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A clinical comparison of two flap designs for coronal advancement of the gingival margin: semilunar *versus* coronally advanced flap

Ronaldo B. Santana[1], Carolina M. L. Mattos[1] and Serge Dibart[2]

[1]Graduate Program in Dentistry, Department of Periodontology, Dental School, Federal Fluminense University, Niteroi, Rio de Janeiro, Brazil; [2]Department of Periodontology, School of Dental Medicine, Boston University, Boston, MA, USA

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Abstract

Background: The semilunar incision was introduced in oral surgery more than a century ago. The semilunar coronally re-positioned flap (SLCRF) is one of the variants of this procedure; however, no previous controlled clinical study has evaluated the SLCRF performed as originally described. The objective of the present study was to compare the clinical outcomes of the SLCRF and coronally advanced flap (CAF) procedure in the treatment of maxillary Miller class I recession (GR) defects.

Materials and Methods: Twenty-two patients, with 22 contra-lateral Miller class I GR defects, were randomly assigned to CAF or SLCRF. Clinical parameters assessed included recession height, width of keratinized tissue, probing depth, vertical clinical attachment level, visual plaque score and bleeding on probing. Clinical recordings were performed at baseline and 6 months later. Inter-measurements differences were analysed with a χ^2 or a paired t-test, with significance set at $\alpha < 0.05$.

Results: Both flap designs were effective in obtaining and maintaining a coronal displacement of the gingival margin. The CAF resulted in clinical improvements significantly better than SLCRF for percentage of root coverage (RC), frequency of complete RC and gain in clinical attachment level. RC obtained in the immediate post-surgical period of SLCRF-treated sites was not maintained throughout the subsequent evaluations.

Conclusion: RC is significantly better with CAF compared with the original SLCRF technique in the treatment of shallow maxillary Miller class I GR defects.

Key words: gingiva; periodontal plastic surgery; surgical flaps

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The semilunar incision was introduced in oral surgery, more than a century ago, by Partsch (1898, 1899). This incision or variants thereof have been described in mucogingival procedures for root coverage (RC) since then (Harlan 1906, Harvey 1965, Sumner 1969, Marggraf 1985, Romanos et al. 1993). More recently, Tarnow (1986) reported the semilunar coronally re-positioned flap (SLCRF) technique, which is a procedure indicated for the treatment of gingival recession in areas with minimal labial probing depth (PD) and adequate band of keratinized gingiva. It is described as a coronally advanced, tensionless and sutureless flap that does not involve the adjacent papillae, thus preserving the aesthetics (Tarnow 1986). Additional advantages of the procedure, according to the author (Tarnow 1994), include the fact that it does not shorten the vestibule and results in a perfect colour blend with adjacent tissues, with a simple, predictable and fast procedure. Occasional case reports (Pollack 1990, Torum 2003, Sorrentino & Tarnow 2009) have documented the clinical applicability of the technique, and recent studies have evaluated new modifications to the technique such as incision design and suturing (Haghighat 2006), use of microsurgical procedures for flap manipulation and suturing (Bittencourt et al. 2006, 2007) and effects of

Conflict of interest and source of funding statement

The authors do not possess any financial relationships that may pose a conflict of interest or potential conflict of interest and have no commercial relationship to any of the products and instruments used.
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EDTA root conditioning on clinical outcomes (Bittencourt et al. 2007). To the best of our knowledge, no previous controlled clinical study has evaluated the SLCRF procedure performed as originally described (Tarnow 1986), or compared this flap design with other surgical techniques used for coronal flap advancement. Therefore, the objective of the present study was to compare the clinical outcomes of the SLCRF and coronally advanced flap (CAF) procedure in the treatment of maxillary Miller class I recession defects (Miller 1985).

Materials and Methods

Study population and experimental design

The study was designed as a randomized, prospective, parallel-arm, controlled clinical trial. It was conducted in accordance with the guidelines of the Helsinki Declaration of 1975, as revised in 2000, and after approved by institutional review board. Written informed consent was obtained from all patients after a thorough explanation of the nature, risks and benefits of the clinical investigation and associated procedures.

The study population consisted of patients referred for periodontal treatment at the School of Dentistry, Federal Fluminense University, Brazil. The following inclusion criteria were used: adult patients with no contraindications for periodontal surgery, and who had not taken medications known to interfere with periodontal tissue health or healing in the preceding 6 months, exhibiting the presence of bilateral Miller class I gingival recessions ($\leq$ 5 mm) in maxillary incisors, canines, or pre-molars, PD $<$ 3 mm without bleeding on probing (BOP), width of keratinized tissue (WKT) $\geq$ 2 mm and tooth vitality and absence of caries or restorations in the areas to be treated were included. Patients with untreated periodontal disease, smokers, subjects with immunosuppressive systemic diseases (i.e., cancer, AIDS, diabetes) were not included in the study. Miller class II, III or IV recession defects, presence of apical radiolucency or caries or restorations in the areas to be treated and previous lack of cooperation with the maintenance programme (as evaluated by an unjustified absence from scheduled maintenance visits, continued traumatic tooth-brushing technique, or faulty plaque control measures) were also exclusion criteria. Thirteen females and nine males, 18–47 years of age (mean age, 36 years), were included in the study from September 2002 to December 2004. Sample size was determined by Power analysis, assuming an α of 0.05, a two-tailed z value of 1.96 and a standard deviation of 0.72. This calculation indicated that with a sample of 16 subjects, the study would have $>$90% power to detect a 1 mm difference in recession depth between the two groups.

All patients were subjected to initial periodontal therapy and were adherent to maintenance care for at least 6 months before the beginning of the study. Treatment included oral hygiene instructions, scaling and root planing where needed, tooth polishing plaque control measures and correction of traumatic toothbrushing technique. All patients were instructed and trained to use a soft toothbrush and to eliminate habits related to the aetiology of the recession. Baseline full-mouth plaque and bleeding scores were low. Each defect was randomly assigned to one of the two treatment modalities used: (a) controls ($n = 22$): CAF and (b) test ($n = 22$): SLCRF by the toss of a coin immediately before each surgical appointment. Treatment allocation was registered in an allocation table sheet that was unavailable to the clinical examiner throughout the study. Both the control and test sites were treated at the same surgical appointment and no information on treatment allocation was provided to the patient.

Clinical data collection

Clinical parameters were assessed as described previously (Mattos & Santana 2008) at the mid-facial site from the teeth using the cemento-enamel junction (CEJ) as a fixed reference point from which the variables were recorded. All measurements were recorded using a UNC #15 periodontal probe with a rubber stopper by a blinded, trained and calibrated examiner (C. M. L. M.), unaware of the treatment provided, at baseline and 6 months later, except for recession height (RECH) that was measured at baseline, 1, 3 and 6 months after surgery. Baseline measurements were performed immediately before the surgical procedure. Measurements were recorded to the nearest higher millimetre. The point of maximum convexity of the marginal gingival contour – the gingival zenith – was used as the reference for measurements of the gingival margin (GM). Visual plaque score and BOP were assessed dichotomously at the mid-buccal location. RECH was measured as the distance from the CEJ to GM. WKT was measured as the distance between the GM and the MGJ. PD was measured as the distance from the GM to the bottom of the gingival sulcus. PD and gingival recession were used to calculate the clinical attachment level (CAL).

Surgical procedures

Surgical procedures were performed by one operator (R. B. S.). Before surgery, each patient was given a single dose of 500 mg sodic dipyrone as an analgesic. Intra-oral antisepsis was performed with a 0.2% chlorhexidine rinse. Anaesthesia was obtained by regional blocks with 2.0% lidocaine with 1:100,000 epinephrine.

Root preparation

Thorough root planing was performed with hand, rotary and ultrasonic instruments in all treated sites. A fine-grain finishing bur (Perio-Set, Intensiv SA, Grancia, Switzerland) was always used to reduce the convexity of the root surfaces and to remove sharp edges and grooves. After instrumentation, the root surfaces were washed with saline solution to attempt to remove any remaining detached fragments from the defect and surgical field.

Semilunar coronally positioned flap (SLF)

Exposed root surfaces were prepared as described above. The SLF procedure was performed as originally described by Tarnow et al. (1986). Briefly, a semilunar incision was carried out following the outline of the GM. This incision ended into the papilla on each inter-proximal area of the tooth to be treated, but not all the way to the tip of the papilla. At least 2 mm of gingiva was preserved on each side of the flap in order to preserve the blood supply. The semilunar incision was curved apically to an extent to guarantee that the apical part of the flap rests on bone after the coronal advancement to cover the root. An intra-sulcular incision was performed mid-facially. Then, a split-thickness dissection was performed from the initial incision coronally until connecting to the intra-sulcular incision.

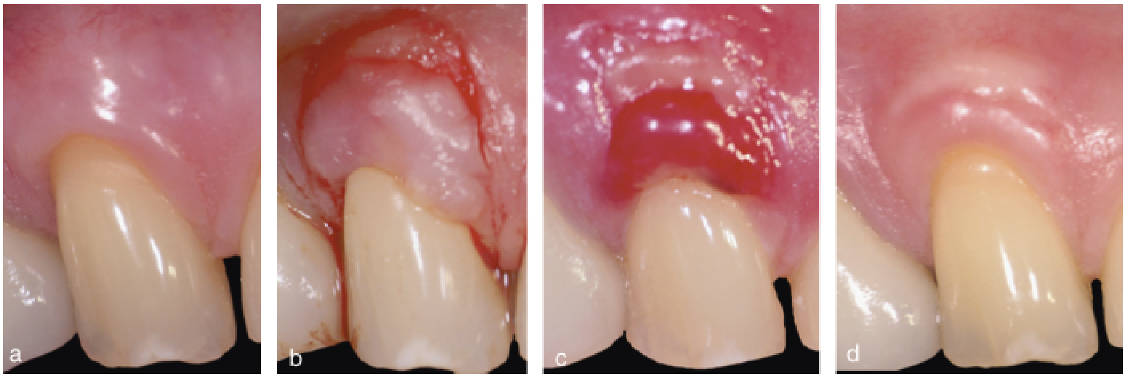

Fig. 1. Clinical aspect of site treated by semilunar coronally repositioned flap: (A) Baseline; (B) flap positioning; (C) 1-week healing; and (D) 6-month healing.

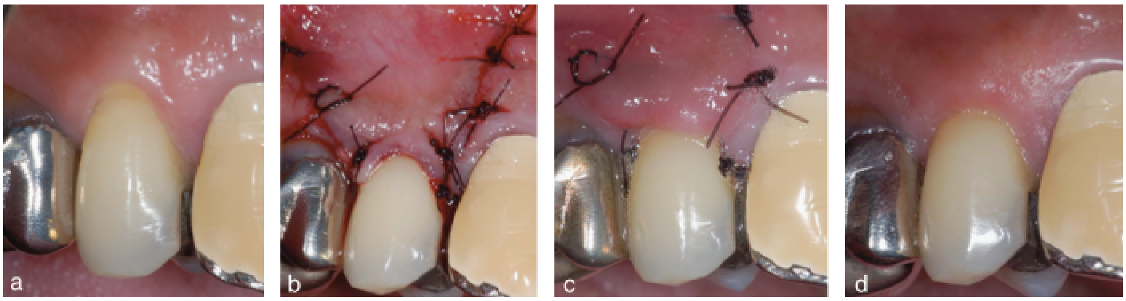

Fig. 2. Clinical aspect of site treated by coronally advanced flap: (A) Baseline; (B) flap positioning; (C) 1-week healing; and (D) 6-month healing.

The mid-facial tissue was completely released, coronally positioned to the CEJ and held in place against the tooth with a moist gauze pad placed with light pressure, perpendicular to the flap, for 5 min. No sutures were placed (Fig. 1). A surgical dressing (CoePak, Jersey City, NJ, USA) was changed after 7 days and removed after 14 days.

CAF

The CAF was designed performing two vertical releasing incisions at both the mesial and distal aspects of the recession to be treated, in such a way that both the proximal papillae were not included as part of the flap (Fig. 2). Papillae were never bisected. Beveled divergent vertical incisions were performed in the attached gingiva, initiating at the CEJ level on the mesial and distal line angles of the tooth, avoiding the formation of butt joints between the flap and adjacent tissues, and were continued several millimetres apically into the alveolar mucosa.

The vertical incisions were joined by an intra-sulcular incision. In the interproximal area, the papillae were split in a mesio-distal dimension, resulting in a flat surface of connective tissue for contact between the flap tissues and the retained portion of the papillae after re-positioning and suturing of the flap. A combined mucoperiosteal–mucosal trapezoidal flap was elevated such that the first 3–4 mm coronal aspect of the alveolar bone was exposed, while the remaining buccal bone was still covered by the periosteum and gingival connective tissue. A complementary horizontal incision was performed on the apical aspect of the flap, by means of a partial-thickness dissection, releasing the flap from the attached periosteum and muscle fibres. This allowed the elongation and free coronal positioning of the flap. Roots were prepared as described above. The flap was, then, positioned at least 1 mm coronal to the CEJ and maintained in place by means of individual 5.0 monofilament sutures. A surgical dressing (CoePak) was changed after 7 days and removed after 14 days.

Post-surgical care

The patients were put on systemic analgesics consisting of 750 mg of paracetamol (Tylenol 750, Jansen-Cilag Farmaceutica, Sao Paulo, Brazil) every 6 h for 4 days. The patients were instructed to continue their regular home hygiene care, except in the operated area, in which toothbrushing was discontinued for the first 30 days after surgery and plaque control was maintained by means of gentle topical applications of chlorhexidine gluconate (2.0%) in saturated cotton swabs twice a day. Gentle toothbrushing with an extra soft-bristle toothbrush was then initiated. Analgesics were prescribed on an individual basis. The sutures were removed 2 weeks after the surgery in the CAF group.

Maintenance schedule

Following surgery, all patients were seen weekly during the first 3 months and biweekly for the next 3 months. Maintenance visits consisted of reinforcement of oral hygiene procedures and professional supragingival coronal polishing. Additional oral chemical plaque control was performed once every 3 months by means of mouth rinses with a solution of chlorhexidine gluconate 0.12% b.i.d., for 1 week.

Statistical analysis

All descriptive statistics were expressed as mean ± standard deviation (SD). Baseline measurements were subjected to inter-group comparisons, and were analysed by the non-parametric Wilcoxon test or the χ^2-test. Inter-group and intra-group comparisons between baseline and 6-month measurements were analysed by the Wilcoxon test or the χ^2-test. Wilcoxon's signed ranks test was used for intra-group comparisons and the Wilcoxon's rank sums test was used for inter-group comparisons. Statistical significance was set at the 95% probability level ($P<0.05$).

Results

Healing was uneventful for all 22 patients (44 recessions) and no patient was excluded or dropped out of the study. The recessions were located in four central incisors, four lateral incisors, 16 canines, 12 first pre-molars and eight second pre-molars. Full-mouth BOP and VPI were maintained below 20% indicating a good standard of supragingival plaque control during the study period (Table 1). Healing of the CAF progressed as normal healing of periodontal flap procedures (Fig. 2). By 1 week, the wound exhibited minimal colour alteration, with reduced oedema and erythema. The vertical incisions were clearly distinguishable. These characteristics progressively disappeared throughout the 6-month healing period. In the final evaluation, the gingival colour, texture and contour of the areas treated by the CAF procedure appeared essentially identical to the adjacent soft tissues (Fig. 2). Minimal scarring was noticeable in the alveolar mucosa in a minority of sites. Clinical inspection revealed that areas treated with the SLCRF procedure exhibited a distinct aspect of healing pattern. In the first week, the flap tissues appear extremely red in colour and swollen (Fig. 1C). In the area of the semilunar incision, a white-coloured area of debris, resembling a fibrin clot, was frequently found. The wound edges were frequently elevated in relation to the central periosteal region. These aspects persisted, but progressively diminished during the healing period. The erythemathous aspect persisted for up to 3 months, while the area of the white-coloured debris progressively epithelized in about 2 weeks; however, colour and texture remained altered for the duration of the study. At the 6-month evaluation, a notable semilunar white scar was present in all the sites treated by the SLCRF procedure (Fig. 1D).

Pre- and post-surgical measurements for the SLCRF and CAF groups are shown in Table 1. No statistically significant differences were observed between groups in any of the clinical parameters at baseline. Intra-group comparisons between baseline and 6-month measurements revealed that statistically significant changes from baseline were found for RECH and CAL for both the SLCRF and CAF groups. Neither group exhibited significant changes for PD, SBI and VPI. The SLCRF demonstrated statistically significant increases of WKT.

The magnitude of changes between pre- and post-surgical measurements for the SLCRF and CAF groups are shown in Table 2. Inter-group comparisons demonstrated statistically significant RH reduction and CAL gain changes favouring the CAF procedure. Changes in WKT favoured the SLCRF procedure. Differences in measurements for PD, SBI and VPI did not reveal significant differences between the groups. Complete RC was accomplished in 9.03% (two out of 22) of the treated cases in the SLCRF group and in 63.64% (14 out of 22) in the CAF group.

Results for mean RC obtained 1, 3 and 6 months following the surgical procedures are presented in Fig. 3. At the 1-month re-evaluation, both groups exhibited similar mean percentages of RC. Sites treated by the SLCRF procedure exhibited a continuous reduction of the degree of RC in the 3- and 6-month re-evaluations, while the sites treated by the CAF exhibited an almost unchanged behaviour throughout the study period. At the 6-month evaluation, the degree of RC was significantly bigger for sites treated by CAF than those treated by the SLCRF procedure.

Table 1. Baseline and 6-month clinical measurements (mm)

Treatments	VPS	BOP	PD	RECH	CAL	WKT
Baseline						
SLCRF	18 ± 4	15 ± 3	0.6 ± 0.5	2.9 ± 0.4	3.7 ± 0.6	4.3 ± 0.6
CAF			0.5 ± 0.6	3.1 ± 0.6	3.6 ± 0.6	4.5 ± 0.6
Significance			NS	NS	NS	NS
6 Months						
SLCRF	14 ± 5	12 ± 6	0.8 ± 0.6	1.7 ± 0.5	2.5 ± 0.6	5.2 ± 0.7
CAF			0.7 ± 0.7	0.5 ± 0.7	1.2 ± 0.8	4.3 ± 0.9
Significance			NS	*	*	*

*p value <0.05 (statistically significant).
SLCRF, semilunar coronally repositioned flap; CAF, coronally advanced flap; VPS, visual plaque score; BOP, bleeding on probing; PD, probing depth; RECH, recession height; CAL, clinical attachment level; WKT, width of keratinized tissue; NS, non-significant.

Table 2. Magnitude of changes of clinical measurements obtained 6 months after surgery in comparison with baseline (mm)

Treatments	Variables					
	VPS	BOP	PD	RECH	CAL	WKT
SLCRF	− 4 ± 5	− 3 ± 5	0.2 ± 0.6	1.2 ± 0.5	1.2 ± 0.6	0.9 ± 0.7
CAF			0.1 ± 0.7	2.6 ± 0.7	2.4 ± 0.7	− 0.2 ± 0.9
Significance			NS	*	*	*

*p value <0.05 (statistically significant).
SLCRF, semilunar coronally repositioned flap; CAF, coronally advanced flap; VPS, visual plaque score; BOP, bleeding on probing; PD, probing depth; RECH, recession height; CAL, clinical attachment level; WKT, width of keratinized tissue; NS, non-significant.

Discussion

The present randomized controlled clinical trial compared two flap designs for the surgical coronal advancement of the GM in the treatment of maxillary facial gingival recessions. The results demonstrated that both flap designs were effective in obtaining a coronal displacement of the GM; however, the CAF flap

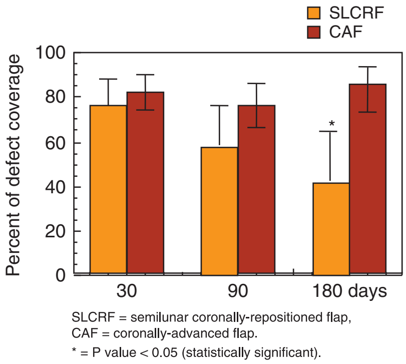

Fig. 3. Changes in mean defect coverage from baseline. *p value <0.05 (statistically significant). SLCRF, semilunar coronally repositioned flap; CAF, coronally advanced flap.

design resulted in clinical improvements significantly superior to the ones obtained by the SLCRF. Visual macroscopic soft-tissue healing was significantly different between the two procedures. Areas treated with the CAF procedure progressed as normal healing of periodontal flap procedures with the gingival colour, texture and contour identical to the adjacent soft tissues, and minimal scarring noticeable in the alveolar mucosa, in a minority of sites, after 6 months of healing. Areas treated with the SLCRF procedure exhibited a significantly different clinical healing pattern and demonstrated a transient, long-term (3-month), reddish phase and altered colour and texture for the duration of the study. One important clinical finding was the presence of significant white scars in all the sites treated by the SLCRF procedure 6 months after the procedure. These unique aspects of the healing phenomena associated with the SLCRF procedure need further consideration with regard to case selection, especially considering that the procedure is mostly indicated for cosmetic reasons. A significantly delayed reddish, healing phase, followed by a noticeable semilunar white scar located just a few millimetres apical to the CEJ is a potential drawback for the procedure, specially in patients with a high smile-line. Soft-tissue appearance variables and the follow-up time are significantly associated with post-surgical cosmetic assessment (Kerner et al. 2009a, b). Additional evaluations such as objective quantitative measurements of aesthetic improvement and patient satisfaction may be important in refining the comparison of the two procedures with regard to the aesthetic outcomes.

Positive differences favouring the CAF design were also expressed as a higher percentage of RC (83.88% *versus* 41.78%), complete RC (63.6% *versus* 9.0%) and gain in CAL (2.4 *versus* 1.2 mm). Moreover, the stability of RC were detected earlier and maintained better with the CAF design (Fig. 3). The differences in complete RC appears to be a significant clinical difference between the procedures, because a recent study reported that complete RC following periodontal plastic surgery is perceived as the most successful outcome by patients, dentists and periodontists (Rotundo et al. 2008).

The SLCRF design resulted in a significantly increased WKT (0.9 ± 0.7 mm) *versus* a mean 0.2 ± 0.9 mm loss observed for the CAF procedure. No differences between the groups were observed for changes in PD. Both groups exhibited equivalent reduced SBI and VPI scores indicating a good standard of supragingival plaque control during the study period.

In a recent systematic review on the effects of CAF procedures on the treatment of gingival recession defects, Cairo et al. (2008) concluded that the technique resulted in mean REC reduction and complete RC. The results of the present report revealed that the CPF group exhibited 83.90% RC after 6 months of healing and 63.6% of complete RC. Virtually identical results were reported by Huang et al. (2005a, b) in two independent publications, with mean 83.50% and 82.3% RC and 60.9% and 60.6% complete RC after 6 months. Santamaria et al. (2009) reported 83.46% RC after 2 years. Harris & Harris (1994) reported 98.8% of mean RC and 95% of cases with complete RC in the treatment of shallow (average 2.15 mm of pre-surgical RECH). Allen & Miller (1989) and Santamaria et al. (2008) reported 97% of RC 6 months after the surgical procedure. The results of the present study were, however, superior to other 6-month studies evaluating the CAF procedure for RC. Lins et al. (2003) reported 60% mean RC, Cortes et al. (2004) reported 71% of RC, and da Silva et al. (2004) showed 69% of RC 6 months after the CPF procedure. Lower degrees of RC were reported by other authors in long-term studies. Gürgan et al. (2004) reported a mean RC of 68.3% after 12 months and 44.9% after 60 months following the CAF procedure. Superior results than the ones obtained in the present study were also reported as mean 98.6% and 96.7% RC after 12 and 36 months after surgery, respectively (deSanctis & Zucchelli 2007). Differences in treatment results might be possibly associated with differences in case selection and treatment protocol used in the studies. Several factors were correlated with the clinical results of the CPF (Nieri et al. 2009) procedure including baseline recession depth and amount of KT (Saletta et al. 2001, Berlucchi et al. 2005), flap thickness bigger than 1 mm (Baldi et al. 1999, Saletta et al. 2001, Huang et al. 2005), adjacent papillae width and height (Saletta et al. 2001, Berlucchi et al. 2005), post-surgical position of the gingival margin (Pini-Prato et al. 2005), flap tension at the time of suture (Pini-Prato et al. 2000) and tobacco smoking habits (Chambrone et al. 2009).

One unexpected finding of the present study was the poor clinical outcomes of the SLCRF (mean of 41.78% RC and 9.03% of complete RC) after 6 months of healing. These results were significantly inferior to those reported previously in the literature. Marggraf et al. (1985), reporting on 2 years of follow-up, found a mean amount of RC of 72% and complete coverage was observed in 54.5% of treated teeth. Romanos et al. (1993), reporting on 5–8 years of follow-up, detected a mean of 2.64 ± 1.3 mm of reduction on recession, 0.34 ± 1.4 mm of gain in keratinized gingiva and a complete coverage of gingival recession in 18/75 teeth (24%). Bittencourt (2006) reported 90.95% of RC and a complete soft-tissue RC in 52.94% of treated cases. These results, although variable, are clearly superior to the ones obtained in the present sample. Such important discrepancies are likely explained by the differences in the surgical protocols and measurement methods used. In the present report, the SLF cases were treated as originally described (Tarnow 1986). Thus, following incisions and flap elevation, no sutures were used for flap fixation. All others used additional methods of flap fixation such as sutures (Marggraf et al. 1985, Romanos et al. 1993) or adhesives (Bittencourt et al. 2006, 2007). Additional flap fixation and stabilization may have yielded enhanced healing in SLF-treated sites. Moreover, Bittencourt et al. (2006, 2007) used microsurgical techniques that might have improved the handling of thin and delicate soft tissues during the SLCRF procedures, thus enhancing their clinical outcomes.

Another surprising finding of the present study was the documentation of the lack of stability in RC observed in the early-healing periods of the SLF procedure. The high amounts of RC obtained in the immediate post-surgical period were not maintained throughout the subsequent evaluations and a significant shift in apical direction of the GM occurred. These findings are in sharp contrast with the previous literature for both the SLF and the CAF procedures. Some studies (Caffesse & Guinard 1978, 1980) reported that the clinical parameters evaluated following CAF were mostly unchanged 1 month, 3 months and more than 3 years following the procedure. Thus, the long-term results of the coronal advancement of the flap margin to cover exposed root surfaces could be predicted and established in early time periods of healing, in accordance with findings of significant long-term maintenance of high levels of RC following CAF (Zucchelli & Wennström 1996, deSanctis & Zucchelli 2007) as well as with the short-term results of the present study, which demonstrated unsignificant changes in the degree of RC following the CAF procedure between 1 and 6 months following surgery. Similar results, albeit more modest, are also available for the SLCRF (Marggraf et al. 1985, Romanos et al. 1993). It is also important to notice, however, that the present study is a short-term (6-month) evaluation, and the differences observed could change over time (Kerner et al. 2009a, b). Longitudinal evaluation of the present sample may allow the documentation of eventual changes and the appreciation of the stability of clinical results of each technique.

The reasons for such sharp differences between the SLCRF and CAF procedures in the present study are poorly understood. Differences appear to exist only in the technical aspects of the procedures themselves, namely, the direction of releasing incisions, the positioning and the fixation of the flap. We speculate that the continued recession of the GM during the initial healing times might be attributable to the wound healing events occurring after the SLCRF. In this procedure, a horizontal incision is performed perpendicular to the axis of the flap movement and parallel to the GM, which is positioned coronally to cover the root surface. During healing, a significant hypertrophic scar is noted at the area of this incision. Wound contraction is a well-known phenomenon following wound healing in general (Snowden 1981, Omnell et al. 1994, Stephens et al. 1996, Petroll et al. 1998, Bullard et al. 1999, Nedelec et al. 2000), and periodontal healing in particular (Wikesjö et al. 1991), and could negatively influence the healing following the SLCRF procedure. The wound contraction that occurs at the base of the flap may pull the flap margin apically, and because no sutures are used to anchor or stabilize the pedicle, there is no antagonistic force in effect to counterpart this action; thus the net result is the apical traction of the flap margin, clinically detected as gingival recession following the SLCRF (Petroll et al. 1998). The CAF procedure, however, appears to be more stable due to the fact that the releasing incisions are performed parallel to the axis of flap movement, and additional stabilization is obtained by sutures during the critical early healing events (Wikesjö et al. 1992, Werfully et al. 2002); therefore, the contraction forces do not act contrary to the axis of tissue displacement. In this respect, contrary to the suggestions of the original descriptions of the procedure (Tarnow 1986), performing an SLCRF for RC without stabilizing it with adequate suturing, as performed in the present study, might pose a significant risk of diminished clinical success of the procedure. Thus, the likely superior flap anchorage, obtained via suturing (Marggraf et al. 1985, Romanos et al. 1993) or placement of surgical adhesive (Bittencourt et al. 2006, 2007), might explain the superior results reported by previous studies in comparison with the present data. Moreover, the GM was easily positioned and maintained 1 mm or more coronally to the CEJ in all sites treated by the CAF procedure (Fig. 2B). Coronal positioning and stabilization were more critical in sites treated by the SLCRF and the use of surgical dressing as the single method for flap stabilization may not be adequate, or worse, may dislodge the flap during the placement of the dressing. This fact may have also impacted the results, because the placement and stabilization of the flap coronally to the CEJ are positively correlated with the degree of RC following CAF (Pini-Prato et al. 2005).

The influence of case selection criteria on the reported results is unclear because others (Marggraf et al. 1985, Romanos et al. 1993) treated recessions smaller than 6 mm, PD smaller than 2 mm, gingival tissues free of inflammation and absence of inter-proximal bone loss, while Bittencourt et al. (2006, 2007) treated recessions smaller than 3 mm. The present study treated defects smaller than 4 mm. Although our results were inferior to both studies, the height of REC was bigger than reported by Bittencourt et al. (2006, 2007) and smaller than reported by Marggraf et al. (1985); therefore, the initial severity of the recession does not appear to have played a significant role in the reported differences indicating that no relationship appears to exist between the initial severity of the recession and amounts of RC obtained, if the initial RECH is between 3 and 6 mm. The present and the former (Marggraf et al. 1985, Bittencourt et al. 2006, 2007) studies agree with the indication for SLCRF for teeth without gingival inflammation and interproximal bone loss (Miller class I); thus, these factors are also unlikely related to the differences reported. Moreover, Bittencourt et al. (2006, 2007) used a caliper with a 0.1 mm resolution for data acquisition and microsurgical soft-tissue manipulation and reported the highest degrees of RC reported to date with the SLCRF procedure, most likely explained by the fact that a more sensitive measuring instrument presents an increased detection rate of RC, which is particularly critical in shallow recession defects. The present study and others (Marggraf et al. 1985, Romanos et al. 1993) used conventional macrosurgical approaches and clinical periodontal probes with a resolution between 0.5 and 1.0 mm for data acquisition. Moreover, despite our best efforts to keep our evaluations ''blinded'', the distinctive scars in the early-healing phases for both procedures and in late stages for the SLCRF procedure may have precluded true masking of the procedures.

Therefore, the apparent discrepancies between the RC presented by the present study *versus* the former publications (Marggraf et al. 1985, Romanos et al. 1993, Bittencourt et al. 2006, 2007) are most likely explained by the absence of additional resources for flap fixation such as sutures or surgical adhesives, by differences in methods used to measure the clinical parameters and enhanced flap manipulation by the use of surgical magnification.

In summary, both flap designs were effective in obtaining and maintaining a coronal displacement of the GM, however, the CAF flap design resulted in clinical improvements significantly superior to the ones obtained by the SLCRF for percentage of RC, frequency of complete RC and gain in CAL. The high amounts of RC obtained in the immediate post-surgical period of SLCRF-treated sites were not maintained throughout the subsequent evaluations in contrast with the earlier stability of RC following the CAF procedure. It is concluded that RC is significantly better with CAF compared with the original SLCRF technique in the treatment of shallow maxillary Miller class I gingival recession defects performed under standard clinical situations without surgical magnification.

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Address:
Ronaldo B. Santana
Graduate Program in Dentistry
Department of Periodontology
Dental School
Universidade Federal Fluminense
Rua Sao Paulo
28 Niteroi
Rio de Janeiro 24040 115
Brazil
E-mail: rbarsantana@ig.com.br

Clinical Relevance

Scientific rationale for the study: The semilunar incision was introduced in oral surgery more than a century ago. The SLCRF is one of the variants of this procedure, and was described in the *Journal of Clinical Periodontology* in 1986. So far, however, no controlled clinical study has evaluated the SLCRF performed as originally described.

Principal findings: SLCRF-treated sites exhibited a significantly altered visual wound healing and RC was unstable during the evaluation period of 6 months.

Practical implications: The predictability of the originally described SLCRF is questionable.