Background: Various surgical techniques have been proposed for treating gingival recession. This randomized clinical trial compared the coronally positioned flap (CPF) alone or in conjunction with a subepithelial connective tissue graft (SCTG) in the treatment of gingival recession.

Methods: Eleven non-smoking subjects with bilateral and comparable Miller Class I recession defects were selected. The defects, at least 3.0 mm deep, were randomly assigned to the test (CPF + SCTG) or control group (CPF alone). Recession depth (RD), probing depth (PD), clinical attachment level (CAL), width of keratinized tissue (KT), and gingival/mucosal thickness (GT) were assessed at baseline and 6 months postoperatively.

Results: Recession depth was significantly reduced 6 months postoperatively ($P < 0.05$) for both groups. Mean root coverage was 75% and 69% in the test and control groups, respectively. There were no significant differences between the two groups in RD, PD, or CAL, either at baseline or at 6 months postoperatively. However, at 6 months postoperatively, the test group showed a statistically significant increase in KT and GT compared to the control group ($P < 0.05$).

Conclusions: The results indicate that both surgical approaches are effective in addressing root coverage. However, when an increase in gingival dimensions (keratinized tissue width, gingival/mucosal thickness) is a desired outcome, then the combined technique (CPF + SCTG) should be used. J Periodontol 2004;75: 413-419.

KEY WORDS
Gingival recession/surgery; gingival recession/therapy; grafts, connective tissue; surgical flaps; tooth root.

Periodontal plastic surgery is defined as surgical procedures performed to prevent, correct, or eliminate anatomic, developmental, or traumatic deformities of the gingiva or alveolar mucosa. One of the most common indications for periodontal plastic surgery is the treatment of gingival recession, i.e., the apical shift of the gingival margin in relation to the cemento-enamel junction (CEJ).

Several surgical approaches have been used to achieve root coverage. The coronally positioned flap (CPF) and the subepithelial connective tissue graft (SCTG) with several variants are among the most widely used techniques. Although many comparisons have been made using different surgical approaches, the literature lacks studies directly comparing the CPF and SCTG techniques.

The objective of this randomized clinical trial was to compare the outcome of gingival recession therapy using CPF alone or in conjunction with SCTG in a split-mouth design.

MATERIALS AND METHODS
Patient Selection and Experimental Design
Eleven subjects, 6 males and 5 females, aged 18 to 43 years, were recruited. Table 1 includes demographic details. Power analysis indicated that with 11 subjects, the study would have greater than 85% power to detect a 1 mm difference in recession depth between the two groups. All participants met the study inclusion criteria: bilateral Miller’s Class I recession.
defects (≥3 mm in depth) involving maxillary canine or premolar teeth (recession depth difference between left and right defect ≤2 mm); presence of identifiable CEJ; periodontally and systemically healthy; no occlusal interferences; no contraindications for periodontal surgery; and not taking medications known to interfere with periodontal tissue health or healing. Recession defects associated with caries or restorations, as well as teeth with evidence of pulpal pathology, were excluded.

The subjects were selected from patients referred for regular dental treatment at the School of Dentistry at Piracicaba, University of Campinas, Brazil. Informed consent was signed by each of the subjects after thorough explanation of the nature, risks, and benefits of the clinical investigation and associated procedures. The University’s Ethical Committee approved the consent form and experimental protocol.

The study protocol involved a screening appointment to verify eligibility, followed by initial therapy to establish optimal plaque control and gingival health conditions; surgical therapy; and postoperative evaluation 6 months later. Gingival bleeding index (GBI) and visible plaque index (VPI) were used to assess gingival health conditions throughout the study.

Randomization
At the start of the surgical appointment, bilateral defects were randomly assigned by coin toss to the test group (CPF + SCTG) and control group (CPF) (Table 1).

Clinical Parameters
The following clinical parameters were assessed by a trained and calibrated examiner at baseline and 6 months after surgery on the midbuccal aspect of the study teeth: recession depth (RD), measured as the distance from the CEJ to the gingival margin (GM); probing depth (PD), measured as the distance from the GM to the bottom of the gingival sulcus; clinical attachment level (CAL), measured as the distance from the CEJ to the bottom of the sulcus; apico-coronal width of keratinized tissue (KT), measured as the distance from the mucogingival junction (MGJ) to the GM, with the MGJ location determined using a visual method; and thickness of gingival/mucosal tissue (GT). GT was assessed at two different positions: GT1: at the middle of the apico-coronal width of the KT, and GT2: 2 mm apical to the MGJ. One endodontic finger spreader attached to a rubber stopper was perpendicularly inserted in the gingival tissue, and the thickness reading was determined with a caliper to the nearest 0.1 mm.

An automated system was used to assess RD, PD, CAL, and KT to the nearest 0.2 mm. A custom stent was used for probe positioning.

The percentage of root coverage was calculated after 6 months according to the following formula:

\[
\frac{(\text{Preoperative RD}) - (\text{Postoperative RD})}{(\text{Preoperative RD})} \times 100
\]

Initial Therapy
Initial periodontal therapy consisted of oral hygiene instructions, ultrasonic instrumentation, and coronal polishing 1 to 2 months prior to surgery. Restorative treatment needs in non-study teeth were also addressed. Immediately prior to baseline, alginate impressions of the maxillae were obtained and casts were made. Casts were used for fabrication of custom acrylic stents. Stents were used during clinical parameter assessment to assure reproducibility of probe position and angulation between appointments, and not as a reference point for the clinical measurements.

Surgical Procedures
For analgesia and postoperative edema control, each patient was given a single dose of 4 mg betamethasone and 750 mg acetaminophen 1 hour prior to surgery. Anxious patients were also given 5 mg diazepam.

Extraoral antisepsis was performed with a 2.0% chlorhexidine solution and intraoral with 0.12% chlorhexidine.

Table 1.
Demographic Data and Defect Allocation

<table>
<thead>
<tr>
<th>Patient</th>
<th>Gender</th>
<th>Age (years)</th>
<th>Tooth Number</th>
<th>CPF</th>
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<td>1</td>
<td>F</td>
<td>18</td>
<td>11</td>
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<tr>
<td>2</td>
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<td>5</td>
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<tr>
<td>3</td>
<td>M</td>
<td>33</td>
<td>6</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>32</td>
<td>12</td>
<td>5</td>
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<td>5</td>
<td>M</td>
<td>23</td>
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<td>6</td>
<td>M</td>
<td>27</td>
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<tr>
<td>Mean</td>
<td></td>
<td>29.2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Figures 1 through 4.
Control group (CPF). Figure 1: Recession defect. Figure 2: Split-thickness trapezoidal flap. Figure 3: CPF. Figure 4: Defect, 6 months post-surgery.

Anesthesia was achieved with lidocaine 2.0% with 1:100,000 epinephrine. Root surfaces were thoroughly instrumented with manual scalers to achieve a flattened surface. For control sites (Figs. 1 through 4), the flap design started with an intrasulcular incision at the vestibular aspect of the involved teeth and extended horizontally to the center of the interdental gingiva, at the CEJ level, mesial and distal to the defects. Two oblique, apically divergent relaxing incisions, extending beyond the MGJ, completed the flap design. The trapezoidal split-thickness flap was elevated with sharp dissection, and extended as far as necessary to allow for flap advancement to the CEJ without tension. The vestibular epithelium of the interdental papillae was removed to provide a proper wound bed for healing (Fig. 2). Finally, the flap was positioned at the level of or slightly coronal to the CEJ and fixed with mattress sutures, while interrupted sutures were placed at the vertical incisions (Fig. 3). Abundant saline irrigation was performed during the procedures.

For test sites (Figs. 5 through 8), the procedure was identical to the one just described, except for the addition of a CT graft (Fig. 6). A CT graft in the proper dimensions was harvested from the palate (premolar area) using the trap door approach and trimmed as necessary to remove visible epithelium. Graft dimensions were determined by the distance between the vertical incisions, and by the distance from the CEJ to 4.0 mm apical to the buccal bone crest. Graft thickness was measured just after harvesting using a needle attached to an endodontic rubber stopper and a caliper to the nearest 0.1 mm. Average graft thickness was 1.3 mm (data not shown).

The CT graft was placed at the CEJ level in a vertical orientation covering the entire defect and adjacent recipient bed. An "x"-shaped sling bioabsorbable suture was used to hold the graft in place, anchoring...
the periosteum apical to the graft, and tied on the palatal aspect of the tooth (Fig. 6). However, the suture did not penetrate the graft. The flap was positioned at the level of or slightly coronal to the CEJ and fixed with mattress sutures, while interrupted sutures§§ were placed at the vertical incisions (Fig. 7).

Both surgical procedures were performed at the same appointment. No periodontal dressing was used.

**Postoperative Protocol**

Subjects were prescribed analgesics (acetaminophen§ 750 mg q.i.d.) for 2 days and twice daily 0.12% chlorhexidine rinse†† for 4 weeks. Subjects were instructed to abstain from brushing and flossing the maxillary teeth until suture removal (14 days), and to consume only soft foods during the first week. They were also instructed to avoid any other mechanical trauma to the treated sites.

Subjects were enrolled in a periodontal maintenance program (professional plaque control), weekly for the first 4 weeks and then monthly until the end of the study period.

**Statistical Analysis**

Descriptive statistics were expressed as mean ± standard deviation (SD). Data were analyzed using Student t test for paired observations to assess changes obtained within and between groups. The significance level for rejection of the null hypothesis was set at alpha = 0.05.

**RESULTS**

All patients tolerated the surgical procedures well, experienced no postoperative complications, and complied with the study protocol. Full-mouth GBI and VPI were kept below 20%. The study teeth were free of plaque and gingival inflammation prior to surgery, during, and at the end of the study.

The descriptive statistics for the clinical parameters at baseline and after 6 months, for both groups, as well
as the mean differences within and between groups, are presented in Table 2.

At baseline, no statistically significant differences were found between the two groups for any of the parameters evaluated.

In the control (CPF) group, statistically significant changes from baseline were found for RD, PD, and CAL. RD decreased by 2.73 ± 0.99 mm (mean ± SD), which represents average root coverage of 68.8%. Complete root coverage was achieved in only one of 11 defects. PD increased by 0.55 ± 0.91*, while CAL decreased by 0.28 ± 0.37*. In the test (CPF + SCTG) group, statistically significant changes from baseline were found for all parameters. RD decreased by 3.16 ± 0.86 mm (mean ± SD), which represents average root coverage of 75.3%. Complete root coverage was achieved in two of 11 defects. PD increased by 0.42 ± 0.43 mm, while CAL decreased by 2.30 ± 1.05 mm.

In the test (CPF + SCTG) group, statistically significant changes from baseline were found for all parameters. RD decreased by 2.73 ± 0.99* mm, GT1 increased from 1.34 ± 0.28 mm to 1.78 ± 0.29 mm, and GT2 increased from 1.15 ± 0.28 mm to 1.96 ± 0.37 mm.

In the intergroup comparison at 6 months, statistically significant differences were found between the control and test groups only for KT, GT1, and GT2 (Table 2).

**DISCUSSION**

The objective of this split-mouth, randomized, controlled clinical trial was to compare the coronally positioned flap alone (CPF) or in combination with a subepithelial connective tissue graft (CPF + SCTG) in terms of recession resolution. Considering the study design and the groups’ homogeneity at baseline, differences in clinical outcomes can be attributed to the treatments employed.

In the present study, both groups experienced improved clinical outcomes in terms of root coverage and gain in CAL, with no statistically significant difference between groups (Figs. 4 and 8). There was a statistically significant increase in PD for both groups, but this was not considered clinically significant, since PD did not exceed 3 mm at any site and there was no bleeding on probing or other signs of inflammation.

However, the results for KT, GT1, and GT2 demonstrated significant differences between the groups. In the test group (CPF + SCTG), there was a statistically significant increase in KT, GT1, and GT2, while in the control group (CPF), there were non-significant changes in KT (decrease) and GT (increase). Whether and to what extent the lack of examiner blinding may have biased these results have not been ascertained.

The percent root coverage results obtained in the present study, 69% for CPF and 75% for CPF + SCTG, fall within the ranges of other studies reported in two review articles. In reports of studies of at least 6 months’ duration with a minimum of 10 patients per group, the range of defect resolution in sites treated with CPF was 55% to 98% (mean 77%), while for CPF + SCTG-treated sites, the range was 52% to 99% (mean 82%). Our present results appear to fall short when complete root coverage is considered (one and two of 11 defects for CPF and CPF + SCTG, respectively). In the aforementioned review, complete root coverage was achieved an average of 45% of the time (range: 9% to 84%) for CPF-treated sites, and 56% of the time (range: 50% to 88%) for CPF + SCTG-treated sites. The variance can be accounted for by differences in defect severity, surgical protocol, and other factors.

The CPF design used in this study was the design described by Allen and Miller, who treated 31 Class I defects in 28 sub-

<table>
<thead>
<tr>
<th>Parameter</th>
<th>CPF</th>
<th>CPF+SCTG</th>
<th>Difference (CPF+SCTG - CPF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>3.98 ± 0.62</td>
<td>4.20 ± 0.78</td>
<td>0.22 ± 0.82</td>
</tr>
<tr>
<td>6 months</td>
<td>1.25 ± 0.70</td>
<td>1.04 ± 0.67</td>
<td>−0.22 ± 0.85</td>
</tr>
<tr>
<td>Difference</td>
<td>2.73 ± 0.99*</td>
<td>3.16 ± 0.86*</td>
<td>0.44 ± 0.89</td>
</tr>
<tr>
<td>PD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>1.47 ± 0.45</td>
<td>1.49 ± 0.35</td>
<td>0.02 ± 0.48</td>
</tr>
<tr>
<td>6 months</td>
<td>1.89 ± 0.45</td>
<td>2.04 ± 0.51</td>
<td>0.14 ± 0.54</td>
</tr>
<tr>
<td>Difference</td>
<td>−0.42 ± 0.43*</td>
<td>−0.55 ± 0.54*</td>
<td>−0.13 ± 0.72</td>
</tr>
<tr>
<td>CAL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>5.45 ± 0.76</td>
<td>5.60 ± 0.95</td>
<td>0.14 ± 0.92</td>
</tr>
<tr>
<td>6 months</td>
<td>3.15 ± 0.99</td>
<td>3.07 ± 0.96</td>
<td>−0.08 ± 1.00</td>
</tr>
<tr>
<td>Difference</td>
<td>2.30 ± 1.05*</td>
<td>2.53 ± 1.14*</td>
<td>0.32 ± 1.25</td>
</tr>
<tr>
<td>KT</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Baseline</td>
<td>3.38 ± 1.53</td>
<td>2.79 ± 0.93</td>
<td>−0.59 ± 1.37</td>
</tr>
<tr>
<td>6 months</td>
<td>3.17 ± 1.23</td>
<td>3.35 ± 0.71</td>
<td>0.17 ± 0.77</td>
</tr>
<tr>
<td>Difference</td>
<td>0.21 ± 0.63</td>
<td>−0.55 ± 0.91*</td>
<td>−0.76 ± 0.96†</td>
</tr>
<tr>
<td>GT1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>1.27 ± 0.29</td>
<td>1.34 ± 0.28</td>
<td>0.07 ± 0.31</td>
</tr>
<tr>
<td>6 months</td>
<td>1.28 ± 0.22</td>
<td>1.78 ± 0.29</td>
<td>0.50 ± 0.23</td>
</tr>
<tr>
<td>Difference</td>
<td>−0.01 ± 0.32</td>
<td>−0.44 ± 0.37*</td>
<td>−0.43 ± 0.38†</td>
</tr>
<tr>
<td>GT2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>1.08 ± 0.27</td>
<td>1.15 ± 0.28</td>
<td>0.07 ± 0.29</td>
</tr>
<tr>
<td>6 months</td>
<td>1.30 ± 0.34</td>
<td>1.96 ± 0.37</td>
<td>0.66 ± 0.37</td>
</tr>
<tr>
<td>Difference</td>
<td>−0.22 ± 0.49</td>
<td>−0.81 ± 0.42*</td>
<td>−0.59 ± 0.44†</td>
</tr>
</tbody>
</table>

* Within-groups comparison (P<0.05).
† Between-groups comparison (P<0.05). All other within- and between-groups comparisons were non-significant (P>0.05).
jects. They reported 98% mean root coverage, with complete root coverage in 84% of the defects. However, the recession defects they treated (mean RD = 3.25 mm; no defect >4.0 mm) were shallower than the defects treated in the present study, a factor that could account for the difference in outcomes.

Raetzke\textsuperscript{6} and Langer and Langer\textsuperscript{7} proposed the use of the SCTG to improve the predictability of root coverage procedures, and the technique has been widely used, with many modifications of the original surgical approaches.\textsuperscript{8-11,17} The bilaminar blood supply from the overlying gingival flap and the underlying periosteum promotes the high survival potential of the SCTG. In most, if not all, SCTG studies, the graft is positioned in a horizontal orientation, and is fixed over the denuded root surface with proximal sutures. In the present study, the graft was positioned in a vertical orientation to evaluate effects on mucogingival thickness and width of keratinized tissue dimensions. Graft immobilization was carried out with a suture anchoring the periosteum apical to the graft, and tied on the palatal aspect of the tooth. The suture did not penetrate either the graft or the interdental papillae. Although the clinical impression at the time of surgery was that the graft was immobile before flap advancement, it cannot be excluded that the graft was subsequently dislodged, perhaps due to periosteum breakdown during early healing. Potential graft movement might have negatively impacted the results.

Despite the popularity of both the CPF\textsuperscript{3-5,12,16} and the SCTG\textsuperscript{6-12,16} techniques for root coverage, the literature lacks studies that directly compare the two techniques. The present study appears to be the first to compare the two approaches in a split-mouth design. Wennström and Zucchelli\textsuperscript{18} reported the only other study that directly compared the two techniques in a parallel group design. The results of the two studies are in agreement; i.e., for Miller Class I recession defects \( \geq 3 \) mm in depth, there is no difference in root coverage outcomes between CPF and SCTG.

Wennström and Zucchelli\textsuperscript{18} examined 45 defects treated by CPF (control sites) and 58 defects treated with CPF + SCTG (test sites), with 4 mm average recession depth for both groups. At 6 months, mean root coverage was 96% in both control and test sites, while complete root coverage was observed in 74% of the control defects and 72% of the test teeth.\textsuperscript{18} Comparison to the results of the present study (mean root coverage: 69% for CPF and 75% for CPF + SCTG) suggests that there must be factors responsible for the quantitative differences in outcome. Although the present study used similar surgical approaches for the treatment of recession defects apparently equal in severity to the defects treated by Wennström and Zucchelli,\textsuperscript{18} there are differences between the two studies. In contrast to the present study, in the aforementioned study,\textsuperscript{18} multiple contiguous sites were treated per subject with each technique; the majority of defects occurred in canines and incisors (56% of maxillary defects); root surfaces were not heavily instrumented; the graft was secured in a coronal position; a surgical dressing was used for the first 8 days of healing; and patients were instructed to use a roll technique for brushing. To what extent any of these differences might have contributed to the less successful outcome in the present study is a matter of speculation. As in other studies employing the CPF + SCTG combination,\textsuperscript{17-21} there was a small increase in the width of keratinized tissue (0.55 \pm 0.91 mm) postoperatively in this study. Because of the surgical approach employed, i.e., graft placed longitudinally to cover entire denuded root surface and completely covered by split-thickness CPF (Figs. 5, 6, and 7), we can conclude that the grafted palatal tissue fails to induce transformation of the overlying alveolar mucosa, at least for the first 6 months postoperatively. This is in agreement with previous studies.\textsuperscript{11,19-21} Use of CPF alone for root coverage resulted practically in no changes in width of keratinized tissue, a result consistent with published reports.\textsuperscript{5,22}

In the present study, tissue thickness was measured at two different sites, the existing keratinized tissue (GT1) and the alveolar mucosa (GT2), to separately assess the effect of the surgical procedures on each tissue. The results indicate that SCTG, as employed in this study, results in a statistically significant increase of both gingival (GT1) and alveolar mucosal (GT2) thickness, with a greater relative effect on the alveolar mucosa. The present results (GT increased by 0.44 to 0.81 mm, depending on location) are consistent with the SCTG findings of Müller and coworkers,\textsuperscript{23,24} who reported a 0.56 to 0.77 \textsuperscript{24} mm increase in gingival thickness 6 months postoperatively. Similarly, the baseline GT values reported here are consistent with earlier reports on gingival thickness.\textsuperscript{23,25,26} In the present study, the average harvested graft thickness was 1.3 mm (data not shown), which, in conjunction with the GT results, leads us to conclude that SCTG undergoes significant thickness reduction during healing.

To what extent the statistically significant increase in GT has any clinical significance is dependent on the clinical question asked. If the question is whether it leads to better root coverage outcomes, the conclusion from the present and published studies\textsuperscript{18} has to be negative. If the question is whether it makes the treated sites less susceptible to future recession, only the results of long-term follow-up studies will provide the answer.

In conclusion, the present study demonstrated that both CPF and CPF+SCTG are effective in providing root coverage in Miller Class I gingival recession defects \( \geq 3 \) mm, although the combined technique should be preferred if increases in gingival dimensions (keratinized
tissue width, gingival/mucosal thickness) are a desired outcome.

ACKNOWLEDGMENT

The authors dedicate this paper to the memory of Dr. Antonio Fernando Martorelli de Lima who was tragically killed in a motor vehicle accident in December 2003. He used to say, “One man’s success is only evident when his ideas are carried forward by others.” He was a dear friend, colleague, and mentor who inspired and continues to inspire his students and colleagues.

REFERENCES


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