Coronally advanced flap with and without connective tissue graft for the treatment of multiple gingival recessions: a comparative short- and long-term controlled randomized clinical trial

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Abstract

Aim: The aim of this study was to compare short- and long-term root coverage and aesthetic outcomes of the coronally advanced flap (CAF) alone or in combination with a connective tissue graft (CTG) for the treatment of multiple gingival recessions.

Methods: Fifty patients with multiple (≥2) adjacent gingival recessions (≥2 mm) in the upper jaw were enrolled. Twenty-five patients were randomly assigned to the control group (CAF), and the other 25 patients to the test group (CAF + CTG). Clinical outcomes were evaluated at 6 months, 1 and 5 years. The aesthetic evaluations were made 1 and 5 years after the surgery.

Results: No statistically significant difference was demonstrated between the two groups in terms of Rec Red and complete root coverage (CRC) at 6 months and 1 year. At 5 years, statistically greater recession reduction and probability of CRC, greater increase in buccal KTH and better contour evaluation made by an independent periodontist were observed in the CAF + CTG group. Better post-operative course and better colour match were demonstrated in CAF-treated patients both at 1 and 5 years.

Conclusions: CAF + CTG provided better CRC at 5 years; keloid formation due to graft exposure was responsible for the worse colour match evaluation.

Conflict of interest and source of funding statement

The authors declare that they have no conflict of interests. This study has been self-supported by the authors.

Key words: aesthetics; CTG; multiple gingival recessions; root coverage; surgery

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predictable surgical procedure for the treatment of an isolated type of recession defect, in terms of complete root coverage (CRC) (Roccuzzo et al. 2002, Cairo et al. 2008). No reports are available on the prevalence of single versus multiple recession type of defects in patients with aesthetic demands. The envelope-type of coronally advanced flap (Zucchelli & De Sanctis 2000) (CAF) is a modality of root coverage surgery has been demonstrated to be a safe and predictable approach (Zucchelli & De Sanctis 2005) for multiple recession-type defects. Root coverage and aesthetic outcomes were long term (5 years) (Zucchelli & De Sanctis 2005) well maintained in patients regularly attending a recall programme.

Very few data are available regarding the effectiveness of SCTG in the treatment of multiple recessions (Zabalegui et al. 1999, Carvalho et al. 2006, Chambrone & Chambrone 2006) and only one long-term controlled study has been performed (Pini-Prato et al. 2010). In this study, at 6 months, no statistically significant difference between CAF + CTG and CAF alone was reported in terms of recession reduction and CRC. Conversely CAF + CTG achieved better outcomes in terms of CRC 1 and 5 years after the surgery. The aim of this study was to compare short- (6 months, 1 year) and long-term (5 years) root coverage and aesthetic outcomes of the CAF alone or in combination with a CTG for the treatment of multiple Miller I and II gingival recessions in patients undergoing to a very strict supporting care programme.

Material and Methods

Fifty subjects, 29 females and 21 males, with aesthetic complaints were enrolled in the study. The patients were selected, on a consecutive basis, among individuals referred to dental clinic Bologna University, in the period comprised between January 2004 and January 2006. The study protocol, questionnaires and informed consent in full accordance with the ethical principles of the Declaration of Helsinki of 1975, as revisited in 2000, was approved by the Institutional Review Board and received the approval by the local ethic committee.

All participants met the study inclusion criteria:

- Age > 18 years;
- Periodontally and systemically healthy;
- FMPS (Full-mouth Plaque Score) < 15% (Fini-Papone et al. 2010);
- Multiple (≥2) Miller (1985) Class I and II recession defects (≥2 mm in depth) on adjacent teeth of the same quadrant of the upper jaw;
- Presence of identifiable CEJ (critical attachment level) on adjacent teeth of the same quadrant of the upper jaw;
- Presence of at least 1-mm high keratinized tissue apical to the root exposure.

Study design

The study was a double-blinded, randomized controlled clinical trial (RCT), with parallel design, comparing the CAF (Zucchelli & De Sanctis 2000) with (test group) and without (control group) CTG for the treatment of multiple recession defects. According to the protocol of the study, five phases were followed:

- initial screening;
- initial therapy and clinical measurements;
- surgical therapy;
- strict maintenance phase;
- re-evaluation visit 6 months, 1 year and 5 years after the surgery.

Aesthetic evaluations made by the patients and by an independent periodontist were performed at 1 and 5 years.

Sample size

The study was powered to detect a minimum clinically significant difference in root coverage of 1 mm using \( \alpha = 0.05 \), a power = 90%, a hypothesized within-group sigma of 0.9 mm, obtained from previous studies (Aichelmann-Reidy et al. 2001, McGuire & Nunn 2003, da Silva et al. 2004, Pilloni et al. 2006, Zucchelli et al. 2009). As a minimum, 23 patients per treatment arm would have been needed.

Investigator training

All participating investigators were required to attend two training and calibration meetings. Aims of the meetings were to review the objectives of the study and the protocol, standardize the case selection, the measurement techniques and the surgical procedures.

Randomization

Patients were assigned to one of the two treatment groups with the use of computer-generated randomization table. Each patient participated in the study with multiple recession defects affecting adjacent teeth of one quadrant of the upper jaw. Allocation concealment was obtained using sealed coded opaque envelope containing the treatment to the specific subject. The sealed envelope containing treatment assignment was opened at time of the surgery immediately after treatment of the root surfaces.

Initial therapy and clinical measurements

Following the screening examination, all subjects received a session of prophylaxis including instructions in proper oral hygiene measures, 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. Surgical treatment of the recession defects was not scheduled until the patient could demonstrate an adequate standard of supragingival plaque control.

All measurements were carried out by a single masked examiner (MM) at baseline, 6 months, 1 and 5 years after the surgeries. MM did not perform the surgeries and was unaware of the treatment assignment. Measurement of recession depth (RD), as the distance between the CEJ and gingival margin, was repeated three times by the examiner for a total of 50 defects with a coefficient of 0.86. Full-mouth (FMPS) and local plaque and bleeding (FMBS) scores were
recorded as the percentage of total surfaces (four per tooth), which revealed the presence of plaque (O’Leary et al. 1972) and bleeding respectively.

The following clinical measurements were taken 1 week before the surgery and at the 6 months, 1 and 5 years follow-up visits at the mid-buccal aspect of the treated teeth:

- gingival RD
- probing depth (PD)
- clinical attachment level (CAL)
- keratinized tissue height (KTH)

All measurements were performed by means of the manual probe and were rounded up to the nearest millimetre (Zucchelli et al. 2009).

**Patient evaluation of post-operative morbidity and aesthetics**

A questionnaire was given to each patient; it included dichotomous questions and the evaluation of the intensity of the given event on a visual analogic scale (VAS) of 100 mm (Cortellini et al. 2009).

The questionnaire was divided in two parts to be completed in different time periods:

- the first part, regarding the post-operative morbidity was completed 1 week after the surgery;
- the second part, concerning patient satisfaction with aesthetic was completed at the 1 and 5 years follow-up visits.

Post-operative course (in terms of pain/discomfort) was evaluated 1 week following surgery based on VAS scale (Zucchelli et al. 2010). In the CAF + CTG treated subjects, in the case of post-operative discomfort patients also had to specify if it was dependent on the palatal or buccal wound healing. Patient’s aesthetic satisfaction was evaluated at 1 and 5 years follow-up visits based on a VAS.

**Objective evaluation of aesthetics**

Objective evaluation of colour match, contour and degree of keloid formation (Zucchelli et al. 2009, 2012) was scored at 1 and 5 years post-surgical evaluation visit by an expert periodontist (C.M.) on a VAS. He was independent of the clinical examiner and did not perform the surgeries. Keloid was scored dichotomously.

**Treatment of the root surfaces**

Mechanical and chemical (EDTA) (Del Pizzo et al. 2005) treatments of root surfaces were performed prior to starting the surgery.

**Surgical techniques**

All surgeries were performed by the same expert periodontist (GZ).

**Control group**

The surgical technique adopted in the test recession defects was the envelope type of CAF proposed by Zucchelli & De Sanctis (2000).

**Test group**

The same surgical approach was used in the test group with the only difference that a CTG was added. The CTG derived from the disepithelialization with the blade of a palatal free gingival graft (Zucchelli et al. 2010); graft thickness did not exceed 1 mm. Surgical chair time was measured with a chronometer.

**Post-surgical instructions and infection control**

Post-operative pain and oedema were controlled with Ibuprofen® (Brufen, Ibuprofen, Abbott S.r.l., Latina, Italy). Patients were instructed not to brush their teeth in the treated area but to rinse with chlorhexidine solution (0.12%) three times a day for 1 min. Fourteen days after the surgical treatment, the sutures were removed. Plaque control in the surgically treated area was maintained by chlorhexidine rinsing for additional 2 weeks. Patients were again instructed in mechanical tooth cleaning of the treated tooth. All patients were re-called for prophylaxis and reinforcement of motivation and instruction for a traumatic tooth brushing technique 2 and 4 weeks after suture removal, once a month for the following 3 months and subsequently every 3 months until the final examination (5 years).

**Data analysis**

Descriptive statistics were expressed as mean (95% confidence intervals). CRC was evaluated after 1 and 5 years by calculating the percentage of cases, in each treatment group, with the gingival margin at the level or coronal to the CEJ.

One-way ANOVA was used to evaluate differences between test and control group regarding: mean age, mean baseline values of RD, CAL, KTH and PD, mean number of teeth treated per patient, mean surgical chair-time, post-operative morbidity, patient satisfaction and independent periodontist evaluation of colour match and contour.

Chi-square analysis was used to compare test and control groups concerning keloid formation at 1 year and at 5 years, to evaluate the relationship between graft exposure and the number of treated teeth per patient and between keloid formation and graft exposure in the CAF + CTG group.

Linear regression models were fitted to evaluate the existence of any significant difference regarding, RD, CAL, PD, KTH, between techniques (CAF versus CAF+CTG), times (baseline, 6 months, 1 year and 5 years where applicable) and the interaction between techniques and time whereas, with the same purpose, a logistic regression model was used for the outcome CRC.

To take into account the correlation in the data due to the presence of multiple treated gingival recessions per subject, the above-mentioned regression models were estimated following a generalized estimating equation (GEE) approach. We adjusted the estimates of coefficients’ standard errors and confidence intervals by using a robust variance–covariance estimator (Rogers 1993).

A multiple regression ANOVA for repeated measures with split plot design was used to evaluate between techniques and times differences and interactions with regard to patient satisfaction, periodontist colour match and contour. All statistical analyses were performed using Stata 12.1 (StataCorp, College Station, TX, USA).

**Results**

The search results are presented in Figure 1. Following the initial oral hygiene phase as well as the
Post-treatment examinations, all subjects showed low frequencies of plaque harbouring tooth surfaces (FMPS 15%) and bleeding gingival units (FMBS 15%), indicating good standard of supragingival plaque control during the study period. Details of patient and surgical chair time are presented in Table 1. Healing was uneventful for all treated cases.

In the CAF + CTG group, shrinkage of the covering flap with graft exposure was noticed in two patients at 6 months, six patients at 1 year and nine patients at 5 years. Bleeding from the palatal wound was reported in one patient for 2 days after surgery. A comparison between baseline, 1- and 5-year clinical outcome of patients treated by means of the CAF and CAF + CTG is shown in Figs 2 and 3 respectively. The descriptive statistics for the clinical parameters measured at baseline, 1 and 5 years after surgery for both groups are shown in Table 2. At baseline, there were no statistically significant differences between the two groups for any of the considered clinical parameters.

Clinical outcome (6 months, 1 year and 5 years)

Statistical significance was evaluated using GEE with the robust covariance estimator to account for the correlation in the data. Tooth was used as the unit of analysis.

RD: Significant ($p < 0.01$) decreases were observed both in the control and in the test group at 6 months, 1 year and 5 years compared to the baseline measurements. A significant between-groups ($p < 0.01$) difference was found at 5 years with a higher RD reduction in the test group compared to the control (Table 3).

CRC: In the control group among the 73 treated defects, CRC was achieved in 68 (at 6 months), 65 (at 1 year) and 57 (at 5 years) gingival defects. The difference was statistically significant between 5 years and 6 months ($p < 0.01$) and between 5 years and 1 year ($p < 0.05$), whereas no significant difference was found between 1 year and 6 months.

In the test group among the 76 treated defects, CRC was achieved in 68 (at 6 months), 66 (at 1 year) and 69 (at 5 years) gingival defects; the differences were not statistically significant.

A significant between-groups differences were observed at 5 years with an effect of treatment in terms

### Table 1. Baseline patient-related characteristics and surgical chair time

<table>
<thead>
<tr>
<th></th>
<th>Control group (CAF 73 teeth)</th>
<th>Test group (CAF + CTG 76 teeth)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient</td>
<td>25 (10 males and 15 females)</td>
<td>25 (11 males and 14 females)</td>
</tr>
<tr>
<td>Age (range)</td>
<td>34.2 ± 6.2 years (22–44)</td>
<td>33.2 ± 7.4 years (22–46)</td>
</tr>
<tr>
<td>Number treated teeth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>per patient</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>2.92 ± 0.9</td>
<td>3.04 ± 0.7</td>
</tr>
<tr>
<td>Range</td>
<td>2–5</td>
<td>2–5</td>
</tr>
<tr>
<td>Type of teeth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incisor</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>Canine</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Premolar</td>
<td>32</td>
<td>36</td>
</tr>
<tr>
<td>Surgical chair time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(min.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>29.8 ± 3.2</td>
<td>40.2 ± 6.8*</td>
</tr>
<tr>
<td>Range</td>
<td>25–35</td>
<td>36–45</td>
</tr>
</tbody>
</table>

*Between-groups statistically significant difference.
CAF, coronally advanced flap; CTG, connective tissue graft.
of odds ratio equals to 3.22 (the probability of CRC in the test group was more than three times that in the control one) (Table 4).

**PD:** Significant \((p < 0.02)\) decrease was found in the control group at 1 year compared to the baseline measurement, whereas no significant differences were found in the test group. No between-group differences were found neither any interaction with time.

**CAL:** Significant \((p < 0.01)\) decrease was found in both groups at 1 year and 5 years compared to the baseline measurements. Significant \((p < 0.01)\) between-groups differences were found at each time with higher values in the test group with respect to the control group.

### Post-operative morbidity and aesthetic evaluations

The postoperative VAS values are reported in Table 5. Multiple regression ANOVA for repeated measures with split plot design was used to evaluate differences between techniques and times and interactions using patients as the unit of analysis. The post-operative course-related VAS scores were high for both procedures indicating limited post-operative pain/discomfort for both patient groups. However, a statistically significant better post-operative course \((p < 0.01)\) was reported by the CAF group.

The 1-year patient aesthetic assessment was high in both groups with no statistically significant differences between them as well as the 5-year evaluation.

#### Colour match

Statistically significant better 1-year \((p < 0.01)\) and 5-year \((p < 0.01)\) colour match scores were demonstrated for the CAF-treated patients. No statistically significant differences were demonstrated between 1- and 5-year colour match evaluations in both patient groups.

#### Contour

The 1-year contour assessment was high in both groups with no statistically significant differences between control and group test. However, statistically significant \((p < 0.01)\) better 5-year contour scores were demonstrated for the CAF + CTG group. A statistically significant difference was demonstrated between 1- and 5-year contour evaluations in CAF-treated subjects \((p < 0.01)\) while no statistically significant differences were demonstrated between 1- and 5-year contour evaluations in CAF + CTG group.

Statistically greater keloid formation was found in the test group both at 1 year \((p < 0.05)\) and 5 years \((p < 0.01)\). A significant difference \((p < 0.01)\) was found in the test group concerning keloid evaluation.
Table 3. Linear regression results for RD using GEE with the robust covariance estimator to account for the correlation in the data. Tooth was used as the unit of analysis

<table>
<thead>
<tr>
<th></th>
<th>b (Robust SE)</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>3.055 (0.458)</td>
<td>(2.939 to 3.171)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (ref.)</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Test</td>
<td>0.103 (0.092)</td>
<td>(−0.082 to 0.288)</td>
<td>0.268</td>
</tr>
<tr>
<td>Times</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At surgery (ref.)</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>At 6 months</td>
<td>−2.986 (0.057)</td>
<td>(−3.101 to −2.871)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>At 1 year</td>
<td>−2.945 (0.055)</td>
<td>(−3.056 to −2.834)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>At 5 years</td>
<td>−2.753 (0.072)</td>
<td>(−2.899 to −2.608)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Group × Times</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test × T at 6 months</td>
<td>−0.066 (0.089)</td>
<td>(−0.244 to 0.112)</td>
<td>0.458</td>
</tr>
<tr>
<td>Test × T at 1 year</td>
<td>−0.081 (0.092)</td>
<td>(−0.265 to 0.103)</td>
<td>0.380</td>
</tr>
<tr>
<td>Test × T at 5 years</td>
<td>−0.312 (0.094)</td>
<td>(−0.502 to −0.123)</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Group × Times = interactions between group and the different evaluation times. b, regression coefficient estimate; 95% CI, 95% confidence intervals; GEE, generalized estimating equation; Robust SE, Robust standard error; Ref., reference category; RD, recession depth.

Table 4. Logistic regression results for CRC using GEE with the robust covariance estimator to account for the correlation in the data. Tooth was used as the unit of analysis

<table>
<thead>
<tr>
<th></th>
<th>b (Robust SE)</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>2.610 (0.436)</td>
<td>(1.756 to 3.464)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (ref.)</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Test</td>
<td>−0.470 (0.581)</td>
<td>(−1.610 to 0.670)</td>
<td>0.419</td>
</tr>
<tr>
<td>Times</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At 6 months (ref.)</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>At 1 year</td>
<td>−0.515 (0.298)</td>
<td>(−1.099 to 0.069)</td>
<td>0.084</td>
</tr>
<tr>
<td>At 5 years</td>
<td>−1.493 (0.348)</td>
<td>(−2.175 to −0.811)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Group × Times</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test × T at 1 year</td>
<td>0.262 (0.349)</td>
<td>(−0.422 to 0.947)</td>
<td>0.453</td>
</tr>
<tr>
<td>Test × T at 5 years</td>
<td>1.641 (0.568)</td>
<td>(0.527 to 2.755)</td>
<td>0.004</td>
</tr>
</tbody>
</table>

Group × Times = interactions between group and the different evaluation times. b, regression coefficient estimate; 95% CI, 95% confidence intervals; CRC, complete root coverage; GEE, generalized estimating equation; Robust SE, Robust standard error; Ref., reference category.

Table 5. Independent periodontist evaluation of aesthetic outcomes: mean values (95% confident intervals). Results from ANOVA for repeated measures with split plot design using patients as the unit of analysis

<table>
<thead>
<tr>
<th></th>
<th>Control group (CAF)</th>
<th>Test group (CAF + CTG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient evaluation VAS</td>
<td>86.4 (81.1–91.7)</td>
<td>76.4 (71.5–81.3)*</td>
</tr>
<tr>
<td>Pain (1 week)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aesthetics</td>
<td>88.4 (83.6–93.1)</td>
<td>84.4 (79.6–89.1)</td>
</tr>
<tr>
<td>1 year</td>
<td>82.8 (78.6–87.0)</td>
<td>81.6 (76.4–86.7)</td>
</tr>
<tr>
<td>5 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Periodontist evaluation</td>
<td>90.8 (86.5–96.0)</td>
<td>78.4 (72.2–84.5)*</td>
</tr>
<tr>
<td>VAS (0 = very bad, 50 = average, 100 = excellent)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour match</td>
<td>85.2 (81.6–88.8)</td>
<td>73.6 (67.3–79.9)*</td>
</tr>
<tr>
<td>1 year</td>
<td>87.6 (82.9–92.2)</td>
<td>89.6 (85.2–93.9)</td>
</tr>
<tr>
<td>Contour</td>
<td>76.6 (70.1–83.4)*</td>
<td>87.2 (82.8–91.5)*</td>
</tr>
<tr>
<td>5 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Periodontist evaluation</td>
<td>94%</td>
<td>94%</td>
</tr>
<tr>
<td>– keloids</td>
<td>1 year</td>
<td>5 years</td>
</tr>
<tr>
<td>Keloids</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Between-groups statistically significant difference.
†Time-related within-group statistically significant difference.
CAF, coronally advanced flap; CTG, connective tissue graft; VAS, visual analogic scale.

Discussion

The purpose of the present RCT was to compare short- (6 months and 1 year) and long-term (5 years) clinical and aesthetic outcomes of the CAF with and without CTG in the treatment of multiple gingival recessions. The study was conducted on a carefully selected population of Miller Class I and II multiple gingival recessions presenting keratinized tissue apical to the root exposure, treated by a skilled periodontist with well-standardized surgical procedures and in patients with high standard of oral hygiene and undergoing to a very strict regimen of post-surgical control visits. Results obtained from this study indicated that both techniques were effective in reducing RD at 6 months and 1 year with no statistically significant difference between them. Furthermore, the results of fitting a logistic regression model showed no significant between-groups difference at 6 months and 1 year in terms of CRC. A lack of statistical significance between groups in a trial designed to demonstrate superiority does not mean that the two treatment techniques are equivalent (Gunsolley et al. 1998). In this study, a lack of significant RD reduction and CRC between the two groups might be due to the limited sample size. This rate of successful outcome of the treatment was similar to that reported in the literature in a case-series study (Zucchelli & De Sanctis 2000) where the same surgical technique was used. Conversely present root coverage results were higher than the short-term (6 months and 1 year) outcomes reported in the only controlled study (Pini-Prato et al. 2010) comparing CAF with or without CTG in the treatment of multiple gingival recessions. Reasons for the differences can only be speculated on. Possible explanations can
be found in the different number of operator (two versus one) or study design (split mouth versus parallel) or in the strict entry criteria of this study. The present data demonstrated that successful outcomes achieved with both surgical approaches can be long term maintained. However, 5 years after surgery a higher recession reduction was demonstrated in the test groups. Furthermore, in terms of CRC, a significant between-groups difference, with a 3.22 times greater probability to achieve CRC with CAF + CTG was demonstrated. When comparing the number of cases with CRC at different time periods, the only statistically significant change was the reduction between 1 and 5 years in patients treated with CAF alone. This tendency was also reported in the Pini Prato study (Pini-Prato et al. 2010) where an apical relapse of the gingival margin in CRC-treated sites between the 6-month and 5-year follow-ups was observed. This negative trend following CAF was attributed with less thickness/amount of keratinized tissue achieved. It is interesting to note that in this study the apical relapse of the gingival margin was observed only in eight of 25 CAF-treated patients with the majority (68%) of patients maintaining the successful outcomes achieved at 6 months for the following 5 years. The present successful overall long-term root coverage results achieved with CAF alone could be at least in part ascribed to the very strict regimen of post-surgical control visits. It is not uncommon, in fact, for patients to follow the clinician’s and hygienist’s instructions correctly for the first year and then gradually lose motivation (Leknes et al. 2005, Pini-Prato et al. 2012). Long-term marginal soft tissue relapse after CAF, occurring in some patients only, could be ascribed to the decrease in patient motivation, despite the strict control regimen, rather than true limitations associated with the surgical technique. It can be speculated that the adjunct of CTG, by providing greater soft tissue thickness/KTH, not really improve the surgical outcomes compared to CAF alone, but facilitates long-term patient maintenance.

The clinical outcomes of this study were partially confirmed by the objective aesthetic evaluation. Contour evaluation respected faithfully the root coverage outcomes with no difference between groups in short-term (1 year) scores and better long-term (5 years) results for the CAF + CTG. Conversely, the colour match assessment demonstrated better scores for the CAF both at 1 and 5 years. This discrepancy between root coverage outcomes and colour match evaluation could be ascribed to the greater keloid formation in the CTG-treated sites (Zucchelli et al. 2003, Cairo et al. 2010). In this study, keloid formation was mainly associated with graft exposure. It is interesting to note that a statistically significant correlation was found between the number of gingival recession treated with the CTG and graft exposure both at 1 and 5 years. It could be speculated that large grafts can impair the vascular exchange between the covering flap and the underlying receiving bed and, thus, increase the risk for flap dehiscence and unesthetic graft exposure. This study data showed that patient satisfaction regarding aesthetics was very high for both treatment groups with no difference between them both at 1 and 5 years. It can be speculated that the overall root coverage outcomes achieved in the present patient population was so successful that the recurrence of a shallow gingival recession or the keloid formation was not critical enough to negatively influence the mean patients aesthetic scores although remarkable by an expert in the field of periodontology.

**Conclusions**

Within the limit of this study, the following conclusions can be drawn:

- The CAF with or without CTG were effective in terms of RD reduction and CRC of multiple gingival recession defects until the 1-year examination visit, with no statistically significant difference between them.
- The CAF + CTG was associated with an increased recession reduction and probability of obtaining CRC at 5 years.
- Better results in terms of post-operative course and colour match evaluation made by an expert periodontist were recorded in patients treated with CAF. Conversely, better 5-year contour assessments were reported for the CAF + CTG treated subjects.

**References**


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**Clinical Relevance**

**Scientific rationale for the study:** Very few comparative studies on the treatment of multiple gingival recessions are currently available.

**Principal findings:** This randomized comparative clinical study indicated that multiple gingival recessions can be successfully covered with the envelope type of CAF with or without CTG. CAF alone was associated with more comfortable post-operative course and less keloid formation. The adjunct of CTG provided better long-term CRC.

**Practical implications:** In the treatment of multiple gingival recession the use of CAF should be suggested because of the limited post-operative discomfort and the favourable improvements in periodontal parameters, while the adjunct of CTG should be done site specifically when the aesthetic and/or dentine hypersensitivity patient requests impose to more predictably achieve CRC.