

Systematic Review of Periodontal Plastic Surgery in the Treatment of Multiple Recession-Type Defects

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ABSTRACT

Objectives: The objectives of this systematic review were (1) to evaluate results obtained with different periodontal plastic surgery procedures in the treatment of multiple recession-type defects and (2) to assess differences in results from randomized controlled trials and other types of studies (i.e., controlled clinical trials and case series).

Materials and Methods: The MEDLINE, EMBASE and CENTRAL databases were searched up to June 2008 to identify randomized controlled trials, controlled clinical trials and case series with a follow-up period of at least 6 months for patients with multiple recession-type defects who were treated with periodontal plastic surgery.

Results: Of 632 articles initially retrieved, only 16 were deemed suitable for more detailed analysis. Of these, only 4 case series met the inclusion criteria. Mean recession and clinical attachment level decreased substantially from baseline to final examination, and probing depth also declined. Mean width of keratinized tissue increased. Mean root coverage ranged from 94% to 98% over the 4 studies, and complete root coverage was achieved for 68% to 90% of patients in the 3 trials for which this variable was reported.

Conclusions: Analysis of the limited information available in the dental literature showed improvements in clinical parameters with all of the periodontal plastic surgery procedures. Randomized controlled trials are needed to identify the indications for each surgical technique and any prognostic factors.

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In most adults, the root surfaces of one or more teeth may become exposed through displacement of the gingival margin apical to the cemento-enamel junction¹ (i.e., gingival recession).² This problem has various causes:

- anatomic conditions, including lack of attached gingiva, muscular inserts near the gingival margin,^{3,4} poor tooth alignment⁵ or inadequate thickness of the alveolar bone plate and root prominences⁶

- acquired pathological conditions, such as periodontitis⁷ or viral infection⁸
- iatrogenic factors, such as improper restorations invading the biological space⁹
- mechanical trauma, including trauma associated with toothbrushing¹⁰ or lip piercing.¹¹

Gingival recession is a matter of concern for both patients and dental professionals, especially when exposure of the root surface

is linked to deterioration in esthetic appearance and increase in dental hypersensitivity.¹¹ Traditionally, the primary goals of periodontal therapy are to eliminate any etiologic agents associated with inflammatory disease and to improve clinical parameters, such as clinical attachment level and probing depth. In treating gingival recession, attempts should be made to improve all clinical parameters, especially clinical attachment level and root sensitivity, if present. In a recent cross-sectional survey of specialists in periodontics and general dentists,¹² the predominant indication for root-coverage procedures was esthetics (90.7% of respondents). Of the available periodontal plastic surgery (PPS) techniques, free gingival grafting was generally the most favoured option, followed by subepithelial connective tissue grafting (SCTG), coronally advanced flap (CAF) and guided tissue regeneration (with only a small group of the dentists preferring the regeneration procedure).

During the past few years, the effectiveness of PPS procedures in the treatment of localized or multiple recession-type defects (MRTD) has been reported in several trials. Studies testing different techniques, such as CAF alone,^{13–16} SCTG alone or in combination with rotated or advanced flaps,^{17–23} and guided tissue regeneration,^{24–26} have demonstrated that surgical treatment of exposed root surfaces improves clinical attachment levels and reduces gingival recession in most patients. Other recent studies have suggested that the choice of treatment for MRTD involving 2 or more adjacent teeth may be based on a variety of factors, such as anatomic structure, anticipated level of discomfort during healing, cost and need for more than one surgical procedure to treat the entire recession site.^{22,23}

Recent extensive systematic reviews have focused on the effect of PPS procedures in treating localized gingival recession.^{27–33} The authors of these reviews found descriptions of a variety of surgical techniques and flap designs used to correct localized gingival recession, all of which yielded statistically significant improvements in gingival recession and clinical attachment level. The authors also recommended that SCTG, CAF or guided tissue regeneration be used for root coverage in clinical practice.

However, these previous reviews^{27–31} had some limitations. For example, they included only English-language publications. Moreover, some of the reviews^{27–29,31} pooled all sources of evidence available (randomized controlled clinical trials [RCTs], controlled clinical trials and case series), regardless of methodologic quality. Some reviews^{28–31} did not report specific inclusion criteria for types of defect (according to Miller's classification³⁴), and some^{28–30} did not report a specific follow-up period. Finally, several of the reviews^{27–30} did not report the use of acellular dermal matrix grafts or enamel matrix protein.

Of these systematic reviews,^{27–33} 4 included data only up to 2002,^{27–30} and none focused specifically on PPS procedures in the treatment of MRTD. As such, there is no compilation of evidence-based information for this type of defect.

Given the common occurrence of recession areas involving adjacent teeth and the lack of information linking the results achieved to different surgical techniques, the objectives of this systematic review were to evaluate the results obtained with different root-coverage procedures in the treatment of MRTDs and to assess differences in results from RCTs and other types of studies (i.e., degree of concordance in treatment effects between randomized and nonrandomized groups).

Materials and Methods

Study Selection and Type of Intervention

The study protocol used for this review was based on that used for previous publications.^{32,33} Studies eligible for inclusion in this review were RCTs, controlled clinical trials and case series involving at least 10 patients per group, with a follow-up period of at least 6 months. Studies had to be limited to patients with a clinical diagnosis of gingival recession affecting adjacent teeth (i.e., recession areas selected for treatment classified as Miller³⁴ Class I or Class II) who underwent PPS procedures (e.g., free gingival grafting; laterally positioned flap; CAF; SCTG, alone or in combination with lateral or advanced flaps; guided tissue regeneration; enamel matrix protein; or acellular dermal matrix grafting). Data from nonrandomized trials were pooled. Trials that reported data for both localized and multiple recession areas were excluded.

Outcomes Measures and Search Strategy

The outcome measures assessed were changes in gingival recession, clinical attachment level and keratinized tissue, as well as percentage of patients with complete root coverage and mean root coverage.

The MEDLINE, EMBASE and Cochrane Central Register of Controlled Trials (CENTRAL) databases were searched up to June 2008 with the following MeSH terms, key words and other free terms: GINGIVAL RECESSION [single MeSH term], ((recession NEAR gingiva*) OR (recession NEAR defect*)) OR "recession-type defect*", ((exposure NEAR root*) OR (exposed NEAR root*)), (gingiva* NEAR defect*), denude* NEAR "root surface*", GUIDED TISSUE REGENERATION [exploded MeSH term], "tissue NEAR regenerat*", ((gingiva* NEAR esthetic*) OR (gingiva* NEAR aesthetic*)), periodont* AND "plastic surgery," "soft tissue graft*" OR "coronally advanced flap*," "laterally positioned flap*" OR "laterally-positioned flap*," "connective tissue graft*" OR "connective-tissue graft*," gingiva* NEAR transplant*, "dermal matrix" NEAR graft*,

“enamel matrix protein.” Boolean operators (OR, AND) were used to combine searches. Papers published in any language and any journal were considered. The following journals were also searched by hand to include any possible trial not retrieved by electronic search: *Journal of Periodontology*, *Journal of Periodontal Research*, *Journal of Clinical Periodontology* and *International Journal of Periodontics and Restorative Dentistry*.

Assessment of Validity and Methodologic Quality

Two independent reviewers (L.C. and L.A.C.) screened the titles, abstracts and full texts of the articles identified by searching. Disagreement between the reviewers was resolved by discussion and consensus. If data were missing, the authors of the original reports were contacted and asked to provide further details.

The methodologic quality of the included studies was assessed by consideration of the following points and questions:

- Method of randomization: (a) adequate, if random number tables, coin toss or shuffled cards were used to assign treatments; (b) inadequate, if any other method was used to assign treatments; (c) unclear, if method of randomization was not reported or explained; or (d) not applicable (i.e., for trials without randomization).
- Allocation concealment: (a) adequate, if examiners were kept unaware of randomization sequence; (b) inadequate, if allocation was not concealed; (c) unclear, if the method of allocation concealment was not reported or explained; or (d) not applicable (i.e., for trials without randomization).
- Completeness of the follow-up period (yes/no responses): (a) Were equal numbers of patients present at baseline and follow-up? (b) Were all of the patients who entered the trial properly accounted for at completion? (c) Did the statistical analysis include the total number of patients enrolled in the study?
- Blinding of examiners with regard to the treatment procedures used in the study period (yes/no response): Were the examiners blinded?

In addition, risk of bias was categorized according to the following classification: (a) low risk of bias (i.e., plausible bias that is unlikely to seriously alter the results) if all criteria were met (i.e., adequate methods of randomization and allocation concealment and “yes” answers to all questions about completeness of follow-up questions and blinding of examiners); (b) moderate risk of bias (i.e., plausible bias that raises some doubt about the results) if one or more criteria were partly met; or (c) high risk of bias (plausible bias that seriously weakens confidence in the results) if one or more criteria were not met.

Results

Search Results

A total of 632 titles of potentially relevant publications was retrieved from the databases. Of these, 616 articles were excluded after review of the title and abstract. The full texts of the remaining 16 papers were reviewed in more detail. Of these, 4 were considered appropriate for analysis. The other 12 were excluded for the following reasons: fewer than 10 patients per group,^{35–37} inclusion of patients with Miller³⁴ Class III recession areas,^{38,39} data for postsurgical clinical parameters not available or follow-up period less than 6 months,^{40,41} surgical sites not presenting contiguous recessions (i.e., sites with no recession interposed between teeth with recession),⁴² inclusion of localized gingival recessions^{43–45} or duplicate reporting.¹⁵

The search strategy was designed to include all types of evidence (RCTs, controlled clinical trials and case series), and one of the study objectives was to compare the results from RCTs with those obtained in nonrandomized trials. However, the search did not yield any RCTs that focused exclusively on the treatment of MRTD. Therefore, only nonrandomized trials were included in the analysis (**Table 1**). Besides, trials that had incorporated both localized and multiple recession areas were excluded.

Quality Assessment

For the trials included in the analysis, the numbers of patients at baseline and at final examination were equal, all patients who entered each study were properly accounted for at completion, and the statistical analysis included the total number of patients enrolled. The follow-up periods ranged from 6 to 60 months. However, the studies were not blinded, and none of the publications were randomized or controlled clinical trials. Therefore, all 4 studies were considered to be at high risk of bias.

Description of Studies

Data regarding changes in probing depth, percentage of root coverage, gain in keratinized gingiva and number of sites with complete coverage are reported in **Table 2**. The 4 case series described 4 different surgical procedures: 1 described the use of CAF alone and 3 involved the use of SCTG with CAF. A total of 70 patients were treated in the 4 studies, with the patient being the preferred unit of analysis.

Coronally Advanced Flap

Only 1 trial was found in which CAF was used for treatment of MRTD. Zucchelli and De Sanctis⁴⁷ evaluated the effectiveness of a modified CAF technique for the treatment of MRTD in 22 patients with esthetic demands. At the 12-month follow-up examination, mean root coverage was 97%. Of the 73 maxillary recessions

Table 1 Characteristics of included studies

Study	Methods	Participants and reasons for treatment	Outcomes	Unit of analysis
Çetiner and others ⁴⁶	12-month university-based case series: CAF + expanded mesh SCTG	10 patients, 23–48 years old; reasons not reported	RD, PD, CAL, KT, CRC, MRC (individual patient data reported)	Recession
Zucchelli and De Sanctis ⁴⁷	60-month university-based case series: modified CAF	22 patients, 18–34 years old; esthetics	RD, PD, CAL, KT, CRC, MRC (individual patient data reported)	Patient
Chambrone and Chambrone ²²	6-month practice-based case series: CAF + SCTG for maxillary versus mandibular sites, with tetracycline	28 patients, 18–34 years old; esthetics and dental hypersensitivity	RD, PD, CAL, KT, CRC, MRC (individual patient data reported)	Patient
Carvalho and others ²³	6-month university-based case series: modified CAF + SCTG	10 patients, 24–36 years old; reasons not reported	RD, PD, CAL, KT, CRC, MRC (aggregated patient data reported)	Patient

Note: CAF = coronally advanced flap, SCTG = subepithelial connective tissue graft, RD = recession depth, PD = probing depth, CAL = clinical attachment level, KT = keratinized tissue, CRC = complete root coverage, MRC = mean root coverage.

present at baseline, 64 (88%) were completely covered, and complete root coverage was achieved in 16 (73%) of the 22 patients. At the 60-month follow-up evaluation, 94% of the exposed root surfaces were still covered with soft tissues, and 15 (68%) of the 22 patients had complete root coverage.

SCTG with Coronally Advanced Flap

The other 3 studies analyzed in this review evaluated the use of SCTG in association with CAF.

The first of these studies⁴⁶ assessed the effectiveness of expanded-mesh SCTG in association with CAF. Complete root coverage was achieved for 12 (80%) of 15 treated areas (in a total of 10 patients), with mean root coverage of 96%.

The second publication²² evaluated clinical results obtained with SCTG placed under a CAF for the treatment of MRTD in a sample of 28 patients, 14 of whom had maxillary sites of recession and 14 of whom had mandibular sites. Mean root coverage from baseline to 6 months after surgery was 96%, and complete root coverage was achieved in 20 (71%) of the patients. This study had one distinct difference from the other case series included in this review — it was the only study that considered maxillary and mandibular recession defects separately: improvements in gingival recession were significantly better for patients with maxillary MRTDs than for those with mandibular MRTDs. Moreover, mean root coverage was 94% for the mandibular sites and 98% for the maxil-

lary sites, and the percentage of sites with complete root coverage was 57% (8/14) and 85% (12/14), respectively.

The third trial²³ reported the effectiveness and predictability of root coverage at adjacent sites of multiple gingival recessions using a modified coronally advanced flap¹⁵ associated with an SCTG in a sample of 10 nonsmoking patients. The authors observed that this combination of techniques was effective and produced predictable root coverage in shallow defects (mean root coverage of 98% and complete root coverage in 90% of patients).

Data Analysis and Clinical Outcomes

Given the small number of publications and the heterogeneity of procedures reported (i.e., differences in flap design and type of grafting), the study characteristics were considered too variable to allow data to be combined for meta-analysis. Therefore, the data from the 4 studies^{22,23,46,47} were tabulated (Table 2), and the results considered in terms of mean values.

Overall, mean recession (\pm standard deviation) declined from 2.95 ± 0.36 mm at baseline to 0.13 ± 0.03 mm at final examination. Complete root coverage was achieved in 44 (73%) of the 60 patients (from 3 studies^{22,23,47}) with multiple gingival recessions. Overall mean root coverage at the final examination was 96%. Clinical attachment level decreased from 4.37 ± 0.32 mm at baseline to 1.49 ± 0.18 mm at the final examination, and probing depth decreased from 1.45 ± 0.16 mm to 1.31 ± 0.20 mm. Mean width of keratinized tissue increased from 2.43 ± 0.52 mm at baseline to 3.94 ± 0.41 mm at the final examination.

Table 2 Changes in various outcomes from baseline to final measurement

Study	Mean measurement (SD)				Mean root coverage (%)	% of patients with complete root coverage ^a
	Recession depth (mm)	Probing depth (mm)	Clinical attachment level (mm)	Keratinized tissue (mm)		
Çetiner and others ⁴⁶					96	Not reported ^b
Baseline	3.11 (0.80)	1.38 (0.52)	4.40 (0.86)	3.93 (0.72)		
Final	0.11 (0.27)	1.13 (0.35)	1.18 (0.35)	5.11 (0.76)		
Zucchelli and De Sanctis ⁴⁷					94	68 (15/22)
Baseline	2.78 (1.13)	1.06 (0.26)	3.84 (1.20)	1.80 (0.86)		
Final	0.22 (0.56)	1.07 (0.26)	1.29 (0.59)	3.18 (0.53)		
Chambrone and Chambrone ²²					96	71 (20/28)
Baseline	3.84 (1.50)	1.52 (0.47)	5.29 (1.30)	1.66 (1.09)		
Final	0.14 (0.23)	1.12 (0.43)	1.52 (0.47)	3.82 (0.91)		
Carvalho and others ²³					98	90 (9/10)
Baseline	2.10 (0.82)	1.86 (0.74)	3.97 (1.02)	2.34 (1.47)		
Final	0.07 (0.26)	1.93 (0.37)	2.00 (0.46)	3.65 (0.94)		
Overall					96	73 (44/60)
Baseline	2.95 (0.36)	1.45 (0.16)	4.37 (0.32)	2.43 (0.52)		
Final	0.13 (0.03)	1.31 (0.20)	1.49 (0.18)	3.94 (0.41)		

SD = standard deviation.

^aWith raw data in parenthesis.

^bThis study described treatment of 15 sites in 10 patients, and complete root coverage was achieved for 12 (80%) of these 15 sites.

Discussion

Several surgical procedures to correct mucogingival problems and improve the esthetics of the patient's smile have been described in the dental literature. The 4 studies included in this review^{22,23,46,47} recorded statistically significant improvements for all clinical parameters except probing depth (**Table 2**). The best results were achieved by Carvalho and others,²³ but that study (along with the study by Çetiner and others⁴⁶), involved the smallest number of patients ($n = 10$).

Data from a variety of PPS procedures reviewed by other authors¹² showed root coverage ranging from 60% to 84% in the treatment of localized gingival recessions. In the systematic review reported here, mean root coverage ranged from 94% to 98%, and complete root coverage ranged from 68% to 90% of patients. Reporting of initial recession depth from all treated sites has been recommended by Bouchard and others⁴⁸ but was available in only 3 of the trials analyzed here.^{22,46,47} Although 3 of the studies were conducted in a university setting and the fourth was conducted in a private periodontal practice,

electronic probes and probing acrylic stents were not used in any of the trials.

All of the studies included in this analysis had a small number of patients, and each tested only one PPS procedure (i.e., no control group). Moreover, no 2 studies used the same surgical procedure. These differences among the studies may be explained by the difficulty in recruiting patients with similar defects or bilateral MRTD sites. Because of the limited number of studies and the lack of RCTs comparing different techniques, it is difficult to recommend a particular PPS procedure for the treatment of MRTD, and it is impossible to draw conclusions about the superiority of one PPS procedure over the others.

The secondary objective of this review was to compare the results achieved in RCTs with those obtained in controlled clinical trials and case series, but no RCTs were identified and this comparison could not be performed. Case series have serious methodologic flaws, and their inclusion in a systematic review leads to very weak evidence and adds little to general knowledge of a problem. The fact that none of the studies identified for this study used

blinded assessment further undermines the strength of the evidence. As such, the greatest strength of the current paper is its role in calling attention to the paucity of well-designed studies that properly evaluate PPS procedures for the treatment of MRTD. These results also emphasize that RCTs are needed to identify the indications for each surgical technique and their prognostic factors.

Two of the studies identified in this review did not include smokers.^{22,23} Although mean root coverage and percent of patients with complete root coverage were similar for trials with and without smokers (Table 2), cigarette smoking has been reported to affect the short- and long-term outcome of PPS procedures.⁴⁹ The patient's smoking status should therefore be carefully evaluated if surgical correction of gingival recession is being considered.⁴⁹⁻⁵¹

In 1 study, all treated surfaces were conditioned with tetracycline solution during preparation of the site, which is a form of root demineralization.²² The results achieved with such root demineralization have been controversial. Exposed root surfaces have been treated with a solution of citric acid and tetracycline HCl to enhance the degree of attachment of new connective tissue to previously denuded root surfaces through exposure of collagen fibrils of the cementum or dentin between the root surface and the transplanted graft.⁵²⁻⁵⁵ In contrast, some RCTs have suggested no significant clinical benefit of root conditioning in conjunction with root-coverage procedures.⁵⁶⁻⁵⁸

In all 4 trials, patient selection was based on esthetic considerations or dental hypersensitivity (or both), and treatment was intended to prevent continuing development of gingival recession, root abrasion or root caries and to improve hygiene (Table 1). This information suggests that patients' concerns should be carefully evaluated before any surgical correction is planned, with particular attention to whether it is possible to achieve the patient's desires with the proposed treatment modality.

Consequently, before performing any PPS procedure, the dental professional should select the most appropriate technique for each defect, to ensure that patients' individual needs and complaints are addressed and to achieve the best esthetic and functional results. The selection of one PPS procedure rather than another for the treatment of MRTD depends on a variety of factors, such as size of the defect (length and width), width of keratinized tissue adjacent to the defect, number of adjacent teeth to be treated, amount of connective tissue available from the donor site, location of the MRTD (mandibular or maxillary), depth of the vestibular fornix and mucogingival phenotypes.^{19,22} Insufficient studies are available to allow evaluation of the different PPS procedures, and well-designed RCTs are needed to address these questions. The Consolidated Standards of Reporting Trials (CONSORT) guidelines^{59,60} provide guidance on the appropriate design and reporting of clinical trials, to ensure that readers understand the design, conduct, analysis

and interpretation of trials and can assess the validity of their results. The CONSORT guidelines improve the transparency and quality of reporting of RCTs.⁶⁰

Conclusions

Only limited information about the use of PPS for MRTD is available in the dental literature. Systematic review of this information led to the following conclusions:

- All of the PPS procedures evaluated (i.e., CAF alone or in combination with SCTG) led to improvements in recession depth, clinical attachment level and width of keratinized tissue.
- RCTs are needed to identify the indications for each surgical technique and possible prognostic factors. The design and reporting of future studies should take into account the requirements of the CONSORT statements.
- Patients' individual needs should be carefully evaluated before surgical correction of MRTD is planned, to ensure that their chief complaints can be resolved.

This review also yielded some general recommendations:

- If MRTDs involve 2 or more teeth, each surgical site should be considered as a single unit, in terms of determining the extent of complete root coverage (i.e., 100% root coverage is recorded only if all adjacent teeth have adequate root coverage).
- Multicentre studies may be required to increase the number of patients and to achieve adequate statistical power. ♦

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