Changes in Keratinized Tissue Width Following Connective Tissue Grafts and Diode Laser- vs Blade-Gingivoplasty

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The objectives of this study were to clinically and histologically assess the capacity of bilaminar subepithelial connective tissue grafts (SCTGs) alone or in combination with gingivoplasty (Gv) to increase the keratinized gingiva width (KGW) in contralateral mandibular sites lacking KG (10 patients, 42 sites). The effects of Gv timing (1 vs 2 months) and technique (blade vs laser) were also evaluated. SCTGs alone resulted in mean KGW increase of 0.1 to 0.7 mm. Laser-Gv significantly increased KGW by an additional 1.9 mm at 4 months postabrasion as opposed to 0.9 mm achieved with blade-Gv. Histologically, laser-treated sites displayed parakeratinization with more pronounced rete pegs than observed in blade-abraded sites. Int J Periodontics Restorative Dent 2019;39:279–288. doi: 10.11607/prd.3557

Subepithelial connective tissue graft (SCTG) procedures are currently considered the gold standard in the treatment of gingival recessions.1 The increased keratinized gingiva width (KGW) at recession sites treated with SCTGs has been widely documented1 and ranges between less than 1 mm2–5 and more than 3 mm.6–8 When soft tissue non–root coverage augmentation procedures are considered, the use of SCTGs in a bilaminar technique does not seem to represent a consistently viable alternative to free gingival grafts in increasing KGW.9,10 When palatal donor tissues are embedded within recipient areas lacking KG, gingivoplasty (Gv) of the grafted sites at 3 to 4 weeks postgrafting was reported to result in keratinized overlying epithelium (Ep) in monkeys.11 In humans, the same results could not be reproduced when healed SCTGs were abraded at 8 weeks postgrafting.12 These discrepancies can be related to the length of the postgrafting healing period prior to Gv, the technique used for superficial tissue abrasion, and the histologic properties of the donor tissue.

Limited literature is currently available regarding the application of SCTGs when non–root coverage soft tissue augmentation is required for increasing KGW.13 The objectives of this pilot prospective study were to clinically and histologically
evaluate the (1) capacity of SCTGs, alone or in combination with Gv, to increase KGW following the insertion of palatal grafts in combination with repositioned flaps at recipient sites lacking KG; and (2) effects of Gv timing (1 vs 2 months) and technique (blade vs diode laser) on SCTG outcomes.

Materials and Methods

Ten systemically healthy patients (8 women and 2 men) ranging between 20 and 45 years of age (mean age: 24.7 ± 7.2 years) planning on undergoing orthodontic therapy and requiring a non-root coverage procedure for gingival thickness increase were selected from a patient population attending the Lebanese University Department of Orthodontics based on the following inclusion criteria: (1) thin buccal gingiva in bilateral sites with KGW < 2 mm; (2) absence of buccal gingival recession ≥ 1 mm; (3) absence of interproximal attachment and bone loss; (4) presence of buccal sulcular depth ≤ 3 mm; (5) no intake of medications known to cause gingival overgrowth; and (6) smoking ≤ 5 cigarettes per day. Study objectives, procedures, and estimated risks and benefits were explained to the patients, and their written informed consent was obtained. The protocol was approved by the university’s Ethical Committee (CUEMB20) and was in full accordance with the ethical principles of the Declaration of Helsinki as revised in 2008. All patients received initial therapy and instructions in nontraumatic roll brushing technique prior to surgery. At the end of the hygienic phase, all patients demonstrated adequate oral hygiene measures and displayed a full-mouth plaque score (FMPS) ≤ 10%.14

Study Design

All bilaterally selected teeth received SCTGs. According to the experimental design in Fig 1, 10 patients were randomly and equally divided in 2 groups. In Group 1 (n = 5), 22 healed contralateral sites were randomly assigned to undergo blade-Gv at 1 month (11 test sites) or 2 months (11 control sites) to assess the impact of Gv timing on keratinization. In Group 2 (n = 5), the efficacy of the Gv technique was investigated. At 2 months after SCTG healing, diode laser-Gv was performed in test sites (n = 10) while control sites underwent blade-Gv (n = 10).

In both groups, four punch biopsy samples (two test and two control) were consecutively obtained for each patient as follows: two at the healed grafted sites just prior to Gv, and two at the healed abraded sites 4 months post-Gv. A customized acrylic stent with a groove on the midbuccal aspect of the selected teeth was used to consistently reproduce the periodontal probe’s alignment during clinical measurements and to guide positioning for harvesting biopsy samples.
Surgical Procedures and Biopsy Harvesting

Following local anesthesia, sulcular incisions were made and connected to the horizontal incisions in the interdental papillae, located mesially and distally to the selected teeth at the cementoenamel junction (CEJ) level. Partial-thickness dissection was carried out, extending at least 3 mm apical to the mucogingival junction (MGJ) and mesiodistally to the line angles of adjacent teeth. Palatal grafts consisting of deep connective tissue (CT) and periosteum were harvested using a trap-door approach in the canine-premolar area. Care was taken to remove visible adipose and glandular tissues and to create a uniform graft thickness of 1 to 1.5 mm. Apico-coronal and mesiodistal graft dimensions paralleled those of the recipient site and were recorded relative to the stent to serve as guide for subsequent Gv. The graft was secured at the CEJ and sutured with the flap to the interproximal papillae using interrupted 6-0 monofilament sutures (Ethilon, Ethicon). Care was taken to completely cover the donor tissue with repositioned flaps at all sites.

One or 2 months after healing of SCTGs (Figs 2a, 2b, 3a, and 3b), a circular, 2-mm-diameter punch biopsy sample was obtained from each patient interproximally until contact was made with bone in the grafted area’s perimeter. This was apical to the MGJ and along the papillae’s midline longitudinal axis (Figs 2c and 3c). The samples were then processed for histologic evaluation. Subsequently, blade-Gv was carried out in all sites in Group 1 and in control sites of Group 2 as follows: the overlying Ep/CT of the area corresponding to the entire extent of the original SCTG was removed using a #15 blade through elevation of a split-thickness flap (Fig 2d). To eliminate the risk of potential recession, the SCTG portion located coronally to the MGJ and covered by KG was not abraded. The Gv area extended mesiodistally and apically by 2 to 3 mm.

Using similar delineation criteria in the test sites of Group 2, Gv was performed using soft tissue diode laser (elexxion claros, elexxion AG) with a 810-nm wavelength (Fig 3d).
The manufacturer’s guidelines for gingivoplasty/gingivectomy were followed using 400-µm-diameter glass-fiber tips with a pulse output of 15 W and frequency of 9 Khz in “paint brush” strokes.

At 4 months post-Gv in both groups, a second punch biopsy sample was obtained at all sites within the boundaries of the healed abraded grafts (Figs 2e, 2f, 3e, and 3f), just apical to the previously obtained core.

Following all surgical procedures, analgesics were prescribed as needed as well as 0.12% chlorhexidine rinse 3 times a day for 4 weeks. Sutures were removed 10 to 15 days postoperatively. Patients were asked to avoid mechanical plaque control for 4 weeks and were recalled for oral hygiene reinforcement and professional maintenance on a monthly basis until 4 months post-Gv.

Clinical Parameters

Schiller iodine solution was used to stain the alveolar mucosa and facilitate MGJ identification. Clinical measurements were evaluated at all test sites at baseline (1), just prior to Gv/postgrafting (2), and 4 months post-Gv (3) as follows: KGW measured from GM to MGJ (KGW1, KGW2, KGW3); MGJ location measured from the stent (MGJ1, MGJ2, MGJ3); GM location measured from the stent (GM1, GM2, GM3); and thickness of the buccal gingival tissues (TT) (TT1, TT2, TT3) recorded by inserting the probe perpendicularly through the midbuccal gingiva until bone contact, just coronally to the MGJ. All measurements were rounded to the nearest 0.5 mm and carried out by two calibrated experienced periodontists (F.A.E.H. and Z.A.K.M.) using a periodontal probe.

Histologic and Histomorphometric Evaluation

All soft tissue specimens were immediately rinsed with sterile saline and fixed in 10% neutral buffered formalin solution for at least 24 hours. The samples were dehydrated in five subsequent alcohol baths of ascending concentrations, cleared in four successive xylol baths, and embedded in paraffin. The samples were step-sectioned 50 µm apart, along a plane parallel to the long axis of the biopsy sample. In each specimen, 5 sections of 4- to 5-µm thickness—representing the most central portion of the biopsy—were stained either with hematoxylin-eosin (H&E) (n = 2), Masson’s trichrome stain (n = 1), Verhoeff’s stain (n = 1), or silver Gordon & Sweet’s stain (n = 1). The selected slides were coded and analyzed by the

Fig 3 Clinical photographs of the laser-treated mandibular right-canine and first-premolar test sites in Group 2: (a) prior to grafting, (b) 2 months following subepithelial connective tissue graft placement, just prior to abrasion, and (c) outline of the biopsy sample obtained by means of a customized punch just below the mucogingival junction, (d) immediately after laser-mediated gingivoplasty, (e) 4 months postabrasion, and (f) at harvesting of the second biopsy sample. Note the large band of white, scar-like tissue occupying most of the abraded area (e, f).
same independent histopathologist using a blinded protocol.

H&E-stained sections were evaluated for general histologic tissue characteristics, orthokeratinization, parakeratinization, or absence of keratinization of the covering Ep. The presence and location of adipose tissue were noted. The collagen component was assessed on the Masson’s trichrome–stained slides under a light microscope with incorporated micrometer. The CT was divided into 3 subepithelial zones parallel to the epithelial surface and measuring 1 to 2 mm thick, according to evident differences in density and organization of the collagen fibers. An overall assessment of collagen density in each zone was then recorded at ×10 magnification using the semi-quantitative scale that classifies the visual CT appearance as dense or loose. For the elastic (Verhoeff’s stain) and reticular fibers (silver stain), the overall content in each subepithelial zone was visually evaluated at ×10 as dense or loose.

Data Analysis

Descriptive statistics were expressed as means and standard deviations for all clinical parameters. Comparisons between test and control sites at each evaluation period (baseline, postgrafting, and 4 months post-Gv) were performed using Wilcoxon test. The same test was applied for assessing temporal changes between the three evaluation periods of the outcome variables within test and control groups. The significance level was set at $P < .05$.

Results

In total, 11 pairs of mandibular teeth ($n = 22$) were included in Group 1 and 10 mandibular pairs ($n = 20$) in Group 2. The paired sites in Group 1 included 10 canines, 8 first premolars, 2 central incisors, and 2 lateral incisors. In Group 2, the paired sites were represented by 6 canines, 10 first premolars, and 4 second premolars. All patients healed uneventfully, were available for the follow-up evaluations, and maintained good levels of oral hygiene with no clinical signs of inflammation throughout the study.

Clinical Findings

Group 1

All temporal changes and measurements are shown in Table 1. No significant differences were found relative to baseline KGW between test and control sites. KGW increased significantly postgrafting ($KGW2 > KGW1; P < .05$) and post-Gv ($KGW3 > KGW2; P < .05$). In all post-Gv sites, a 1- to 2-mm-wide scar-like tissue was evident at the coronal border of the abraded area. The use of SCTGs did not result in any significant MGJ displacement in test and control sites ($P = .406$ and .068, respectively). However, subsequent blade-Gv yielded a significant apical MGJ displacement ($MGJ3 > MGJ2$) when carried out at 1 ($P = .001$) and 2 months ($P = .008$). A statistically significant coronal GM displacement was noted following SCTG healing ($GM2 < GM1$) in both test ($P = .014$) and control sites ($P = .008$). Blade-Gv did not significantly alter GM2 ($P > .05$), but GM3 was still significantly more coronal when compared to GM1 at test and control sites ($P = .031$ and .018, respectively). A significant TT increase was observed following SCTG healing, from 0.73 ± 0.10 mm to 2.23 ± 0.26 mm at test sites and from 0.67 ± 0.13 mm to 2.18 ± 0.25 mm at control sites ($P = .0001$). A significant TT reduction was observed at 4 months post-Gv, resulting in TT3 values of 1.36 ± 0.32 mm and 1.32 ± 0.34 mm in test and control sites, respectively ($P = .0001$). Despite this reduction, TT3 was still significantly greater than baseline ($P = .0001$).

No significant differences were detected relative to the temporal changes in clinical variables between test and control sites in Group 1 (Table 2).

Group 2

All temporal changes and measurements are shown in Table 1. Baseline KGW did not differ significantly between test and control sites. No significant change in KGW was observed as a result of SCTG use. Gv resulted in significant ($P < .05$) KGW increases both relative to postgrafting ($KGW3 > KGW2$) and baseline ($KGW3 > KGW1$) in both test and control sites. Healed SCTGs yielded a significant coronal MGJ displacement in test sites ($MGJ1 > MGJ2; P < .05$). Such observation was not evident in control sites ($P = .25$). Subsequent laser- and blade-Gv resulted in a significant MGJ apical displacement ($MGJ3 > MGJ2$) in both test ($P = .001$) and control sites ($P = .025$). The overall apical...
Table 1 Temporal Changes of Clinical Parameters from Baseline (1) to Postgrafting (2) and Postgingivoplasty (3) for Both Groups

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group 1</th>
<th>Group 2</th>
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<tr>
<td></td>
<td>Blade-Gv at 1 mo (test)</td>
<td>Blade-Gv at 2 mo (control)</td>
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<tr>
<td>KGW</td>
<td>1.64 ± 0.95</td>
<td>1.95 ± 0.85</td>
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<tr>
<td>KGW1</td>
<td>2.18 ± 0.84</td>
<td>2.68 ± 1.01</td>
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<tr>
<td>KGW2</td>
<td>3.04 ± 0.88</td>
<td>3.36 ± 1.23</td>
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<tr>
<td>KGW3</td>
<td>6.64 ± 1.03</td>
<td>6.82 ± 0.87</td>
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<tr>
<td>MGJ</td>
<td>6.68 ± 1.01</td>
<td>7.18 ± 1.05</td>
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<tr>
<td>MGJ1</td>
<td>7.50 ± 0.60</td>
<td>7.64 ± 1.42</td>
</tr>
<tr>
<td>GM</td>
<td>5.00 ± 1.60</td>
<td>4.86 ± 1.07</td>
</tr>
<tr>
<td>GM1</td>
<td>4.45 ± 1.12</td>
<td>4.50 ± 1.14</td>
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<tr>
<td>GM2</td>
<td>1.36 ± 0.32</td>
<td>1.32 ± 0.34</td>
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<tr>
<td>TT</td>
<td>0.73 ± 0.10</td>
<td>0.67 ± 0.13</td>
</tr>
<tr>
<td>TT1</td>
<td>2.23 ± 0.26</td>
<td>2.18 ± 0.25</td>
</tr>
<tr>
<td>TT2</td>
<td>1.50 ± 0.00</td>
<td>2.10 ± 0.21</td>
</tr>
<tr>
<td>TT3</td>
<td>1.50 ± 0.00</td>
<td>1.50 ± 0.00</td>
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All values are given in mm as mean ± standard deviation. KGW = keratinized gingival width; MGJ = mucogingival junction; GM = gingival margin; TT = gingival tissue thickness.

MGJ displacement (MGJ3 > MGJ1) was only significant in test sites (P < .004). GM was significantly displaced in a coronal direction following SCTG healing in all sites (GM2 < GM1; P < .05). This postgrafting GM position was maintained with no subsequent alterations post-Gv (P > .05). GM3 at 4 months post-Gv was still significantly more coronal when compared to baseline at all sites (GM3 < GM1; P < .05). SCTG application produced a significant increase in TT at all sites (TT2 > TT1; P < .05) with subsequent reduction post-Gv (TT3 < TT2; P < .05). However, the overall TT change was positive, with TT3 significantly greater than baseline (TT3 > TT1; P < .05). KGW increase following SCTG use alone was not significantly different between test and control sites (P = .007). Subsequent KGW gains detected post-Gv (KGW3 – KGW2; 1.90 ± 1.31 mm in test vs 0.88 ± 0.35 mm in control sites, P = .049) and overall KGW changes resulting from the combination of SCTG and abrasion (KGW3 – KGW1, P < .05) were statistically significant in favor of laser-Gv sites (Table 2). Changes in MGJ location were significantly different between test and control sites post-Gv (MGJ3 – MGJ2, P = .020), and between initial and final evaluations (MGJ3 – MGJ1, P = .047) (Table 2). GM and TT temporal changes were not statistically significant between test and control sites (P > .05) (Table 2).

Histologic Findings

Postgrafting Biopsy Samples

Postgrafting biopsy samples displayed a nonkeratinized Ep and mostly had a flat Ep-CT interface with no rete pegs (Fig 4a). In most specimens (17 of 20), low collagen density (Figs 4a and 4b) characterized the CT immediately underlying the gingival Ep (zone 1, Fig 4c). The intermediate area (zone 2) in 16/20 biopsy samples demonstrated a higher content in collagen fibers, indicating a denser graft-collagen network than that of the overlying mucosa. Adipose tissue was observed only in zone 2 (Fig 4d) in 4/20 biopsies, with variable fat content and nonspecific distribution pattern (Figs 4b and 4d). The deepest portion (zone 3, Fig 4e) of the postgrafting cores appeared as dense CT in 8 specimens and as loose in 12 (Figs 4b and 4e). In 3 biopsy samples, all 3 zones were histologically similar with no discernible differences in collagen density. The trend of change in collagen content from superficial to deeper areas did not demonstrate any noticeable differences between test and control sites. The distribution of elastic fibers was highly dense and random in zone 1, dense in half of the cores in zone 2, and highly variable in density in zone 3. Overall, the reticular fiber network was predominantly dense in the deeper zones (2 and 3) with low density in zone 1.

Postgingivoplasty Biopsy Samples

The easily recognizable clinical demarcation between the grafted and host’s tissues in postgrafting biopsy
Fig 4 (a, b) The biopsy sample can be visually divided in 3 zones parallel to the epithelial surface. Trichrome stain results in green-stained collagen and black nuclei while the remaining cytoplasm and keratin are colored in red (original magnification × 10). Note the loose connective tissue in zone 1 (c), the presence of adipose tissue in zone 2 (d), and the dense collagen component in zone 3 (e) (×40 magnification).

Table 2 Comparison of Clinical Parameters Between Test and Control Sites in Both Groups at Different Time Intervals: Baseline (1), Postgrafting (2), and Postgingivoplasty (3)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group 1</th>
<th>Group 2</th>
<th>P</th>
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<tbody>
<tr>
<td>Changes in KGW</td>
<td>Blade-Gv at 1 mo (test)</td>
<td>Blade-Gv at 2 mo (control)</td>
<td>P</td>
</tr>
<tr>
<td>KGW2–KGW1</td>
<td>0.54 ± 0.93</td>
<td>0.73 ± 0.64</td>
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<td>KGW3–KGW2</td>
<td>0.86 ± 0.50</td>
<td>0.68 ± 0.68</td>
<td>.231</td>
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<tr>
<td>KGW3–KGW1</td>
<td>1.41 ± 1.04</td>
<td>1.41 ± 0.97</td>
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<tr>
<td>Changes in MGJ</td>
<td>Laser-Gv at 2 mo (test)</td>
<td>Blade-Gv at 2 mo (control)</td>
<td>P</td>
</tr>
<tr>
<td>MGJ2–MGJ1</td>
<td>0.04 ± 0.88</td>
<td>0.36 ± 0.64</td>
<td>.164</td>
</tr>
<tr>
<td>MGJ3–MGJ2</td>
<td>0.91 ± 0.49</td>
<td>0.68 ± 0.75</td>
<td>.227</td>
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<tr>
<td>MGJ3–MGJ1</td>
<td>0.95 ± 0.96</td>
<td>1.04 ± 0.99</td>
<td>.300</td>
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<tr>
<td>Changes in GM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GM2–GM1</td>
<td>–0.54 ± 0.61</td>
<td>–0.36 ± 0.32</td>
<td>.297</td>
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<tr>
<td>GM3–GM2</td>
<td>0.04 ± 0.27</td>
<td>0.00 ± 0.38</td>
<td>.500</td>
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<tr>
<td>GM3–GM1</td>
<td>–0.50 ± 0.67</td>
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<td>.424</td>
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<td>Changes in TT</td>
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<tr>
<td>TT2–TT1</td>
<td>1.50 ± 0.20</td>
<td>1.51 ± 0.26</td>
<td>.461</td>
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<tr>
<td>TT3–TT2</td>
<td>–0.86 ± 0.45</td>
<td>–0.86 ± 0.23</td>
<td>.617</td>
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<tr>
<td>TT3–TT1</td>
<td>0.64 ± 0.37</td>
<td>0.64 ± 0.32</td>
<td>.438</td>
</tr>
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</table>

All non-P values are given in mm as mean ± standard deviation.

KGW = keratinized gingival width; MGJ = mucogingival junction; GM = gingival margin; TT = gingival tissue thickness.

*Statistically significant.
samples (Fig 5a) was not evident in post-Gv cores, indicating a higher degree of incorporation of the graft. The Ep lining in blade-Gv sites displayed parakeratinization, nonkeratinization, and combined patterns with lesser rete pegs than normally observed in attached gingiva (Fig 5b). KGW increase corresponded to a parakeratinized Ep displaying a somewhat irregular Ep-CT interface in laser-Gv sites (Fig 5c). Graft boundaries were not identifiable, and zone 2 could not be readily discerned from the overlying native tissue. Overall, post-Gv biopsy samples were characterized by a somewhat higher collagen content in most zones and a variable decrease in fat tissue when compared to post-grafting cores. Blade- and laser-Gv seem to have resulted in a reduction of elastic fibers in all zones, which was more evident in laser-treated sites. A dense reticular network was found in most zones.

**Discussion**

The study objectives were to assess if SCTGs combined with repositioned flaps result in KGW increase in areas lacking keratinized tissue, if removal of the overlying Ep of healed SCTGs leads to an increase in KGW, and if such clinical changes are associated with specific histologic alterations of the recipient/grafted tissues. In the present study, SCTGs alone resulted in a mean initial KGW gain of 0.10 to 0.73 mm prior to Gv. This modest increase can be attributed to possible repotting of the covering flap in an apical direction during wound healing, thus exposing the graft. Histologically, grafted sites were lined by a nonkeratinized Ep covering dense CT, thus confirming the findings of previous histologic reports.

Subsequent blade-Gv, which hypothetically aimed at full exposure of healed SCTGs, did not seem to result in significant changes in collagen density or production of keratinized epithelial layers. Clinically, blade-Gv yielded a further increase of 0.68 to 0.88 mm, although the apico-coronal extent of keratinization did not match the whole surface of the underlying graft. Histologically, this tissue was covered by a normally structured parakeratinized Ep lacking rete pegs, similarly to the scar tissue reported by Edel and Facci

Although statistically significant, the post–blade-Gv KGW increase cannot be considered clinically significant and is somewhat similar to Maurer et al’s findings (0.3 ± 0.5 mm). In contrast, when a modified apically repositioned flap surgical technique was used in a case series, KGW increased from 2.20 ± 0.38 mm to 4.28 ± 0.87 mm. It is noteworthy that no grafts were utilized in that study, and its results have not been duplicated by others. In addition, differences in blade abrasion technique, depth, and apical extension render any direct comparisons between the two studies difficult.

Laser-Gv resulted in a more significant KGW increase when compared to blade-Gv. This gain was microscopically coupled by a lining...
of parakeratinized Ep displaying a somewhat irregular Ep-CT interface that was less ragged than the typical rete pegs observed in normal gingiva. In a rabbit model, Demir et al evaluated the clinical and histopathologic effects of scalpel and Nd:YAG and low-level laser therapy on the healing of oral mucosa after vestibuloplasty. The authors observed areas of parakeratinization in the Ep of the laser groups and reported a significant increase in epithelial thickness with irregular CT protrusions into the Ep undersurface. These conclusions with the Nd:YAG laser (considered to be a near-infrared laser) can clarify the histologic findings of the present study. The question of whether this laser-altered mucosal tissue will assume the full characteristics of KG remains to be elucidated. It is noteworthy however to emphasize that the laser effect was restricted to the coronal portion of the abraded graft. This could be related to muscle-fiber insertion in the more apical vestibular areas in the mandible. Future studies are warranted to assess the influence of jaw location (maxilla vs mandible) on the outcome of laser-Gv.

The choice of the 1-month interval for blade-Gv was based on the assumption that grafted dense CT will maintain its potential capacity of inducing epithelial keratinization after a short healing period. The lack of keratinization of de-epithelialized grafts inserted 2 months prior to abrasion was demonstrated in a human study, contrasting evidence of keratinized-Ep formation when healed palatal SCTGs were de-epithelialized after 3 to 4 weeks in monkeys. The results of the present investigation demonstrated that Gv timing had no impact on the behavior of SCTGs exposed through blade-Gv. The discrepancy with the results of Karring et al could be attributed to the animal model and differences in recipient-site preparation.

Postgrafting, MGJ was not significantly displaced except in laser-Gv sites where it shifted coronally by 0.5 mm, a short-term finding reported in other studies. Subsequent apical MGJ displacement in laser- and blade-Gv sites paralleled the observed KGW gains. Overall, grafting resulted in a significant coronal GM displacement close to 0.5 mm at all sites. No further significant changes were observed post-Gv. It is more likely that the GM coronal displacement had occurred as an immediate result of the surgical procedure and not as a postoperative “creeping attachment,” as has been reported in other investigations.

SCTGs are routinely associated with a significant increase in gingival thickness despite a 50% to 70% loss of thickness during maturation. The majority of dimensional changes seem to occur between 3 weeks and 6 months following SCTG. The results of this study are in agreement with the abovementioned investigations and reveal that SCTGs used for non-root coverage indications yield a TT increase > 1 mm at all sites at up to 2 months postgrafting. Although blade- and laser-Gv resulted in a significant TT reduction at all sites when compared to postgrafting values, the final TT was still significantly greater than that observed at baseline.

Conclusions
Palatal SCTGs tend to maintain their intrinsic histologic characteristics of dense CT in the short healing period following transplantation into alveolar mucosa. This is not, however, associated with phenotypic expression of keratinization by the overlying Ep. Laser-Gv yielded a more significant increase in KGW with more pronounced parakeratinization and rete pegs than observed in blade-abraded sites. The main study limitations include the lack of comparison of Gv timing and its impact on keratinization in the laser group, as well as the overall small number of patients, which renders generalizing the findings of this study premature.

Acknowledgments
The authors report no conflicts of interest in relation with this study.

References

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