Case Series

Treatment of Multiple Recession-Type Defects in Patients With Esthetic Demands*

G. Zucchelli and M. De Sanctis

Background: *When multiple recession defects affecting adjacent teeth in esthetic 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. The aim of the present study was to evaluate, with respect to root coverage, the effectiveness of a new surgical approach to the coronally advanced flap procedure for the treatment of multiple recession defects in patients with esthetic demands.*

Methods: *Twenty-two young systemically and periodontally healthy subjects with at least 2 recession-type defects affecting adjacent teeth in esthetic areas of the mouth were enrolled in the study. All recessions were Miller Class I or II. In each patient, all present recessions were treated at the same time with a modification of the coronally advanced flap technique. The clinical re-evaluation was made 1 year after the surgery.*

Results: *A total of 73 recessions (mean recession depth 2.8 mm) were treated; mean number of gingival recessions in each subject was 3.4. At the 1-year examination, on average, 97% of the root surface was covered with soft tissue and 64 defects (88%) showed complete root coverage. Complete root coverage in all recessions was achieved in 16 out of 22 patients (73%), and no statistically significant relationship was found between the root coverage results and the number of recession defects treated in each patient. A statistically significant increase of keratinized tissue (0.6 mm) was observed after 1 year; this increase was inversely correlated ($P < 0.001$) with the amount of presurgical keratinized tissue. The multiple regression model showed that the final result, in terms of root coverage, was significantly affected by the initial recession depth and by the amount of presurgical keratinized tissue. Greater reductions in recession depth were observed in the cases with worse initial conditions and with lesser amount of keratinized tissue apical to the recession defect.*

Conclusions: *The results of the present study demonstrated that the proposed surgical technique was very effective for the treatment of multiple gingival recessions affecting teeth in esthetic areas of the mouth and that these successful root coverage results could be achieved irrespective to both the number of recessions simultaneously treated during the surgical intervention and the presence, before surgery, of a minimal amount of keratinized tissue apical to the defects.* J Periodontol 2000;71:1506-1514.

KEY WORDS

Gingival recession/surgery; gingival recession/therapy; dental esthetics; tooth root; surgical flaps; patient care planning.

* Department of Periodontology, Faculty of Odontology, Bologna University, Bologna, Italy.

Several surgical approaches have been proposed in the last few years to obtain root coverage on exposed buccal root surfaces.[1] Recent studies on surgical root coverage procedures demonstrated that good results can be achieved irrespective of the utilized surgical technique, provided that the biologic conditions for obtaining root coverage are satisfied (no loss of interdental soft and hard tissue height).[1-3] The selection of one rather than another surgical technique depends on other factors, some of which are related to the defect (the size of the recession defect, the presence or absence of keratinized tissue adjacent to the defect, the width and height of the interdental soft tissue, the depth of the vestibulum or the presence of frenuli), while others are related to the patient.[4]

Among patient-related factors, the attempt to reduce the number of surgeries and intraoral surgical sites, together with the need to satisfy the patient's esthetic demands, must be taken into consideration. In this view, when multiple recessions affect adjacent teeth, they should be treated at the same surgical time and, if possible, the removal of soft tissue from distant areas of the mouth should be avoided in order to minimize patient discomfort. In terms of esthetics, the patient's expectations must be considered. Sometimes "good" root coverage outcome for the clinician is not an acceptable esthetic result for the patient; i.e., a 90% root coverage that represents a very good surgical outcome may not be a completely satisfying result for the patient because, during smiling, most of the coronal millimeter(s) of the still-uncovered root surface is exposed. Thus, when the patient complains about the esthetic appearance, complete root coverage (i.e., to the cemento-enamel junction) is the goal. Even if complete root coverage is obtained, other factors, such as the thickness and color or blending of the surgically treated area, must be taken into consideration in order to fulfill all the esthetic expectations of the patient. Problems related to those factors are very common when an epithelialized free graft is harvested from the palate and utilized to achieve root coverage.[5-11] Excessive gingival thickness can also result when a connective tissue graft taken from the palate is combined with a pedicle flap to cover root exposures (subepithelial connective tissue graft procedures).[2,12-16] Therefore, where multiple gingival recessions affecting teeth in esthetic areas of the mouth are present, all the above-mentioned patient-related factors have to be taken into consideration when selecting surgical techniques.

The aim of the present study was to evaluate, with respect to root coverage, the effectiveness of a new surgical approach to the coronally advanced flap procedure for the treatment of multiple recession-type defects in patients with esthetic demands.

MATERIALS AND METHODS

Study Population and Site Selection

The patient population consisted of 22 young subjects (age range 18 to 34 years) with esthetic problems due to the exposure, during smiling, of recession-type defects. The participants were selected on a consecutive basis among patients consulting the Department of Periodontology, University of Bologna. A screening examination revealed that all subjects showed an unremarkable medical history and none had loss of periodontal support in tooth surfaces other than those showing recession defects.

Each subject enrolled in the study presented at least 2 recession-type defects affecting adjacent teeth in esthetic areas of the mouth (from tooth 15 to tooth 25). All the recession defects fell into Miller Class I or II,[17] since no loss of interdental soft and hard tissue height was present.

Following the screening examination, all subjects received a session of prophylaxis including instruction in proper oral hygiene measures and scaling and professional tooth cleaning with the use of a rubber cup and a low-abrasive polishing paste. A coronally directed roll technique was prescribed for teeth with recession-type defects in order to minimize toothbrushing trauma to the gingival margin. Surgical treatment of the recession defects was not scheduled until the patient could demonstrate an adequate standard of supragingival plaque control.

Clinical Characteristics

Full-mouth (FMPS) and local plaque scores were recorded as the percentage of total surfaces (4 aspects per tooth) which revealed the presence of plaque.[18] Bleeding on probing was assessed dichotomously at a force of 0.3 N with a manual pressure-sensitive probe.† Full-mouth (FMBS) and local bleeding scores were recorded as the percentage of total surfaces (4 aspects per tooth) which revealed the presence of bleeding upon probing.

The following clinical measurements were taken 1 week before the surgery and at the 1 year follow-up:

† PCP-UNC 15 probe tip, Hu-Friedy, Chicago, IL, equipped with a Borodontic spring device, Dentramar, Waalwijk, Holland.

1) marginal gingival recession (REC), measured from the cemento-enamel junction (CEJ) to the most apical extension of the gingival margin; 2) probing depth (PD), measured from the gingival margin to the bottom of the gingival sulcus; and 3) clinical attachment level (CAL), measured from the CEJ to the bottom of the gingival sulcus.

A single investigator, unaware of the goals of the study, performed the clinical measurements at baseline and at 1 year. All measurements were performed using a manual probe and were recorded to the nearest millimeter.

Surgical Technique

Following local anesthesia, a horizontal incision was made with a scalpel to design an envelope flap. The incision was extended to include one tooth on each side of the teeth to be treated in order to facilitate the planned coronal repositioning of the flap tissue over the exposed root surfaces.

When advancing an envelope flap, the surgical papilla also rotate towards the ends of the flap. In particular, the surgical papilla located mesial to the midline of the flap rotate in a mesial-coronal direction, while the papilla distal to the flap midline rotate in a distal-coronal direction. If the entire interdental soft tissue is comprised in the surgical papilla (i.e., if an intrasulcular incision is made interproximally), at the end of the coronal displacement, a portion will be displaced over the crown of the adjacent tooth instead of in the middle of the interproximal area and thus has to be cut away, causing a loss of interdental keratinized tissue.

To avoid this, a modified design of the envelope flap was performed in the present study (Fig. 1, Fig. 2A). The horizontal incision of the envelope flap consisted of oblique submarginal incisions in the interdental areas, incisions which continued with the intrasulcular incision at the recession defects (Fig. 1, Fig. 2B). Each surgical papilla (SP) was dislocated with respect to the anatomic papilla by the oblique submarginal interdental incisions; in particular, the surgical papilla mesial to the flap midline were dislocated more apically and distally, while the papilla distal to the mid-line were shifted in a more apical and mesial position (Fig. 1, Fig. 2B).

The envelope flap was raised with a split-full-split approach in the coronal-apical direction (Fig. 2C): the oblique interdental incisions were carried out keeping the blade parallel to the long axis of the teeth in order to dissect in a split-thickness manner the surgical papilla. Gingival tissue apical to the root

Figure 1.
Schematic drawing of the envelope flap. The surgical papilla (SP) of the envelope flap resulting from the interaction of the oblique submarginal interdental incisions with the intrasulcular incision at the recession defects. During coronal advancement, each surgical papilla rotates towards the ends of the flap (papillae mesial to the midline of the flap rotate in the mesial-coronal direction, while papillae distal to the flap midline shift in a distal-coronal position; see arrows) and finally resides over the de-epithelialized anatomic interdental papillae (dot areas). Black line: horizontal incision of the envelope flap; vertical gray line: midline of the flap; SP: surgical papilla; AP: anatomic interdental papilla.

exposures was raised in a full-thickness manner to provide that portion of the flap critical for root coverage with more thickness. Finally, the most apical portion of the flap was elevated in a split-thickness manner to facilitate the coronal displacement of the flap.

The root surfaces were mechanically treated with the use of curets. It must be considered that only that portion of the root exposure with loss of clinical attachment (gingival recession plus probeable gingival sulcus/pocket) was instrumented. Exposed root surfaces in areas of anatomic bone dehiscence were not instrumented to avoid damaging any connective tissue fibers still inserted in the root cementum. The remaining tissue of the anatomic interdental papilla was de-epithelialized to create connective tissue beds to which the surgical papilla were sutured (Fig. 2D).

A sharp dissection into the vestibular lining mucosa was then carried out to eliminate muscle tension (Fig. 2E). It must be considered that the "adequate" coronal displacement of the flap results from the elimination of lip and muscle tensions in the apical por-

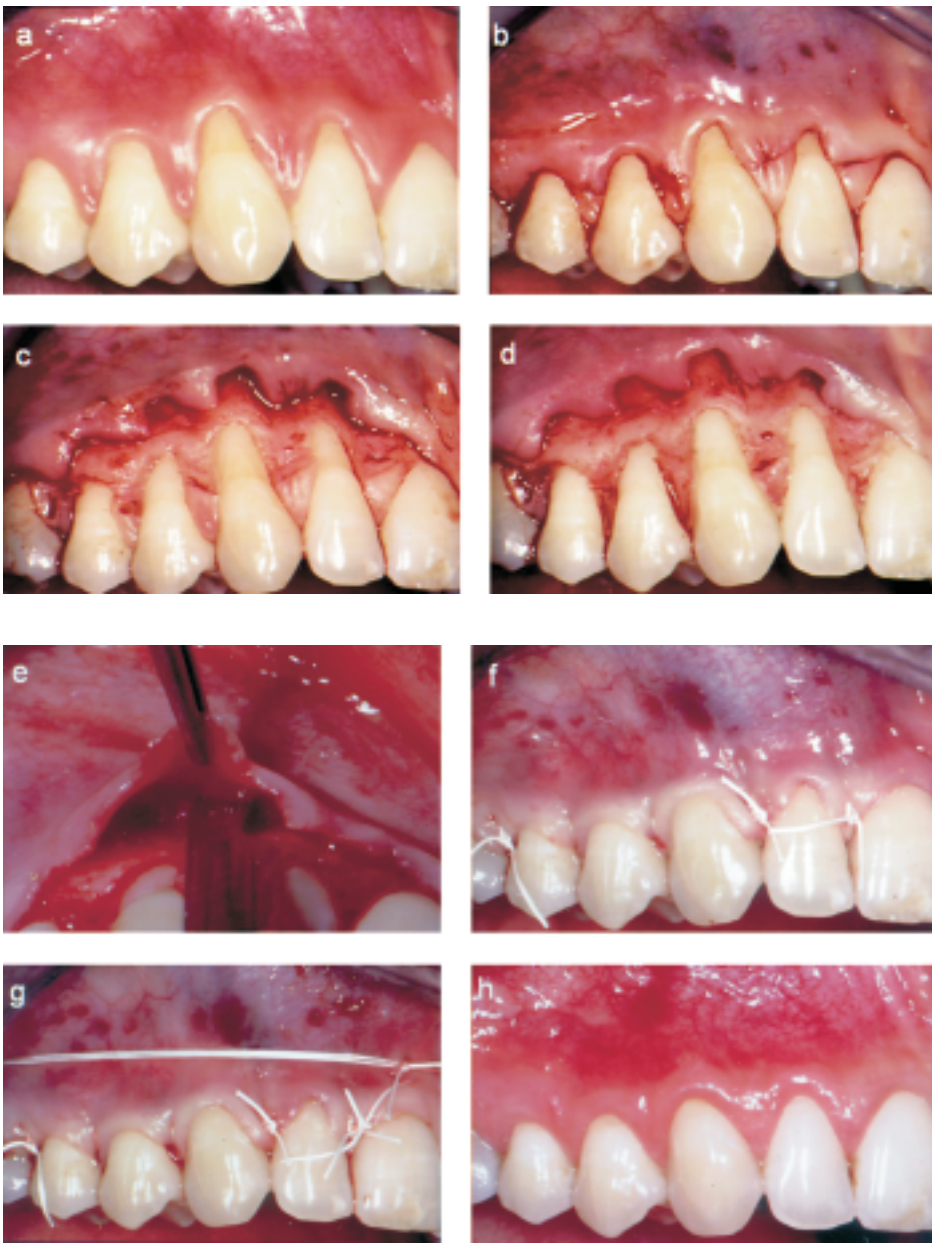


Figure 2.
Surgical technique. ***A.*** *Female, 22 years old, with multiple gingival recessions affecting teeth #11 through #15. (Note the minimal amount of keratinized tissue apical to the recessions at teeth #13 and #14).* ***B.*** *Flap design: the horizontal incision of the flap was made up with oblique submarginal incisions in the interdental areas, which continued with the intrasulcular incision at the recession defects.* ***C.*** *Flap elevation: the envelope flap was raised with a split-full-split approach in the coronal-apical direction.* ***D.*** *Removal of the epithelium of the facial portion of the anatomic interdental papillae.* ***E.*** *Flap mobilization with a sharp dissection into the vestibular lining mucosa.* ***F.*** *Coronal mobilization and suturing (sling sutures) of the flap.* ***G.*** *A horizontal double mattress suture was performed to reduce lip tension on the marginal portion of the flap.* ***H.*** *One-year follow-up. Complete coverage has been achieved in all treated recessions. Note the increase of keratinized tissue, especially at teeth #13 and #14, and the re-alignment of the mucogingival line.*

tion of the flap. During coronal advancement, each surgical papilla rotated towards the ends of the flap and finally resided at the center of the interproximal area (Fig. 2F). Flap mobilization was considered "adequate" when the marginal portion of the flap was able to passively reach a level coronal to the CEJ at each single tooth in the surgical site. The flap, in fact, should be stable in its final position even without the sutures.

Sling sutures were performed to accomplish a precise adaptation of the buccal flap on the exposed root surfaces and to stabilize every single surgical papilla over the interdental connective tissue bed (Fig. 2F). More apically, a horizontal double mattress suture was performed to reduce lip tension on the marginal portion of the flap (Fig. 2G).

Postsurgical Infection Control

Patients were instructed not to brush their teeth in the treated area but to rinse their mouths with chlorhexidine solution (0.12%) twice daily for 1 minute.

Fourteen days after the surgical treatment, the sutures were removed. Plaque control in the surgically treated area was maintained by chlorhexidine rinsings for another 2 weeks. After this period, the patients were again instructed in mechanical tooth cleaning of the treated region using a soft toothbrush and a roll technique. All patients were recalled for prophylaxis 1, 3, and 5 weeks after suture removal and, subsequently, once every 3 months until the final examination (12 months) (Fig. 2H).

Data Analysis

The statistical analysis was performed using a statistical application software.‡ The percentage of root coverage was defined as follows:

$$\frac{100 \times \text{root coverage (baseline recession depth} - \text{1 year follow-up recession depth)}}{\text{baseline recession}}$$

Descriptive statistics were computed for measurements of each parameter at baseline and after 1 year, as well as the difference in each parameter between the 1-year values and the baseline values. The proportion of complete success (100% root coverage) was also computed.

The significance ($\alpha = 0.05$) of changes in gingival recession, clinical attachment level, and probing depth at the 1-year follow-up after coronally advanced treatment was tested by repeated 1-way analyses of variance (ANOVA).

An ordinary least square multiple linear regression model was applied to the entire sample to explore the relative contribution of different predictors on the amount of root coverage; in particular, the predictive variables included the initial recession depth and the presurgical amount of keratinized tissue.

Ordinary least square linear regression analyses were used to evaluate the relationship between the root coverage outcomes (mean percentage of root coverage and percentage with complete root coverage) and the number of recessions treated during each surgery.

RESULTS

Following the initially provided oral hygiene phase as well as at the post-treatment examinations, all subjects showed low frequencies of plaque-harboring tooth surfaces (<20%) and bleeding gingival units (<15%), indicating good standards of supragingival plaque control during the study period.

The 22 patients included in the study presented a total of 73 teeth with buccal recession-type defects. The mean number of gingival recessions treated in each subject was 3.4 (range 2 to 5) (Table 1). In 20 out of 22 subjects (91%), the number of treated recessions was ≥3 mm. All defects were located in the maxilla (from tooth 15 to tooth 25).

Table 2 gives the baseline and 1-year mean data for the various clinical parameters assessed. At baseline, the average depth of the recession defects was 2.8 ± 1.1 mm with a mean clinical attachment loss of 3.8 ± 1.2 mm. The depth of the recessions ranged from 1 to 6. The height of the gingival tissue apical to the recession was, on average, 1.8 ± 0.9 mm; 38% of the recession sites had less than 2 mm of gingival height.

One year following the root coverage procedure, the mean recession depth had decreased to 0.1 ± 0.3 mm. Hence, the average root coverage amounted to

Table 1.

Number of Treated Recessions and Root Coverage Results

Patient	N Recessions	Mean % Root Coverage	% With Complete Root Coverage
1	3	100	100
2	5	100	100
3	3	100	100
4	4	100	100
5	3	88.7	66 (2/3)
6	5	88.2	60 (3/5)
7	2	100	100
8	3	100	100
9	3	91.7	66 (2/3)
10	4	100	100
11	3	100	100
12	4	95	75 (3/4)
13	3	100	100
14	2	100	100
15	3	100	100
16	3	100	100
17	3	100	100
18	4	86.5	50 (2/4)
19	4	100	100
20	4	100	100
21	3	86	33(1/3)
22	3	100	100
MV ± SD	3.4 ± 0.8	97.1 ± 5.1	88.6 ± 20.3

‡ SAS, version 6.12, SAS Institute, Cary, NC.

Table 2.

Comparison of Clinical Variables at Baseline and 1-Year Follow-Up (MV ± SD; in mm)

Variable	Baseline	1 Year	*P* (ANOVA)
REC	2.8 ± 1.1	0.1 ± 0.3	<0.001
PD	1.1 ± 0.3	1.1 ± 0.2	NS
CAL	3.8 ± 1.2	1.2 ± 0.4	<0.001
KT	1.8 ± 0.9	2.4 ± 0.8	<0.001

NS = not significant.

Table 3.

Ordinary Least Square Multiple Linear Regression Analysis to Explore the Relative Contribution of Different Predictors on Root Coverage*

	Estimate	S.E.	*P* Value
Intercept	0.622	0.148	<0.001
Initial RD	0.822	0.032	<0.001
Presurgical KT	–0.139	0.043	<0.01

* The predictive variables included the initial recession depth and the presurgical amount of keratinized tissue. The first predictor included in the equation was initial recession depth.

$R^2 = 0.93$.

F-value: 449.48; $P < 0.001$.

Adjusted $R^2 = 0.92$.

Degrees of freedom: 72.

2.7 ± 1.0 mm. The average loss of clinical attachment was reduced from 3.8 mm to 1.2 mm, while the probing depth remained unchanged (mean value ~ 1 mm). Thus, the gain in clinical attachment at 1 year amounted to 2.6 ± 1.1 mm. Compared with the conditions before surgical treatment, the gingival height showed an increase of 0.6 ± 0.8 mm and amounted to, on average, 2.4 ± 0.8 mm at 1 year post-treatment (Table 2).

Additional information regarding the effectiveness of the surgical technique used for soft tissue root coverage is shown in Table 1. On the average, 97% of the root surface initially exposed due to recession was covered with soft tissue at the 1-year examination. At this point in time, 64 of the 73 treated recession defects (88%) showed complete coverage. None of the treated sites showed greater remaining recession depth than 1.0 mm. Table 1 also indicates the effectiveness of the surgical technique for the treatment of multiple recession-type defects. Complete root coverage in all recessions was achieved in 16 out of 22 patients (73%). Of the remaining 6 patients, 3 patients still showed 1 mm of recession in one of the treated gingival defects and 3 patients had 1 mm of recession in 2 of the surgically treated defects.

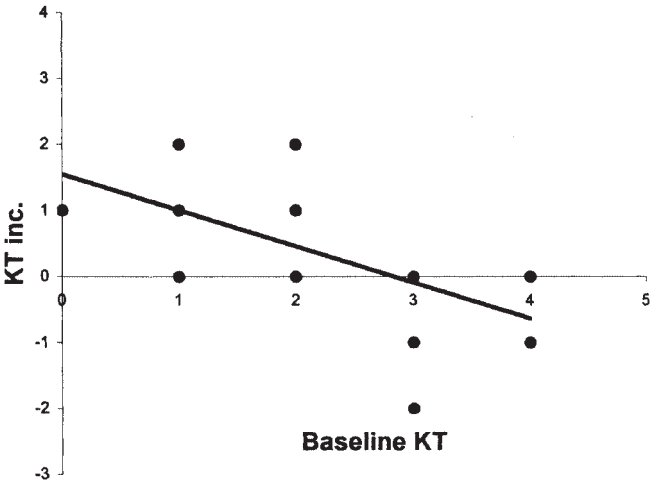
The ordinary least square multiple regression model (Table 3) showed that the final result in terms of amount of root coverage was significantly affected by the initial recession depth and by the amount of presurgical keratinized tissue. Greater reductions in recession depth were observed in the cases with worse initial condition and with a lesser amount of keratinized tissue apical to the recession defect.

The ordinary least square linear regression model showed an inverse relationship ($P < 0.001$) between the increase of keratinized tissue at 1 year and the presurgical amount of keratinized tissue (Fig. 3). The same statistical analysis did not show a statistically significant relationship between the root coverage results (mean percentage of root coverage [$P = 0.3$], percentage with complete coverage [$P = 0.3$]) and the number of recession defects treated in each patient.

DISCUSSION

Treatment of gingival recessions has become an important therapeutic issue due to the increasing number of cosmetic requests from patients. Patients' esthetic demands, due to the exposure, during smiling or function, of portions of the root surface are the main indication for root coverage surgical procedures. Very often, the area with the most coronal millimeter(s) of root exposure is the only visible part of the recession when smiling; therefore, the presence after therapy even of a shallow recession may be an esthetic concern for the patient. Thus, complete root coverage up to the CEJ is the goal to be achieved when the patient complains about esthetic appearance of teeth. Furthermore, even if complete root coverage 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 connective tissue graft is harvested from the palate and utilized for root coverage.

Another factor to be considered is that gingival recession is very seldom localized to a single tooth.



R^2 = 0.35; F-value: 37.6; *P* <0.001
Degrees of freedom: 72
Adjusted R^2 = 0.34

	Estimate	S.E.	*P* Value
Intercept	1.549	0.178	<0.001
Baseline KT	–0.546	0.089	<0.001

Figure 3.
Results of the ordinary least square linear regression of increase in keratinized tissue on the presurgical amount of keratinized tissue.

More frequently, gingival recessions affect groups of adjacent teeth. In order to minimize the number of surgeries and to optimize the esthetic result, all the contiguous recessions should be treated at the same time. Patient-related esthetic considerations would suggest the utilization of surgical techniques which can predictably obtain complete root coverage in all present recessions by using the soft tissue adjacent to the defects. The coronally advanced flap procedure has been demonstrated to be a reliable and predictable treatment modality for obtaining root coverage in isolated types of gingival recessions.[2,19-21] In the present study, a new approach to the coronally advanced flap was used to treat multiple recession defects affecting adjacent teeth in patients with esthetic demands. Some clinical and biological advantages are derived from the use of this new surgical approach. In the envelope type of flap, vertical releasing incisions are avoided so as not to damage the blood supply to the flap; this is of paramount importance in root coverage procedures where the stability of the surgical margin is critical to the success of the surgery. Furthermore, vertical releasing incisions often result (after healing) in unesthetic visible white scars which can be even more unsatisfactory for the patient than the root exposure itself. Other advantages are derived from the split-full-split flap elevation. In fact, more thickness (and thus better opportunity to achieve root coverage) is provided for that portion of the flap residing over the previously exposed root exposures; it facilitates the coronal displacement of the flap; and it guarantees anchorage and blood supply to the surgical papilla in the interproximal areas between the root exposures.

The present study demonstrated that the proposed modification of the coronally advanced flap is an effective treatment modality for the management of multiple recession defects affecting adjacent teeth in esthetic regions of the mouth. In fact, this surgical technique resulted in complete soft tissue root coverage in the greater majority of treated cases. At the 1-year post-treatment examination, 88% of the Class I and II gingival defects (i.e., buccal recessions at teeth with intact periodontal support at proximal surfaces) were successfully covered. This rate of success is similar or even somewhat higher than that previously reported for the coronally advanced flap[2,19-21] and for other root coverage procedures.[1] Furthermore, this surgical technique has shown itself to achieve complete root coverage in all treated recessions in most of the patients (16), irrespective of the number of recessions treated in each intervention.

The absence of a wide zone of keratinized tissue apical to the defects was considered a limitation of the coronally advanced flap technique.[2,19-21] On the contrary, the present study demonstrated an inverse relationship between the apicocoronal dimension of gingival tissue apical to the recession defects and the amount of root coverage achieved with the surgery: better root coverage results were accomplished in the cases with a lesser presurgical amount of keratinized tissue. Furthermore, the results of the study showed that a statistically and clinically significant increase of keratinized tissue was obtained after surgery and that this increase was inversely correlated with the preoperative amount of keratinized tissue. In other words, the increase in keratinized tissue was greater when, before surgery, there was a very narrow (1 mm or less) band of attached gingiva apical to the defects (Fig. 4). The fact that the coronally advanced flap procedure resulted in an increased apicocoronal gingiva height might be explained by several events taking place during the healing and maturation of the marginal tissue: first, the tendency of the mucogingival line to regain its "genetically"

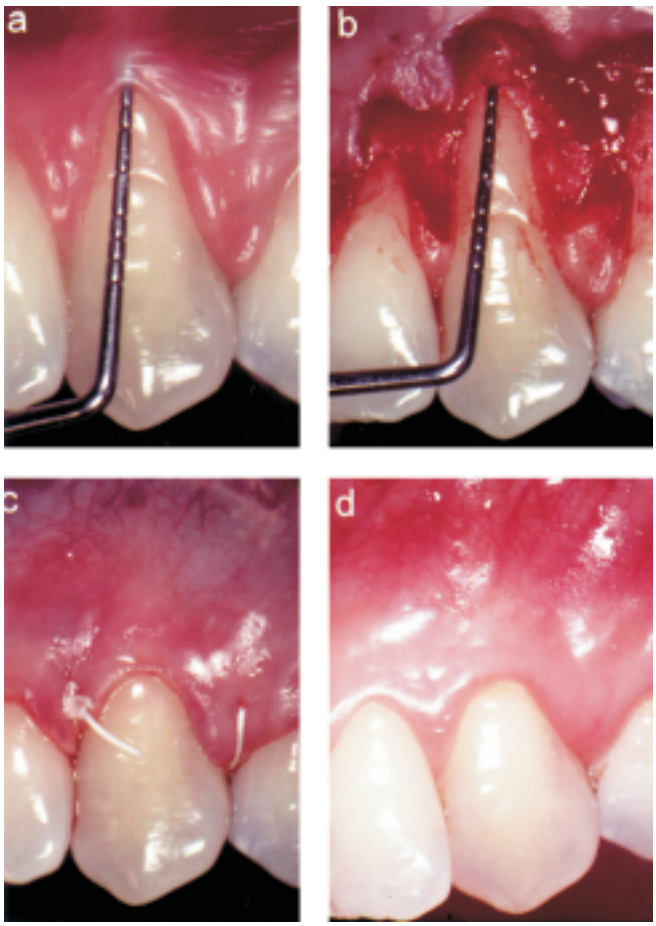


Figure 4.
a) A canine with a deep recession defect and absence of attached gingiva was treated, together with adjacent teeth, with the coronally advanced flap procedure described. b) Split-full-split flap elevation. Note the deep bone dehiscence at the canine. c) At the end of the surgery the mucosal flap was sutured coronally to the level of the CEJ.. d) One-year follow-up. Complete root coverage and marked increase of keratinized tissue have been achieved irrespective of the presurgical minimal amount of keratinized tissue and absence of attached gingiva.

defined position following coronal dislocation with the flap procedure;[22] second, it cannot be excluded that granulation tissue derived from the periodontal ligament tissue might have contributed to the increased gingival dimension.[23,24] The type of healing obtained between the soft tissue and the previously denuded root surface can only be speculated on, since no histological evaluations were available. It is interesting, however, that a mean gain of 2.6 mm in clinical attachment level was recorded following the treatment. This gain probably represents a combination of the formation of new connective tissue attachment and epithelium attachment. Animal studies, including histological evaluations, have demonstrated that new connective tissue attachment is made up of 44% to 50% of the successfully covered recession defects following the use of rotational flap procedures[25] or a coronally advanced flap procedure.[26] Although a new connective tissue attachment most likely fails to form in the entire depth of the defect, the treatment procedure used in the present study did not result in the formation of a deep periodontal pocket (mean probing depth was 1.0 mm at 12 months).

In conclusion, the results of the present study demonstrated that this new approach to the coronally advanced flap technique was very effective for the treatment of multiple gingival recessions in patients with esthetic demands and that these successful results, both in terms of root coverage and increase in keratinized tissue, could be achieved irrespective of both the number of recessions simultaneously treated during the surgical intervention and the presence, before surgery, of a minimal amount (1 mm or less) of keratinized tissue apical to the defects.

REFERENCES

1. Wennström JL. Mucogingival surgery. In: Lang NP, Karring T, eds. *Proceedings of the 1st European Workshop on Periodontology*. Berlin: Quintessence Publishing Co.; 1994:193-209.
2. Wennström JL, Zucchelli G. Increased gingival dimensions. A significant factor for successful outcome of root coverage procedures? A 2-year prospective clinical study. *J Clin Periodontol* 1996;23:770-777.
3. Zucchelli G, Clauser C, De Sanctis M, Calandriello M. Mucogingival versus guided tissue regeneration procedures in the treatment of deep recession-type defects. *J Periodontol* 1998;69:138-145.
4. De Sanctis M, Zucchelli G. Soft tissue plastic surgery in the treatment of gingival recessions. Successful criteria for root coverage. *Parodontologie d'Implantologie Orale* 1996;15:7-18.
5. Mlinek A, Smuckler H, Buchner A. The use of free gingival grafts for the coverage of denuded roots. *J Periodontol* 1973;44:248-254.
6. Matter J. Free gingival graft for the treatment of gingival recession. A review of some techniques. *J Clin Periodontol* 1980;7:103-117.
7. Holbrook T, Ochsenbein C. Complete coverage of denuded root surface with a one-stage gingival graft. *Int J Periodontics Restorative Dent* 1983;3(3):9-27.
8. Miller PD. Root coverage using a free soft tissue autograft following citric acid application. III. A successful and predictable procedure in areas of deep-wide recession. *Int J Periodontics Restorative Dent* 1985;5(2):15-37.
9. Borghetti A, Gardella JP. Thick gingival autograft for

the coverage of gingival recession: A clinical evaluation. *Int J Periodontics Restorative Dent* 1990;10:217-229.
10. Tolmie PN, Rubins RP, Buck GS, Vagianos V, Lanz JC. The predictability of root coverage by way of free gingival autografts and citric acid application: An evaluation by multiple clinicians. *Int J Periodontics Restorative Dent* 1991;11:261-271.
11. Sullivan HC, Atkins JH. Free autogenous gingival grafts. III. Utilization of grafts in the treatment of gingival recession. *Periodontics* 1968;6:152-160.
12. Langer B, Langer L. Subepithelial connective tissue graft technique for root coverage. *J Periodontol* 1985; 56:715-720.
13. Raetzke PB. Covering localized areas of root exposure employing the "envelope" technique. *J Periodontol* 1985;56:397-402.
14. Nelson SW. The subpedicle connective tissue graft. A bilaminar reconstructive procedure for the root coverage of denuded root surfaces. *J Periodontol* 1987;58: 95-102.
15. Harris RJ. The connective tissue and partial thickness double pedicle graft: A predictable method of obtaining root coverage. *J Periodontol* 1992;63:477-486.
16. Harris RJ. The connective tissue with partial thickness double pedicle graft: The results of 100 consecutively-treated defects. *J Periodontol* 1994;65:448-461.
17. Miller PD. A classification of marginal tissue recession. *Int J Periodontics Restorative Dent* 1985;5(2):9-13.
18. O'Leary TJ, Drake RB, Naylor JE. The plaque control record. *J Periodontol* 1972;43:38.
19. Allen EP, Miller PD. Coronal positioning of existing gingiva: Short-term results in the treatment of shallow marginal tissue recession. *J Periodontol* 1989;60:316-319.
20. Guinard EA, Caffesse RG. Treatment of localized gingival recessions. III. Comparison on results obtained with lateral sliding and coronally repositioned flaps. *J Periodontol* 1978;49:457-461.
21. Tenenbaum H, Klewansky P, Roth JJ. Clinical evaluation of gingival recession treated by coronally repositioned flap technique. *J Periodontol* 1980;51:686-690.
22. Ainamo A, Bergenholtz A, Hugoson A, Ainamo J. Location of the muco-gingival junction 18 years after apically repositioned flap surgery. *J Clin Periodontol* 1982;9:49-52.
23. Karring T, Ostergaard E, Löe H. Conservation of tissue specificity after heterotopic transplantation of gingiva and alveolar mucosa. *J Periodont Res* 1971;6:282-293.
24. Lundberg M, Wennström JL. Development of gingiva following surgical exposure of a facially positioned unerupted incisor. *J Periodontol* 1988;59:652-655.
25. Caffesse RG, Kon S, Castelli WA, Nasjleti CE. Revascularization following the lateral sliding flap procedure. *J Periodontol* 1984;55:352-359.
26. Wilderman MN, Wentz FM. Repair of a dentogingival defect with a pedicle flap. *J Periodontol* 1965;36:218-231.

Send reprint requests to: Dr Giovanni Zucchelli, University of Bologna, Department of Periodontology, Via S. Vitale 59 - 40125 Bologna, Italy. Fax: 39 51 234403; e-mail: giovanzu@tin.it

Accepted for publication February 11, 2000.