

A Comparative Study of Modified Semilunar Coronally Advanced Flap and Coronally Advanced Flap in Clinical Practice for the Management of Multiple Gingival Recessions

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Abstract- The objective of the present study was to compare the clinical outcomes between Coronally Advanced Flap (CAF) without Vertical Releasing Incisions (VRIs) and Modified Semilunar Coronally Advanced Flap (MSCAF) and to evaluate the patient centered outcome for CAF without VRIs and MSCAF using Visual Analog Scale (VAS). Ten systemically healthy patients (8 males and 2 female) with a mean age of 41.9 years (range 24-54 years) presented with 47 labial/buccal Miller class I gingival recession defects, were randomly assigned to CAF without VRIs or MSCAF. Clinical parameters assessed included recession height, recession width, probing depth, clinical attachment level, width of keratinized tissue, gingival thickness, full mouth plaque and gingival score. Clinical recordings were performed at baseline and 6 months later. Inter-measurements differences were analysed with a paired t-test, with significance set at $\alpha < 0.05$. Both techniques were effective in obtaining and maintaining a coronal displacement of the gingival margin. The CAF without VRIs resulted in significant clinical improvements better than MSCAF for percentage of root coverage (RC). A statistically significant difference between groups was demonstrated in terms of overall aesthetic result ($P=0.01$; S), root coverage ($P=0.04$; S) on visual analog scale. Six months results showed both techniques can be successfully used to treat Class I gingival recession. However, patient-centered outcomes, such as overall esthetic result and root coverage favoured CAF without VRIs therapy.

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Introduction

The treatment of gingival recessions is becoming increasingly popular among patients. Treatment of buccal/labial gingival recession is frequently necessary for patients with high standards of oral hygiene because of cosmetic concerns or root sensitivity AAP (1). In periodontal therapy, achieving consistent root covering has been crucial. It is frequently possible to achieve root coverage, which satisfies the requirements of both patients and professionals. The three main categories of

root covering treatments are soft tissue autografts, pedicle soft tissue grafts, and combination procedures with or without adjuvant regenerative and root biomodification approaches (2).

Multiple adjacent gingival recession-type defects (MARTDs) can be surgically treated with periodontal plastic surgery techniques. These include modified semilunar coronally advanced flaps, coronally advanced flaps without vertical releasing incisions (Zuchelli and de Sanctis 2000), and coronally advanced flaps with subepithelial connective tissue grafts Allen (2).

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Patient-related factors recommend choosing surgical procedures that enable the simultaneous correction of all gingival abnormalities with the soft tissue surrounding the defects when MARTDs are present in cosmetic parts of the mouth. Thus, for the MARTD to be successfully treated, an effort to decrease the number of surgeries and intraoral surgical sites, together with the requirement to meet the patient's aesthetic demands, must be taken into account Ozcelik *et al.*, (5). The most effective treatment for gingival recession is thought to be a connective tissue graft (CTG). However, when large grafts are removed from the palatal mucosa, patients experience severe discomfort. Large grafts may also hinder circulatory exchange between the receiving bed underneath the covering flap, increasing the risk of flap dehiscence and graft exposure. Owing to these two issues, SCTGs have not been widely used to repair multiple recession abnormalities in patients with aesthetic complaints. Zuchelli *et al.* (6). A predictable technique for root covering with seemingly acceptable aesthetic outcomes at both single and multiple recession sites is the coronally advanced flap (CAF), a root-coverage procedure that does not require a palatal donor site (Bernimoulin, Wennstrom (7,8). The mean root coverage as a result of this procedure varies from 55% (Trombelli *et al.*) (9) to 99% (Harris and Harris) (10).

To the best of our knowledge, no prior research has contrasted the outcomes of the modified semilunar coronally advanced flap (MSCAF) and the coronally advanced flap without vertical releasing incisions (CAF without VRIs). To evaluate the clinical results of CAF without VRIs with the MSCAF for the treatment of numerous adjacent gingival recessions, the current randomized split-mouth trial was conducted.

Materials and Methods

The study was conducted over a six-month period using a prospective, randomized split-mouth design. Ten patients with multiple adjacent gingival recession defects on the buccal or labial surfaces of their teeth who were in good overall health and between the ages of 24 and 54 years (mean age 41.9 ± 12.76 years) were chosen from the Manipal College of Dental Sciences' Outpatient Department of Periodontics at Manipal University in Mangalore.

The inclusion criteria included bilateral class I Millers' adjacent recessions greater than or equal to 2 mm, and the difference in depth of the recessions between both sides was not more than 1 mm. The permitted difference in the CAL was less than 2 mm. PPDs at sites

less than 3 mm in length were included. The plaque index and gingival index were allowed a score of less than 20%. Any cervical lesions were restored, and the teeth had to be properly aligned in the dental arch. Patients aged between 20-55 years

The patients who were excluded were untreated periodontal disease patients, smokers, immunocompromised patients, pregnant patients, patients who were noncompliant and patients with traumatic tooth brushing behaviors.

The procedure, risk and complications were explained to the patient, and informed consent was obtained. The University's Ethical Committee consented to the experimental protocol.

Initial Therapy

As a part of phase I therapy, all patients received scaling and root debridement as needed. The brushing technique was changed to modified stillmans technique, keeping recessions in mind. The patient had to achieve a full-mouth plaque index and full-mouth gingival index scores within the 20% range before commencement of the surgical procedures.

The selected patients were randomly assigned to the CAF without VRIs group or the MSCAF group by a coin toss.

Clinical parameters

Clinical parameters were measured at baseline and at six months at the buccal/labial aspects of the study teeth. Cemento enamel junction to the gingival margins was recorded as the recession height (RH). This was done by using a prefabricated acrylic stent (by subtracting the distance between the stent and the CEJ from the distance between the stent and most of the coronal points of the free gingiva). Recession width (RW): measured at the CEJ by joining the mesial and distal interproximal CEJ with a scalloping margin. Probing depth (PD): measured from the gingival margin to the base of the defect. Clinical attachment level (CAL): CAL is calculated as the sum of recession height and probing depth. Width of the keratinized gingiva (WKG): measured from the distance between the most apical point of the gingival margin (GM) to the mucogingival junction (MGJ). Gingival thickness (GT): GT was measured in the attached gingiva 1 mm apical to the margin of the gingiva using a No. 15 endodontic reamer with a silicone disk stop. After providing local anesthesia, the gingiva was pierced at a 90° angle with slight pressure until the bone was felt. Gingival thickness was measured from the reamer tip to the inner art of the rubber stop to the nearest whole

number.

Surgical procedure

Before the surgical procedure commenced, the patients were told to rinse with an antiseptic mouthwash (chlorhexidine.2%). The procedure was carried out under competition after the administration of local anesthesia (2% lidocaine, 1:1,000,000 epinephrine). The root surfaces were completely debrided and washed thoroughly with saline to flush out all the debris from the surgical area.

Coronally advanced flap without vertical releasing incisions

The procedure was as described and put forward by Zuchelli and de Sanctis. 'To enable the coronal repositioning of the flap tissue over the exposed root surfaces, the procedure involved extending the horizontal incision to encompass one additional tooth on each side of the teeth. To dissect the surgical papilla in a split-thickness fashion, a series of submarginal incisions known as horizontal incisions were made, with the blade parallel to the long axis of the teeth. The intrasulcular incisions followed the submarginal incisions. To increase the thickness of the part of the flap that is essential for root coverage, the gingival tissue apical to the root exposure was elevated to the full thickness. Additionally, the periosteum is located above the avascular root surface. Finally, to aid in the coronal displacement of the flap, the most apical section of the flap was raised beyond the MGJ in a split-thickness fashion. To prevent harm to any connective tissue fibers that were still inserted into the root cementum, the exposed root surfaces in regions of anatomic bone dehiscence were not instrumented. The surgical papilla was sutured to connective tissue beds created by de-epithelizing the residual anatomic interdental papilla tissue. When the marginal part of the flap could passively reach a level coronal to the CEJ at every single tooth in the surgical site, flap mobility was deemed "adequate." Sling sutures were used to accomplish precise adaptation of the buccal flap on the exposed root surface via 5-0 nonresorbable sutures (Zuchelli and de Sanctis) (4).

Modified semilunar coronally advanced flap

The technique used was as described initially by Haghghat in 2006. 'A semilunar incision was made apically, following the curvature of the teeth exhibiting gingival recession. The lateral extensions of the incisions curve coronally within the keratinized tissues to terminate apical to the papillae, mesial and distal to the teeth

exhibiting recession, and maintaining an adequate distance from the papilla tip in the vertical axis such that the vascularity to the mobilized pedicle is not compromised. A partial thickness intrasulcular incision was made along the gingival margins of the two adjacent teeth. A partial-thickness flap extending from the marginal tissue coronally to the semilunar incision apically is mobilized. The mesial and distal papilla was left intact over the middle papilla; between teeth with recession defects, the incision along the gingival margin was extended to create a new papilla tip located apical to that of the original papilla at a distance equal to that of the recession defect. Following partial-thickness flap reflection over the surgical papilla, the remaining original papilla was subsequently de-epithelized. The partial-thickness flap was coronally advanced, with the newly created papilla positioned over the de-epithelized segment. The flap was then sutured with an interrupted suture (5-0 nonresorbable suture) through the middle papilla to stabilize it coronally' (Haghghat) (2).

Post Operative Care

A periodontal pack was placed at the surgical site immediately after the procedure. The patient was told to use intermittent cold compression with ice packs for the first day. Analgesics were prescribed as needed to control any postoperative pain. The patient was told to continue the normal oral hygiene home care procedures without brushing the surgical site. Daily rinsing with 0.2% chlorhexidine mouth was carried out by the patient. Sutures were removed between 7 and 14 days. The patient was instructed not to brush the surgical area and later to start with the Charters method of brushing. At 1, 3 and 6 months, the patient was recalled for re-evaluation and to carry out de-plaquing if needed. Clinical measurements that were taken preoperatively were recorded 6 months after surgery.

Patient evaluation of aesthetics

Preoperative and postoperative photographs were given to the patients, who were asked to evaluate the degree of overall satisfaction, degree of root coverage and color match on a 0, 50, or 100 visual analog scale (VAS).

Patients were asked to select among 100 scores for the considered parameters on the basis of the VAS score at 6 months (Zucchelli *et al.*) (6).

0- Bad

50- Average

100- Excellent

Statistical analysis

The statistical analysis was carried out via SPSS version 20, a commercially available program. Every parameter is analyzed at the subject level. For every clinical variable, the mean±SD was determined. Student's paired t test for intragroup variables and an unpaired t test for intergroup variables was used for statistical analysis. The Wilcoxon signed rank sum test and the Mann-Whitney U test were used. In accordance with Santana (18), power analysis was used to calculate the sample size, assuming a standard deviation of 0.1, a two-tailed Z value of 1.96, and an α of 0.00. According to the computation, the investigation would have > 90% power to identify a 1.2 mm difference in recession height between groups if it included a sample of three patients.

Results

Among the 10 patients, two did not report data for follow-up. In the CAF without VRIs group, a total of 26 teeth were treated (5 canine, 17 premolar, 4 molar), and 21 teeth were treated in the MSCAF group (3 canine, 17 premolar, 1 molar). Healing was uneventful in all patients except one. One patient treated with CAF without VRIs developed hematoma within 24 hours and presented with intraoral swelling, extraoral swelling and extraoral bluish-black discoloration. Swelling subsided by the 3rd week, and extraoral discoloration occurred by the 40th day.

Table 1 shows the baseline and postsurgical defect measurements for both root coverage procedures. Between the two groups, no statistically significant difference was observed in the clinical measurements preoperatively at baseline. All the parameters except PD, GT and WKG for the MSCAF group significantly differed from baseline to six months postoperative. Neither group exhibited significant changes in FMPI or

FMGI.

The degree of changes between the baseline and 6-month measurements for the CAF without VRIs and MSCAF groups are shown in Table 1. Intergroup comparisons revealed no statistically significant differences between any of the parameters assessed. The mean root coverages obtained for CAF without VRIs and MSCAFs were 80.29±18.28% and 67.08±15.08%, respectively. Complete root coverage (CRC) was achieved in two out of 8 patients who were treated with CAF without VRIs and zero out of 8 in the MSCAF group. When the groups were compared six months' post-operative, the amount of RC was more clinically significant for CAF sites without VRIs than for MSCAF sites. Table 2 shows the number of defects and MRCs for the canine, premolar and molars. For CAFs without VRIs, the MRCs for canine, premolar and molar samples were 86, 74, and 91%, respectively, and for MSCAFs, they were 75, 67, and 50%, respectively. The numbers of defects are 5, 13, and 3 and 2, 14, and 1, respectively. ANOVA revealed that there was no statistically significant difference between tooth types with respect to root coverage.

There was a statistically significant difference ($P=0.01$) between patients with and without restoration in the CAF without VRIs group and not in the MSCAF group ($P=0.62$) (Table 3).

The overall satisfaction, degree of root coverage and color match score for the CAF without VRIs group were 93.75±17.67, 81.25±25.87, and 100±0.00, respectively, and those for the MSCAF group were 56.25±17.67, 50±0.00, and 100±0.00, respectively. A statistically significant difference between groups was demonstrated in terms of the overall aesthetic result ($P=0.01$; S), root coverage ($P=0.04$; S), and color match ($P=1$; NS) between groups (Table 4).

Table 1. Pre- and postsurgical measurements for CAFs without VRIs and the MSCAF (MV ± SD; in mm)

Parameters	CAF without VRIs	MSCAF
RH		
Baseline	2.27 ± 0.24	2.25 ± 0.37
6 Months	0.45 ± 0.38	0.6 ± 0.37
RW		
Baseline	3.13 ± 0.40	3.06 ± 0.72
6 Months	0.83 ± 0.69	1.18 ± 0.79
PD		
Baseline	1.07 ± 0.13	1.26 ± 0.28
6 Months	1.03 ± 0.10	1.28 ± 0.45
CAL		
Baseline	3.47 ± 0.47	3.51 ± 0.26
6 Months	1.48 ± 0.54	1.93 ± 0.26
WKG		
Baseline	2.32 ± 0.39	2.56 ± 0.97
6 Months	2.81 ± 0.45	2.90 ± 1.30
GT		
Baseline	1.06 ± 0.17	1.12 ± 0.23
6 Months	1.18 ± 0.25	1.25 ± 0.26
MRC	80.29 ± 18.28%	67.08 ± 15.08%
% of CRC	2/8	0/8

Table 2. Mean root coverage for tooth type (MV $\pm$ SD in %)

Tooth	CAF without VRIs		MSCAF	
	No. Of defects	MRC	No. Of defects	MRC
Canine	5	86.66 $\pm$ 18.26	2	75.00 $\pm$ 35.35
Premolar	13	74.35 $\pm$ 32.35	14	67.85 $\pm$ 22.13
Molar	3	91.66 $\pm$ 14.43	1	50.00 $\pm$ 0.00

Table 3. Mean root coverage in teeth with GIC restoration (MV $\pm$ SD in %)

	CAF without VRIs		MSCAF	
	No. of defects	MRC	No. of defects	MRC
No GIC	13	89.10 $\pm$ 17.80 (S)	11	69.69 $\pm$ 24.51
GIC	8	58.33 $\pm$ 32.12	6	63.88 $\pm$ 19.48

Table 4. Visual analog scale score at 6 months (MV $\pm$ SD)

Parameters	CAF	MSCAF	Significance
Overall satisfaction	93.75 $\pm$ 17.67	56.25 $\pm$ 17.67	0.01 (S)
Degree of RC	81.25 $\pm$ 25.87	50 $\pm$ 0.00	0.04 (S)
Color match	100 $\pm$ 0.00	100 $\pm$ 0.00	1 (NS)

S – significant ($P < 0.05$), NS – not significant ($P > 0.05$)

Discussion

Gingival recession commonly involves multiple adjacent teeth rather than single isolated teeth. Patient-related factors determine the surgical technique used for root coverage, and techniques that allow adjacent recessions to be corrected simultaneously with the soft tissue adjacent to the site need to be considered. (Cetiner *et al.*) (11).

Connective tissue grafts (CTGs), pedicle grafts and free gingival grafts have been used previously for recession management, with CTGs being the gold standard. CTG has a few limitations when root coverage is considered, such as a second surgical site, increased patient morbidity and limited quantity, while multiple recession treatments are considered. Given that these factors sometimes limit their use, CAF and semilunar flaps have recently become popular. To the best of our knowledge, very few controlled clinical studies have evaluated CAF without VRIs and MSCAF procedures, as originally described by Zuchelli and de Sanctis (2000) (4) and Haghighat (2), and no previous study has compared these two techniques.

Therefore, this study compared 2 flap designs for the treatment of multiple adjacent gingival recessions. This study was a 6-month randomized split-mouth controlled clinical study. At baseline, all the measured clinical parameters were statistically similar, thus ensuring similarity between both groups at the beginning of the study.

Although the CAF without VRIs produced clinical improvements that were noticeably better than those

achieved by the MSCAF, the results showed that both flap designs were successful in producing coronal displacement of the gingival margin.

The level of oral hygiene can affect the clinical outcomes of root coverage procedures. In the present cases, the gingival and plaque index scores were low at the beginning of the study and during the study until 6 months. This was seen as personal oral hygiene being reinforced at different intervals, and the scores were less than 20%, which was similar to the findings of a previous study by Zucchelli *et al.*; (23), who reported an FMPI of $< 20\%$ and an FMGI of $< 15\%$.

During the course of the study, all patients were satisfied with the study, and wound healing was uneventful, except for one patient. One patient treated with CAF without VRIs presented with intra- and extraoral swelling (hematoma) within 24 hours of surgery. The intraoral swelling was confined to the alveolar mucosa of teeth 13 and 14, and extraoral swelling along the corner of the mouth obliterated the nasolabial fold. An intraoral stab incision was made along the most fluctuant part, and black coagulated blood was drained. Amoxicillin and Tinidazole in combination with BID for 7 days and the anti-inflammatory agent TID for 3 days were prescribed. A bluish black discoloration started by the third day around the right eye (medial and inferior aspects). The hematoma subsided completely within 3 weeks, and a bluish black discoloration was observed after 40 days. There was no associated pain with the swelling. Healing of the CAF without VRIs progressed, as observed in normal periodontal flap procedures. By the first week, minimal color alteration was observed with

respect to the wound. Reduced edema and erythema were also associated with the procedure. A different pattern of healing was observed in areas treated with the MSCAF procedure since a semilunar incision was made and a portion of the connective tissue was left exposed, resulting in a transient, red color and texture during the initial healing stages. There was no semilunar scar along the incision in any of the patients at the 6-month follow-up. Till the postoperative appointment, the periodontal pack remained in place.

Significant improvement was observed with both treatment modalities for recession. The results presented here indicate that both treatment modalities significantly improved root coverage. A statistically significant improvement at 6 months was found in the gingival RH in both treated groups. The difference in RH reduction between the groups was not statistically significant. The RH in the CAF without VRIs decreased from 2.27 mm to 0.45 mm, corresponding to an MRC of 80.29%, whereas in the MSCAF group, the recession defect decreased from 2.25 mm to 0.6 mm, corresponding to an MRC of 67.08%. CRC was obtained from 2 patients in the CAF without VRIs group.

Distinct advantages favoring the CAF without VRIs design were also expressed as a higher MRC (80.29% versus 67.08%) than the MSCAF design. The differences in CRC incidence rates appear to be significant because Rotundo *et al.*, (12) reported that following treatment at recession sites, complete root coverage following periodontal plastic surgery is considered the best outcome desired by patients, dentists and periodontists. Clinical differences can often be seen even when there is no statistical significance. In the present study, clinical significance was observed even when no statistical significance was detected following analysis, since a difference of 13% existed for MRCs between the 2 techniques. This finding is similar to that of Modica *et al.*, (13), where there is no significant difference between CAF and CAF with the EMD procedure for root coverage; however, it is clinically significant because a difference of 10% exists between MRCs for both techniques.

The results of the present study revealed that the CAF without VRIs group exhibited 80.29% MRC after 6 months, as was similarly observed in the study by Huang *et al.*, (2005a, 2005b) (14,15) with 83.50% and 82.3% MRC after 6 months. Wennstrom and Pini Prato (16) showed that a meta-analysis of trial results in which CAF alone was used as a technique for root coverage resulted in a mean success rate of 83%. The present study results were in close agreement with those of Wennstrom. The

present study achieved a higher MRC than did Lins *et al.*, (2003) (17), who obtained 60% MRC. This difference could be attributed to the presence of vertical releasing incisions and the inclusion of Miller's Class II gingival recession in the latter. Superior results to those obtained in the present study were also reported, with a mean superior result of 97.27% compared with our study, which was obtained by Zucchelli *et al.*, (6). This difference in clinical outcome can be attributed to the inclusion of recession defects ≥ 1 mm in height, the presence of identifiable CEJs, the absence of restored teeth and the exclusion of molars in the Zucchelli study; however, in the present study, teeth with recession defects ≥ 2 mm in height, the presence/absence of identifiable CEJs, and restored teeth and molars were included.

The MSCAF (67.08% MRC) group in the study showed unexpectedly poor clinical outcomes after 6 months of healing. However, the present study has superior results of 67.08% MRC compared with Santana *et al.*, (18) (41.78% MRC after 6 months). This difference occurred because there was no additional flap fixation, such as suturing or parallel design, in the Santana study. As previously reported in a 2-year follow-up study, Marggraf *et al.*, (19) reported a mean RC of 72%, which was significantly superior to the results of the present study. Bittencourt *et al.*, (20) reported 90.95% RC. The superior results in their study compared with our study may be due to the microsurgical technique used in the root coverage procedures resulting in better soft tissue management of thin tissues and the use of calipers of 0.01 mm resolution for the quantification of clinical parameters (20,21)

The surgical procedure and the healing dynamics of the treated tissues may have contributed to the inconsistent improvement in the soft tissue parameters rather than the defect parameters, such as recession depth itself, as there was no significant difference in the clinical parameters between the groups at baseline. The apical area following the semilunar flap for root coverage has been shown to disrupt the blood supply due to surgical trauma, as shown previously (Trombelli *et al.*,) (9). Following the initial period of healing, continued apical displacement of the gingival margin could be related to wound healing events following the MSCAF procedure. In MSCAF, a horizontal incision is placed perpendicular to the axis of the flap movement and parallel to the gingival margins, and the margins are finally coronally positioned. Wound contraction following healing can negatively impact the position of the gingival margin by slightly pulling the flap apically, leading to apical displacement of the margins, which is clinically detected

as gingival recession. The CAF without the VRIs procedure has no releasing incisions, so the wound contraction will not pull the margins apically. (Huang *et al.*,) (15). Additionally, given the same gingival thickness, since the split thickness flap is elevated in the MSCAF, it decreases the thickness of the flap that covers the avascular root surface.

The mean differences in gingival RW between baseline and 6 months were 2.3 mm and 1.8 mm for the CAF without VRIs and the MSCAF, respectively. At 6 months, there was a statistically significant difference from baseline to 6 months ($P=0.005$) for both groups. Similar statistically significant results were presented by Spahr *et al.*, (22), with a mean RW difference of 1.8 mm between baseline and 2 years.

The mean probing depth differences in the present study between baseline and 6 months were 0.03 mm and 0.22 mm, respectively, and no statistically significant differences ($P=0.35$ and 0.84) were detected for the CAF without VRIs and the MSCAF, respectively. This is in agreement with Ozcelik *et al.*, (5), who reported a mean probing depth reduction of 0.01 mm, and with Zucchelli and de Sanctis (6), who reported a 0.05 mm probing depth reduction. A reduction in probing depth is not common in root coverage procedures, as the initial health of the gingiva is well maintained before any surgical procedure is performed.

The gains in the CAL for the CAF without VRIs and the MSCAF were 2.01 mm and 1.51 mm, respectively, at 6 months. The difference from baseline was statistically significant in both groups. This agrees with the findings of Zucchelli and de Sanctis (23,6), who reported increases in the CAL of 2.65 mm and 2.2 mm at 1 year.

In the present study, the mean increase in WKG in the CAF without VRIs was 0.49 mm. This finding is in agreement with the findings of Ozcelik *et al.*, (5), who reported a mean increase in the KTW of 0.6 mm after 6 months. The increase in width may be caused by the mucogingival line's propensity to return to its genetically programmed position after coronal dislocation following surgery. (Ainamo *et al.*,) (24) Granulation tissue derived from the periodontal ligament could also contribute to the increase in width, as observed by Gartrell and Mathews (25). This agrees with the results of Zucchelli and de Sanctis (23), where a 0.5 mm gain was obtained in 1 year and 0.8 mm by the fourth year. A long-term increase in keratinized tissue height was previously reported by Pini Prato *et al.*, (26) for GTR-treated gingival recession; the 18-month increase in WKG (0.56 mm) was followed by a further increase (1.28 mm) that occurred in the following 2.5 years. In contrast to the Zuchelli and de

Sanctis (23) study, a decrease in KTW over 14 years of follow-up was shown by Pini Prato *et al.*, (27) in the CAF. This could be explained by the apical shift of the gingival margin (0.024 mm) per year after treatment. Since this is a 6-month study, long-term evaluation of the increase in the KGW over a period of time is needed. The increase in the WKG in the MSCAF group was 0.34 mm, but it was not statistically significant. It may be hypothesized that by breaking the continuity of the mucogingival line, the VRIs may hinder its realignment and may contribute to the reduced increase in keratinized tissue thickness observed in a short time period. The semilunar incision in the MSCAF encroached on the MGJ and thus disrupted its realignment, which could explain the smaller increase in the WKG in the control group.

The mean gingival thicknesses at baseline and 6 months in the CAF without VRIs group were 1.06 mm and 1.18 mm, whereas those in the MSCAF group were 1.12 mm and 1.25 mm. At 6 months, although GT increased slightly in the CAF without VRIs and MSCAF groups, it was not significantly different between the groups. The flap thickness is one of the predictive factors for the success of root coverage. The results of the present study are in agreement with those of Baldi *et al.*, (1999) (28) and Huang *et al.*, (2005 b) (15), who reported similar root coverage (MRC 82%) with GTs of 0.7 ± 0.2 mm and 1.01 ± 0.3 mm with the CPF procedure. Various studies have shown that a better prognosis is achieved with flaps greater than 0.8 mm in thickness. Given the same thickness for both groups in the present study, the full thickness is elevated in the CAF without VRIs and the split thickness in the MSCAF. Thus, a thin flap lies over the avascular root surface in the MSCAF group compared with the CAF without VRIs group, which explains the better flap survival and higher success of RC in the latter group.

Since the full-thickness flap was raised in the CAF without VRIs, gingival vascular patency was preserved. It also has a high volume of collagen and extracellular matrix, which makes it resistant to contraction and collapse. Split-thickness flaps, on the other hand, rely more on compensatory blood flow from the bone and periodontal ligament since they leave fewer gingival capillaries intact. Necrosis occurs if the flap itself has too few patent arterioles or if there are few arteries. (Hwang and Wang) (29).

Contrary to earlier observations, Wood *et al.*, (30) and others reported that partial-thickness flaps eliminated more radicular bone than their mucoperiosteal equivalents did (0.98 mm versus 0.62 mm, respectively). He ascribed this increased loss to thin connective tissue;

when this biotype was partially dissected, the few surviving vessels were severed, which ultimately resulted in flap death. Thus, in theory, a split-thickness flap over an avascular region would respond similarly to a thin full-thickness flap. A thin full-thickness flap may not have enough blood flow to support itself, much less a graft or other material placed underneath it, if it is isolated from its underlying collateral source. Thus, the thicker the gingiva is, the better the blood supply. Thus, because of the surgical design, a comparatively thinner flap lies over the avascular root surface in the MSCAF group than in the CAF without VRIs group, resulting in less root coverage in the present study for the MSCAF group.

There was a statistically significant difference in the MRC score ($P=0.01$) for the CAF without VRIs group between teeth with and without restoration. Santamaria *et al.*, (31) reported 83.46% MRC with restoration in CPF, with no significant difference compared with the control group. The present study revealed that 58.33% of MRCs were restored in CAFs without VRIs. The significant difference and significant result could be explained by two factors. First, the sample size was small and not the same (8 for GIC and 13 for without GIC), and second, the method of assessing the CEJ was used. The difficulty in assessing the CEJ in restored teeth compared with intact teeth. Even a tooth with an unidentifiable CEJ can be located by slightly elevating the mesial and distal interdental papilla, thereby detecting the CEJ; however, this detection is not possible in a restored tooth. These factors may have led to significant differences between the groups in the present study.

There was no significant difference in root coverage between teeth (canine, premolar, or molar) treated both intragroup and intergroup. The present study included a total of 27 premolars (13 in the CAF without VRIs group and 14 in the MSCAF group) and achieved an MRC of 74% in the CAF without VRIs group and 67% in the MSACF group for premolars. This finding is in agreement with the findings of the santamaria *et al.*, (31) study, which included 28 premolars and 4 canines and reported an MRC of 83.46% for the CAF without VRIs procedure. The MRC achieved for molars in CAF without VRIs was 91%, whereas for MSCAF, it was 50%. These mean differences may be due to differences in the number of molars included in each group (3 in the CAF without VRIs group and 1 in the MSACF group).

Surgical treatment for gingival recession is performed for both functional and aesthetic purposes: both the dentist and patient must be satisfied with the outcomes. Nevertheless, aesthetic evaluation by patients was not performed in many of the studies on root coverage

procedures. Aesthetic evaluation is influenced by subjective perceptions by both dentists and patients. While evaluating aesthetic outcomes, an attempt is made to classify aesthetic evaluations. In this study, a six-month period was the evaluation time employed, as mentioned in a previous study (Cairo *et al.*, (32). The visual analog scale (VAS) was first introduced in 1921 by two employees (Hayes & Patterson, 1921) of the Scott Paper Company (Dawn M *et al.*,) (33). Overall satisfaction, degree of root coverage, and color match are important patient-related outcomes. Patient satisfaction was high with respect to overall results and was significantly greater for the CAF without VRIs group (93%) than for the MSCAF group (56%). Seven patients with CAF without VRIs and one patient with MSACF rated their overall satisfaction with aesthetics as excellent. Kerner *et al.*, (34) reported that the reason for patients seeking aesthetic root coverage procedures was mainly due to aesthetic concerns and less so due to root sensitivity and soft tissue augmentation. (27.35% and 10.81%, respectively). Since, in the present study, there was comparatively more root coverage in the CAF without VRIs than in the MSCAF, the overall aesthetic result given for the CAF without VRIs by patients was 93% (versus 56% for the MSCAF). There was also a statistically significant difference between the groups regarding the degree of root coverage.

A significantly delayed reddish, healing phase, followed by a noticeable semilunar white scar located just a few millimeters apical to the CEJ, is a potential drawback for the MSCAF procedure, especially in patients with a high smile line. This explains why patients had lower overall satisfaction with the MSCAF than with the CAF without the VI.

Three CAFs without VRIs and all 8 MSCAFs judged the degree of root coverage as average. All patients were highly satisfied and responded similarly to the color match (100%) in both groups, with no difference between them. Since both groups are treated with pedicle flaps, they retain more blood supply to the flap than the free grafts do and thus have a good color match with adjacent tissues. No poor score was recorded in either patient group for any of the considered aesthetic parameters.

The limitations observed in the present study are the small sample size, which limits the statistical analysis of the results, and the chance of operator bias, as the surgeon and the clinical investigator were the same person. The stability of root coverage cannot be determined by short-term analysis, such as in the present study, since creeping attachment occurs from 1 month to 12 months after surgery.

In this study, no purpose-designed system using a sophisticated custom-built frame was used. Photographs of recessions were taken in normal clinical situations. Thus, the system does not require additional clinician time and/or volunteer time. Notably, the aim of clinical trials is to evaluate the clinical effect of a specific variable on a designed procedure. In daily practice, it is difficult to conclude from these trials that one procedure is better than another. Furthermore, most of these studies cannot lead to significant conclusions because of their small sample sizes.

By analyzing the results obtained and within the limits of the present study, we can draw the following conclusions:

- Both study groups showed improvements in clinical parameters without any surrounding soft tissue damage for the treatment of gingival recession.
- Both techniques resulted in a reduction in all important clinical measurements, such as recession height, recession width, and a gain in the CAL.
- Compared with that in the other groups, the gain in the keratinized tissue width was significantly greater in the CAF without VRIs group and not in the MSCAF group.

On the basis of patient-related outcomes, CAF without VRIs was preferred over MSCAF design because the true benefits from the patient's perspective are improved aesthetics and the consistency of the outcomes over time, which is achieved more with CAF without VRIs.

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Flap techniques for multiple gingival recessions

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