pilloni et al. 2006).

Surgical procedure

Before starting the surgery, root surfaces were treated. The part of the roots near to buccal attachment loss was instrumented with mini-five Gracey curettes. The mechanical treatment was finished when the softened structure was removed. Immediately after instrumentation, the root surface was washed for 60 s with saline. Chemical treatment of the instrumented root consisted of 24% EDTA gel maintained on the root surface for 2 min., which was done to eliminate the smear layer from the dentine tubuli and to improve coagulum adhesion to the root surface. The root surface was rinsed for 60 s with saline after EDTA application (Zucchelli et al. 2009).

Surgical operations of test and control groups were performed by the same experienced periodontist (O. O.). The CAF procedure used in the control group has been described by Zucchelli et al. (2009), which was a modification for multiple adjacent recessions of the surgical technique described by De Sanctis & Zucchelli (2007). Briefly, two oblique incisions were performed at the mesial and distal line angles of the most distal teeth with GRD. These incisions, together with the intra-sulcular incisions along the mesial and distal recession margins, designed the two external surgical papillae. All surgical papillae were dissected, split thickness, up to the probeable sulcular area; the soft tissue apical to the root exposure was elevated full thickness by inserting a small periosteum elevator into the probeable sulcus and proceeding in the apical direction to expose 3–4 mm of bone apical to the bone dehiscence. Apical to the bone exposure, split-thickness flap elevation continued until it was possible to move the flap passively in the coronal direction. To permit the coronal advancement of the flap, all muscle insertions present in the thickness of the flap were eliminated. Coronal mobilization of the flap was considered adequate when the marginal portion of the flap was able to passively reach a level coronal to the CEJ of all teeth with the recession defects. The facial soft tissue of the anatomic inter-dental papillae were de-epithelialized. Suturing of the flap started with two interrupted periosteal 5–0 sutures at the most apical extension of the VRI; it proceeded coronally with other interrupted sutures, each of them directed from the flap to the adjacent buccal soft tissue, in the apical–coronal direction. This was done to facilitate the coronal displacement of the flap and to reduce the tension on the last coronal 6–0 sling sutures. The sling sutures permitted stabilization of the surgical papillae over the inter-dental connective tissue beds and allowed for a precise adaptation of the flap margin over the convexity of the underlying anatomic crowns. At the end of the surgery, the flap margin was coronal to the CEJ of all teeth included in the flap design. Periodontal dressing was applied at the surgical area.

Test group

Before starting the surgery, orthodontic buttons were applied on the tooth with dental cement, and then cured with light until hardened (Fig. 1d). This process took a few seconds per tooth (about 2 min. per tooth). The surgical technique applied in the test recession defects was the CAF combined with orthodontic buttons without vertical incision. The surgical procedure of the test group was similar with the technique proposed by Zucchelli & De Sanctis (2000). The flap design consisted of a horizontal incision extended to the most distal teeth with gingival recessions on each side. The flap was raised with a split-full-split approach in the coronal–apical direction; the surgical papilla were elevated split thickness. Gingival tissue apical to the root exposures was raised full thickness and it terminated once 3–4 mm of bone was denuded apical to the bone dehiscence (Fig. 1e and f). The most apical portion of the flap was elevated split thickness to facilitate coronal displacement of the flap. The remaining soft tissue of the anatomic inter-dental papillae was de-epithelialized (Fig. 1g). Coronal advancement of the flap was obtained with a partial-thickness dissection into the vestibular-lining mucosa; this incision cut the superficial muscular insertions included in the thickness of the flap. These insertions were identified by pulling the lip and they were elimi-

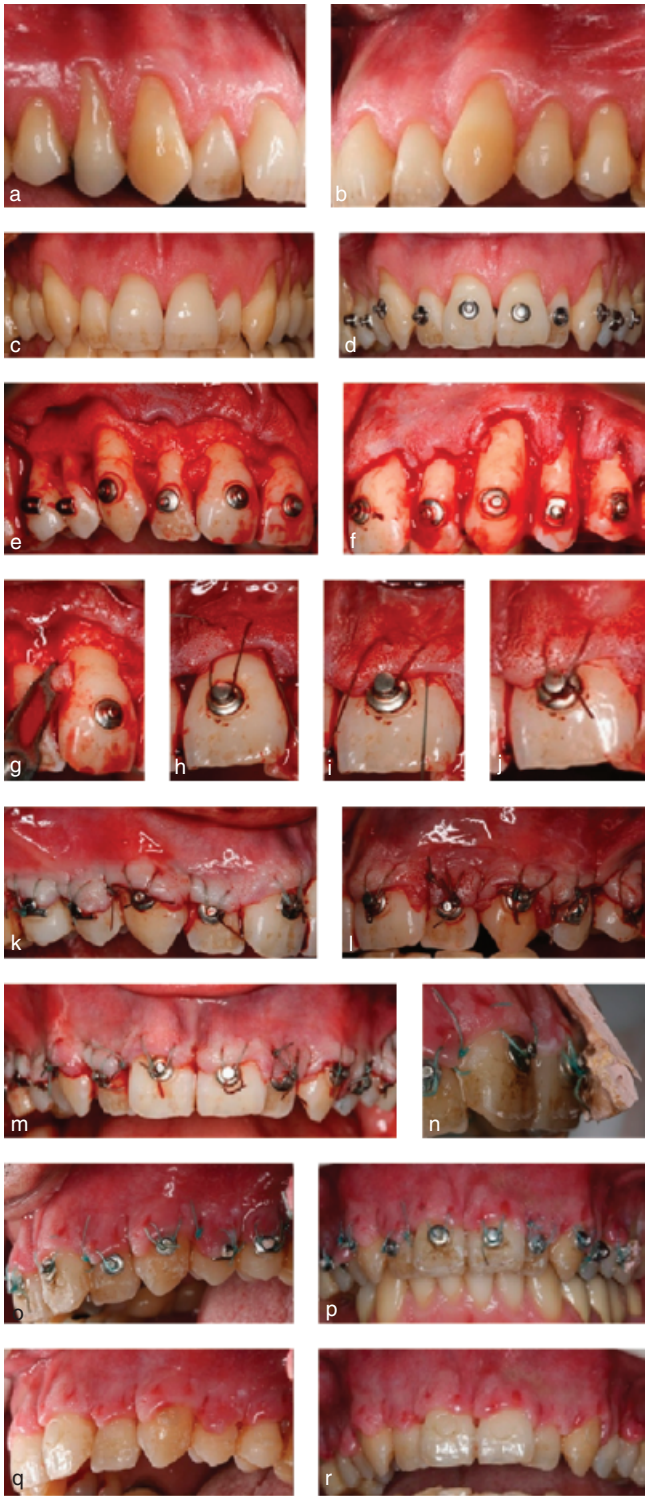

Fig. 1. In a CAF+B group; left and right central incisors, lateral incisors, canines, the first and the second pre-molars in the upper jaw with gingival recessions (a, b and c). Orthodontic buttons were applied on the teeth with dental cement and then cured with light until hardened (d). The flap extended to the most distal teeth with gingival recessions on each side and elevated with a split-full-split approach (e and f). Inter-dental anatomic papillae were de-epithelialized (g). Flap was maintained in a coronally position by suspended sutures around the orthodontic buttons at teeth (h, i and j). At the end of the surgery, the flap margines were at least 3–4 mm coronal to the CEJ of all teeth (k, l and m). Clinical view at 15 days before suture removal (n, o and p) and after suture and button removal (r and s).

nated with the blade kept parallel to the external mucosal surface. Because of the absence of VRIs, the apical movement of the blade for cutting muscular insertions was controlled through the thin, almost transparent, lying mucosa, i.e., the thin lying mucosa permitted to control the movement of the blade. During coronal advancement, flap mobilization was considered adequate when the marginal portion of the flap was able to passively reach a level coronal to the CEJ at every tooth in the surgical area and when the surgical papillae covered the corresponding anatomic papillae.

Two type of sutures were used for this technique; sling 5–0 and stabilizing 6–0 sutures. The sling 5–0 sutures (nylon monofilament, Ethicon, Johnson & Johnson, Woluwe, Belgium) were used to suspend the central area of the flaps on the buttons (Fig. 1h–j). These sling sutures allowed to the most coronal positioning of the flaps. The second 6–0 sutures were performed to accomplish a precise adaptation of the buccal flap on the convexity of the underlying crown surfaces and permitted the stabilization of every surgical papilla over the inter-dental connective tissue bed.

At the end of the surgery, the flap margines were at least 3–4 mm coronal to the CEJ of all teeth (Fig. 1k–p). Periodontal dressing was applied to avoid any mechanical traumas.

All surgical procedures were performed by the same experienced periodontist (O. O.) in order to prevent inter-operator variations. Surgical chair-time, i.e., the time needed for surgery from the first incision to the last suture, was measured with a chronometer.

Evaluation of aesthetic outcomes

The aesthetic evaluation was performed according to the root coverage aesthetic score system (RES), which was published by Cairo et al. (2009). Five variables were evaluated, which include; GM, marginal tissue contour (MTC), soft tissue texture (STT), MGJ alignment and gingival colour (GC) were evaluated. Zero, 3 or 6 points were used for the evaluation of the position of the GM, whereas a score of 0 or 1 point was used for each of the other variables. GM; 0 point = failure of root coverage (GM apical or equal to the baseline recession); 3 point = partial root coverage; 6 point = CRC. MTC; 0 point = irregular GM (does not follow the CEJ); 1 point = proper marginal

contour/scalloped GM (follows the CEJ). STT; 0 point = scar formation and/or keloid-like appearance; 1 point = absence of scar or keloid formation. MGJ; 0 point = MGJ not aligned with the MGJ of adjacent teeth; 1 point = MGJ aligned with the MGJ of adjacent teeth. GC; 0 point = colour of tissue varies from GC at adjacent teeth; 1 point = normal colour and integration with the adjacent soft tissues. Thus, the ideal aesthetic score was 10. Zero point would be assigned if the final position of the GM was equal or apical to the previous recession depth (failure of root-coverage procedure), irrespective of colour, the presence of a scar, MTC or MGJ. Zero points were also assigned when a partial or total loss of interproximal papilla (black triangle) occurred following the treatment.

Patient evaluation of post-operative discomfort and aesthetics

A questionnaire was given to each patient; it included dichotomous questions, and the evaluation of the intensity of the given event was marked on a 100 mm visual analog scale (VAS) (Zucchelli et al. 2009). The questionnaire was divided into two parts: the first part, regarding the post-operative morbidity, was completed 1 week after the surgery, and the second part, concerning patient satisfaction with the aesthetic outcome, was completed at the 6-months follow-up visit. The post-operative course was evaluated 1 week after surgery based on a VAS (VAS-P). Patients were asked to select among 100 scores (zero indicating very bad, 50 indicating average and 100 indicating an excellent post-operative course). Patient satisfaction with aesthetics was evaluated at the 6-months follow-up visit based on a VAS (VAS-E). Patients were asked to select among 100 scores (0 indicating very bad, 50 indicating average and 100 indicating excellent) in terms of overall satisfaction, colour match and the amount of root coverage (Aichelmann-Reidy et al. 2001, Wang et al. 2001, Kerner et al. 2008, Zucchelli et al. 2009).

Post-surgical protocol

The patients were prescribed ibuprofen as needed for analgesia. No adverse events were occurred. All the patients were instructed to abstain from brushing and flossing around the surgical area until suture removal and to consume only soft and warm food during the first week. The patients were instructed to rinse with chlorhexidine solution (0.12%) three times a day for 1 min. The sutures, buttons and periodontal dressing were removed 14 days after surgery (Fig. 1r and s). Plaque control in the surgically treated area was maintained by chlorhexidine rinsing for an additional 2 weeks. After this period, patients were reinstructed in mechanical cleaning of the treated tooth and used a post-surgical soft toothbrush and a roll technique for 1 month. A chlorhexidine rinse was used twice a day during this period. Thereafter, the patients used a soft toothbrush and chlorhexidine once a day. All patients were recalled for prophylaxis 2 and 4 weeks after suture removal and once every 2 months until the final examination (6 months) (Fig. 2a–c).

Statistic analysis

Statistical analysis was performed using the statistical package SPSS v 16.0. For each continuous variable, normality was checked by Kolmogorov–Smirnov and Shapiro–Wilk tests and by histograms. Comparisons between the independent groups were done by using the student *t*-test or Mann–Whitney *U*-test. Data between the time dependent groups were analysed by pair *t*-test or Wilcoxon's rank sum test. The categorical variables between the groups were analysed by using the χ^2-test. Results were presented as mean ± SD. A p value <0.05 was considered as significant. In addition, data were compared using a mixed model analysis of variance among techniques. Subject was included as a random effect and technique was included as a fixed effect in the mixed linear models. Mixed model analyses were conducted using statistical software (SAS v. 9.1.3; SAS Institute Inc., Cary, NC, USA).

Results

The results of the study are summarized in Tables 1–3. During the follow-up period one patient from the test group (three recession defects) and one patient from the control group (four recession defects) were excluded from the study due to poor compliance in terms of oral hygiene. The remaining 41 patients (78 recession defects in the test group and 77 recession defects in the control group) completed the study and their data were included in statistical analysis.

No statistical difference was observed between groups for PPD, GRD, GRW, CAL and KTW measurements at baseline (Table 1). Statistically significant differences of GRD and CAL between baseline and 6 months were observed within each group ($p<0.0001$ and $p<0.001$, respectively) (Table 1). The analysis of the mean differences of the clinical parameters between baseline and 6 months (delta-Δ) showed significant differences between groups for GRD and CAL ($p<0.001$ and $p<0.001$, respectively).

Forty-seven of the 78 defects in CAF (61%) and 66 of the 77 defects (84.6%) in CAF+B group exhibited CRC (Table 2). In addition, at the 6-month follow-up examination, mean root-coverage scores were 89.1% for the control group and 96.2% for the test group.

Data were also analysed with subject as a random effect and technique code as a fixed effect using the mixed-model analysis of variance. The CAF+B group measurements (GRD, CAL and percentage of CRC) were better than the measurements for the CAF group. There was significant difference with respect to techniques in the outcome measurements.

Fig. 2. Clinical view at 6 months (a, b, c and d).

Table 1. Distribution and delta (Δ) of gingival recession width (GRW), gingival recession depth (GRD-6), probing pocket depth (PPD), clinical attachment level (CAL), width of keratinized tissue (KTW) levels between study groups at baseline and 6 months post-operatively

	CAF Mean ± SD	CAF+B Mean ± SD	p^{**}
GRW			
Baseline	3.6 ± 0.6	3.7 ± 0.6	0.401
GRD			
Baseline	4.3 ± 1.1	4.4 ± 1.1	0.671
6 months	− 0.4 ± 0.8	0.3 ± 1.0	0.0001*
Mean difference (Δ)	3.89 ± 0.98	4.65 ± 0.99	0.001**
PPD			
Baseline	1.4 ± 0.5	1.6 ± 0.5	0.129
6 months	1.4 ± 0.5	1.5 ± 0.5	0.184
Mean difference (Δ)	0.01 ± 0.69	0.05 ± 0.70	0.728
CAL			
Baseline	5.7 ± 1.1	5.9 ± 1.1	0.281
6 months	1.8 ± 1.1	1.2 ± 1.0	0.001*
Mean difference (Δ)	3.93 ± 1.28	4.69 ± 1.20	0.001**
Apico-coronal width of keratinized tissue			
Baseline	2.4 ± 1.1	2.4 ± 1.1	0.908
6 months	3.0 ± 1.2	2.9 ± 1.2	0.414
Mean difference (Δ)	0.66 ± 0.95	0.48 ± 0.97	0.261

*p value Wilcoxon Sum rank test between baseline and 6 month within each group.
**p value between CAF and CAF+B (Mann–Whitney U- or Student t-test).
CAF, coronally advanced flap; CAF+B, coronally advanced flap procedure combined with button application; Δ, the difference of the parameters between baseline and 6-months.

Table 2. Distrubition of the post-operative gingival margin location, root coverage percentage and complete root coverage between study groups in the operated patients at 6 months post-operatively

	Post-operative gingival margin location	Mean root coverage percentage	Complete root coverage
	mean ± SD	mean ± SD	*n* (%)
CAF ($n = 77$)	0.2 ± 0.7	89.1 ± 14.3	47 (61.0)
CAF+B ($n = 78$)	1.7 ± 1.3*	96.2 ± 9.4**	66 (84.6)***

*$p = 0.0001$ Mann–Whitney-U test.
**$p = 0.0001$ Student t-test.
***$p = 0.0009$ χ^2-test.
CAF, coronally advanced flap; CAF+B, coronally advanced flap procedure combined with button application.

There was no difference of VAS-P measurements between the treatment groups in the first post-operative week. Patient satisfaction with aesthetics was very high in CAF+B group when compared with CAF group. These results were compatible with the clinical measurements indicated by RES values (Table 3).

The long-term results of this study (Table 3) have shown that the treatment of recession defects with CAF+B lead to statistically significant GRD reduction compared with the CAF alone. In addition, PGE had an important effect on mean decrease of the recession depths (Fig. 3).

Due to the drop-outs, a post hoc calculation for the power analysis of the study was performed and this had revealed higher power calculation (90%) compared with the baseline power analysis due to the greater differences of CRC between the test and control groups than expected.

Discussion

This randomized controlled clinical trial reports the procedure, the clinical and the patient-centered outcomes of a (CAF+B) technique, which is designed to treat multiple GRD.

The most important part of the CAF+B technique is to guarantee the anchorage of the coronally displaced flap. The suspended sutures used in this technique provided the maximum coronally positioning of the flap and in addition stabilized the flap in the coronally displaced position during 2 weeks of wound healing. The results of this study show that the usage of CAF+B technique leads to statistically significant GRD reduction compared with the CAF alone. It was found that there is a positive correlation between post-operative GM location and achieving CRC. The coronal position of the GM relative to the CEJ following CAF+B procedure seems to increase the success of CRC. This result is in accordance with the previous studies, which reported that the greater post-operative coronal displacement of the GM may cause greater root coverage (Pini-Prato et al. 1999, 2005). The results of Pini-Prato's study emphasize that the post-operative location of GM may have an effect, which increases the probability rate of CRC (Pini-Prato et al. 2005). These findings are compatible with the results of present study, which showed that the application of the CAF+B procedure increase the complete root-coverage rate in Miller Class I and II MARTD when compared with CAF technique.

Mean root coverage of the test and the control sites from baseline to 6 months after surgery was 96.2% and 89.1%, respectively. CRC was achieved in 47 (61.1%) of the GRD treated by the CAF and 66 (84.6%) of the GRD treated with the CAF+B. This rate of CRC outcomes of the CAF+B group was similar to that previously reported studies of CAF for single (De Sanctis & Zucchelli 2007) and multiple (89%) (Zucchelli & De Sanctis 2000, Zucchelli et al. 2009) gingival recessions in which similar surgical techniques were used. A recent systematic review, which include the MARTD case series, reported various results for CRC outcomes (Chambrone et al. 2009a). While Carvalho's study (2006) had better CRC results with CAF+SCTG when compared with the results of our study, CRC percentage in our study was generally better compared with other studies (Zucchelli & De Sanctis 2005, Chambrone & Chambrone 2006). However, it is important to note that the Chambrone and Chambrone's study was a case series study, which included 10 cases, so success in the application of CAF+SCTG in this group may not be predictable. In addition, complete root-coverage results in CAF+B group were

Table 3. Distribution of root coverage aesthetic scores (RES) and VAS-aesthetic (VAS-E) at 6 months post-operatively

	CAF Mean ± SD	CAF+B Mean ± SD	p^*
Root coverage aesthetic score	7.43 ± 1.56	8.65 ± 1.47	0.0001
VAS-aesthetic	7.15 ± 1.18	8.18 ± 0.73	0.0001
VAS-P	5.70 ± 1.59	5.31 ± 1.52	0.432

*p value between CAF and CAF+B (Student t-test).
Mean and SD of VAS-pain (VAS-P) at the immediate post-operative period.
VAS, visual analog scale.

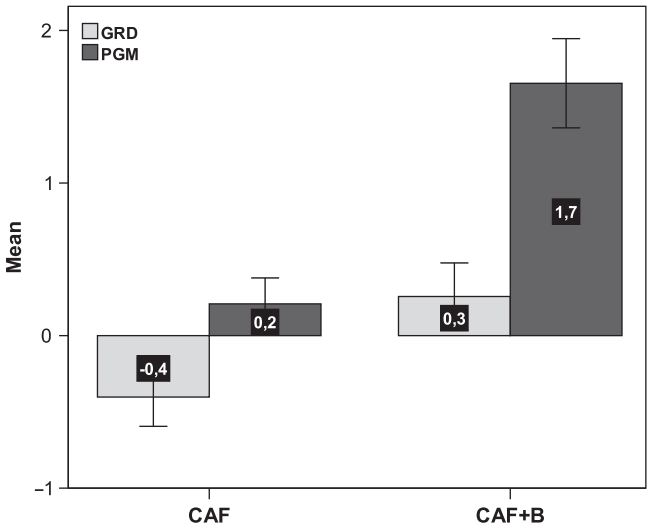

Fig. 3. Mean level of post-operative gingival margin (PGM location) and gingival recession depth (GRD) at 6th month in each study groups.

better than reported in a recent controlled non-randomized clinical study (Pini-Prato et al. 2010) in which CAF was used as a control root-coverage surgical procedure for the treatment of multiple gingival recessions.

Cost, simplicity, aesthetic appearance and patient compliance are very substantial when different treatment techniques are compared. The costs of mucogingival operations may arise when other biomaterials materials such as ADM, EMD and BM are included. In addition, the amount of graft material (autegenous and/or purchased) that is required for MARTD treatment can be more than single recession-type defects. This condition can increase the cost and cause the bigger second operation site. This is especially important when patients do not comply with the use of costly additive materials and or with a second surgery necessary for CTG applications. Furthermore, Zucchelli & De Sanctis (2000) mentioned that even if CRC is surgically accomplished; the result may not be completely satisfactory in the case of excessive thickness or poor blending of the area. This happens very frequently when a free or CTG is harvested from the palate and utilized for root coverage. In addition, the hardness of the treatment technique is another issue, which determines the success rate of the periodontal plastic surgery. When compared with the CTG, BM and ADM application, applying the buttons on the teeth is easy, inexpensive and highly acceptable.

As the patients and the periodontist might have different views on what the best treatment results are; patient-centred outcomes of periodontal therapy should be understood well for the most satisfactory results (Ozcelik et al. 2007). Patient perception of the immediate post-operative pain was similar in both groups. The elongation of the chair-time could most likely affect patient perception of the procedure's difficulty. Although bonding the buttons on the teeth (about 2 min. per tooth) takes some time in the CPF+B technique, there was no displeased patient report in respect to CPF+B procedures. In recent surveys of specialists in periodontics and general dentists, it has been reported that the predominant indication for root-coverage procedures was aesthetics (Zaher et al. 2005, Kerner et al. 2008, Chambrone et al. 2009a). Similarly, Kerner et al. (2008) reported that aesthetics were the main reason, whereas root sensitivity and soft tissue augmentation account for only 27.35% and 10.81%, respectively. In recent years, several technical modifications have been developed, leading to improve CRC and the aesthetic results. CRC may be associated with greater patient satisfaction, therefore when the patient complains about the aesthetic appearance, CRC is the goal (Zucchelli & De Sanctis 2000). However, the achievement of CRC associated with poor colour blending of the treated area, irregular tissue texture or inadequate contiguity with adjacent soft tissues may also affect the aesthetic perception of treatment (Aichelmann-Reidy et al. 2001, Zucchelli et al. 2003, Rotundo et al. 2008, Kerner et al. 2009). In addition, Kerner et al. (2009) reported that soft tissue appearance is more important than the quantitative level of root coverage, and that the colorimetric integration is the most important parameter when dealing with aesthetics. And the authors concluded that the future root-coverage trials should include overall qualitative evaluation as the primary variable (Kerner et al. 2009). Therefore, CRC parameter is usually not enough for evaluating the overall aesthetic satisfaction. As aesthetic assessment is very important and subjective in root-coverage procedures, two types of measurement techniques were used to assess the aesthetic evaluation in this study. The VAS analysis was used to measure the patient satisfaction with aesthetics. The patients treated with CAF+B technique were more satisfied aesthetically when compared with the patients treated with CAF. Other evaluation was done by using the root coverage aesthetic score (RES), to investigate the aesthetic outcomes according to MTC, STT, MGJ alignment and GC. The finding of this evaluation is in accordance with the patient-centred assessment results, which showed that the patients treated with CAF+B had significantly better RES scores when compared with the CAF group.

Although the aesthetic concern is an important parameter, only a few studies evaluated the aesthetic satisfaction fol-

lowing therapy (Bouchard et al. 1994, Rosetti et al. 2000, Aichelmann-Reidy et al. 2001, Wang et al. 2001, Zucchelli et al. 2003). Bouchard et al. (1994) evaluated the outcomes of SCTG for the treatment of localized gingival recessions using grafts without epithelial collar plus conditioning and CAF or grafts with epithelial collar without conditioning. Two examiners performed the aesthetic evaluation and the authors commented that all patient were satisfied with the aesthetical results. In another study Rosetti et al. (2000) compared the GTR procedure with allografts to SCTG in patients with bilateral gingival recessions. Aesthetical evaluation was performed by five examiners. The patient satisfaction survey showed that all patients were satisfied with the aesthetic results. In the split-mouth study by Wang et al. (2001), which compared the BM and the CTG, the periodontist rated that almost all BM sites with an excellent colour match. Patient satisfaction with aesthetics was the same for both treatments, although greater overall satisfaction was expressed for BM sites compared with CTG sites. Aichelmann-Reidy et al. (2001) compared CAF+ADM *versus* CAF+CTG in a split-mouth study and both clinicians and patients decided that sites with CAF+ADM have better aesthetic outcomes. The results of our study were in accordance with the esthetic outcomes of these clinical trials, which showed that the opinions about esthetic concerns may be similar for both the patients and the periodontists.

Although CAFs with and without VRIs, can be used successfully to treat multiple GRD in patients with aesthetic demands (Zucchelli et al. 2009), it was reported that VRIs can cause some biologic and esthetic problems (Bruno 1994, Zucchelli & De Sanctis 2000, Joly et al. 2007, Zucchelli et al. 2009). In the present study, VRIs were avoided in the test group to prevent possible blood supply damage at the early stage of wound healing and occurrence of visible fibrotic scars, which can cause an unesthetic appearance of the operation area (Bruno 1994, Zucchelli & De Sanctis 2000, Joly et al. 2007, Zucchelli et al. 2009).

Another finding of the present study was the statistically significant increase in KTH in both groups. Any attempt to explain this difference is speculative. In previous studies on CAF (Zucchelli & De Sanctis 2005, De Sanctis & Zucchelli 2007) it has been suggested that the increase in keratinized tissue is a slow, long-lasting phenomenon that may be attributed to the tendency of the mucogingival line to regain its genetically determined position (Ainamo et al. 1982, Zucchelli et al. 2009).

As this is a short-term assessment of the efficacy of a technical procedure, the evaluation period used in this study was 6 months from the last surgical treatment. Although this period is considered adequate to provide soft tissue maturity and stability as reported in systematic reviews dealing with root-coverage procedures (Roccuzzo et al. 2002, Cairo et al. 2008), it was shown that the length of follow-up is a positive predictive factor in terms of aesthetics and the follow-up period should not be <12 months (Kerner et al. 2009). Therefore, a longer period of evaluation is probably necessary to assess whether these initial positive results are modified with time.

In conclusion, within the limits of the study design of this randomized controlled clinical trial, the results showed that the usage of the orthodontic buttons and suspended sutures with CAF technique was effective in treating multiple adjacent type gingival recessions. The 6 months results of the present study were very promising in terms of both clinical (root coverage, aesthetics, keratinized tissue height) and patient-centered (immediate post-operative pain, aesthetics) parameters.

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Clinical Relevance

Scientific rationale for the study: CAF with orthodontic button application may be easy and predictable way to provide root coverage in MARTD. The focused question of present study was the determine if the stabilization of the flaps with orthodontic buttons would improve the outcomes of the therapy.

Principal findings: Six months results indicate that the CAF+B technique is effective in the treatment of MARTD. The addition of suspended sutures to orthodontic buttons enhances both clinical and patient-centered results.

Practical implications: This study supports that the stabilizaton of flaps in the early wound healing period significantly affects the success of CAF procedures.