Modified approach for keratinized tissue augmentation in multiple teeth

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Abstract:
This case report demonstrated a modified technique of free gingival graft (FGG) aiming to increase keratinized attached tissue in large recipient areas. A FGG to increase the amount of attached gingival tissue, facilitate oral hygiene, and prevent further clinical attachment loss was realized in two patients. Because the extensive recipient area, a modified technique was performed to obtain a smaller graft of the donor area. A template of the graft was made about 25%–30% smaller than the total recipient area. After graft removal, interspersed incisions were made in the upper and lower edges of it. After 9–24 months of follow-up, the final width of the keratinized tissue was 4.0–4.4 times larger in comparison to initial clinical condition. In conclusion, this FGG technique can be considered an alternative to gain sufficient amount of keratinized gingival tissue using a smaller graft.

Key words:
Tissue graft, creeping attachment, keratinized tissue

INTRODUCTION

The gingiva is a keratinized tissue composed of the attached gingiva, which is a firm and resilient tissue tightly bound to the underlying periostium, and the free gingiva, which surrounds the tooth and is not directly attached to the tooth surface. The gingiva acts as a physical barrier between the oral environment and the underlying connective tissues of the periodontium. However, the required presence of keratinized gingiva (KG) around the tooth to maintain gingival health has been controversial. A previous study suggested that all tooth surfaces with <2 mm of KG are more susceptible to develop clinical inflammation. On the other hand, other studies showed that the maintenance of periodontal health is independent of the presence or the extent of KG. In dental implants therapy, similar to natural teeth, the presence or absence of a minimal zone of keratinized tissue around dental implant to maintain peri-implant soft tissue health is also controversial. Some authors suggested that a minimum width of 2 mm of keratinized tissue was required to maintain tissue health.

Some factors are decisive to clinical indication of a surgical procedure to create or increase the width of KG tissue. Patients complaining of discomfort during tooth brushing in areas with inadequate width of KG are candidates for intervention. Moreover, in dental implants, the soft tissue augmentation has also been indicated for patients with thin gingival tissue; once this biotype was associated with a higher risk for recession and could compromise the soft tissue esthetics.

Autogenous grafts are indicated to soft tissue augmentation in areas with lack of or reduced width of keratinized tissue. A versatile surgical technique using autogenous grafts is the free gingival graft (FGG). This therapy involves complete the removal of a portion of soft tissue from a donor site, commonly the palatal mucosa, and placement of the graft in a prepared recipient bed. The FGG is simple and highly predictable when used to increase the width of attached gingival. However, the disadvantages of using autogenous tissue are mainly the harvesting time of the graft and the increased patient’s morbidity.

To overcome these issues inherent to FGG, this article demonstrates a modified technique, proposed by Rateitschak. The modification consists in performing interspersed incisions in the graft to increase its extension and therefore to avoid extensive harvesting areas.

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CASE REPORT

Patients
Two patients, a 50-year-old female (Case 1) and a 28-year-old male (Case 2), sought treatment at the Periodontal Clinic in the Araraquara Dental School, Department of Diagnosis and Surgery – UNESP, complaining of sensibility during dental brushing in the anterior mandible region. Both patients showed no systemic disease, no known allergies, and were nonsmokers. During clinical examination, bacterial biofilm accumulation and a KG width ≤ 1 mm were observed on the buccal aspect of the mandibular anterior area. Complete mouth scaling and root planning were performed and oral hygiene instructions were given. After 4 weeks, the patients were reassessed; however, the presence of bacterial biofilm and gingival inflammation persisted in the mandibular anterior area associated with a discomfort during brushing reported by the patients. Therefore, a chemical treatment with 0.12% chlorhexidine gluconate was prescribed to help biofilm control and a surgical treatment using the FGG technique was proposed to increase the width of attached gingiva and consequently facilitate oral hygiene and prevent further clinical attachment loss in those patients. However, as an extensive area without attached gingiva was observed in the patients, a modified technique was performed to obtain a smaller graft of the donor area and to reduce patient’s morbidity [Figure 1].

Surgical procedure
A local anesthetic (mepivacaine 2% with epinephrine 1:100,000, DFL, Brazil) was administered to the recipient and donor areas. At the recipient site [Figure 2a], a marginal horizontal linear incision was made at the mucogingival junction using a n° 15C scalpel, creating a partial thickness flap and leaving the periosteum intact [Figure 2b]. The horizontal dimension of the recipient area was determined according to the mesiodistal extension of the area without KG. For both cases, the recipient area involved from teeth #42–32. All movable soft tissues including epithelium, connective tissue, and muscle fibers were removed with a gum scissors to ensure stability in the receptor area [Figure 2c].

Afterward, a template of the graft about 25% to 30% smaller in length than the total recipient area was made with sterilized paper. Using this rule, for a recipient area of 15 mm, a graft size of 10–11 mm is enough, once after performing the interspersed incisions, the graft length increases about 3 mm as shown in the schematic figures [Figure 1a-c]. After preparing the reduced template, it was transferred to the donor area in the palate and the graft borders traced with a scalpel blade. Then, the template was removed and deeper incisions were performed in the borders with the scalpel perpendicular to the palate, aiming to obtain a graft with approximately 2–3 mm thickness is necessary to prevent some damage in the graft caused by the interspersed incisions [Figure 1a and 2d]. Interspersed incisions were made as proposed by Rateitschak. Starting from the upper edge of the graft, vertical incisions were carried out with about 4 mm distance between them. Then, vertical incisions were made in the lower edge interspersed with incisions previously performed in the upper graft edge. In this technique, the upper and lower incisions must be parallel in the vertical direction and their extensions exceeding 1–2 mm from the center of the graft [Figure 1b]. Therefore, the improvement in the graft length enabled the covering of all the recipient areas [Figure 2e and 1c].

After graft preparation, single interrupted subperiosteal sutures using silk suture 4.0 (Ethicon, Brazil) passed through the mesial and distal borders of the graft and the periosteal tissue of the recipient area. To guarantee maximum stabilization of the graft and minimizes the size of the blood clot between the graft and the recipient area, an additional subperiosteal suture was performed below the inferior border of the graft, passed over it in the vertical direction and was tightened in the teeth cervical region [Figure 2f]. Mild compression with gauze soaked in saline was also applied for 5 min. Periodontal dressing (Periobond, Dentsply, Brazil) was applied over the graft in the recipient area.

Postsurgical care
Patients were prescribed 0.12% chlorhexidine gluconate (Periogard, Colgate, Brazil) and instructed to rinse gently twice daily for 15 days. Toothbrushing was discontinued in the surgical area during this period of time. Antibiotic (amoxicillin, 500 mg, 3 times daily) was prescribed for 7 days to prevent a possible postoperative infection for all patients. Moreover, nonsteroidal anti-inflammatory (Nimesulide, 100 mg, 12/12 h) and analgesic (Dypirone, 500 mg, 6/6 h) were also prescribed. Postoperative period was uneventful and patients reported minimum discomfort. After 7 days of the surgery, the suture and periodontal dressing were removed [Figure 3].

The patients of Case 1 and 2 were followed up for 24 and 9 months, respectively. The gain of keratinized tissue was evaluated comparing the height of KG in different points in the buccal face of each tooth from the recipient area using photographic images taken at the immediate preoperative (baseline) and postoperative periods. The height of KG was measured in the same areas before and 24 months after the graft procedure in [Figure 2g] Case 1 and 30 days and 9 months after the surgery in Case 2 [Figure 3c and 3d]. An average of the KG height in the different points was obtained. For Case 1 [Table 1], increase of KG was calculated divided the mean KG height after 24 months by mean KG height in baseline. Similarly, to Case 2 [Table 2], increase of KG after 30 days was calculated divided the mean KG height after 30 days by mean KG height in baseline. Moreover, increase of KG after 9 months was calculated divided the mean KG height after 9 months by mean KG height in 30 days.

Distortions between the pictures were adjusted to mathematical calculations: The pictures were printed and reference

Table 1: Width of keratinized tissue (mm) on the buccal face of each involved tooth in Case 1 at baseline and 24-months follow-up

| Tooth | KG average height (mm) |
|-------|------------------------|
|       | Baseline | 24 months |
| 42    | 2.0      | 5.2       |
| 41    | 0.7      | 5.2       |
| 31    | 0.5      | 5.2       |
| 32    | 1.9      | 5.2       |
| Mean  | 1.3      | 5.2       |

KG – Keratinized gingiva; Ω KG augmentation – Mean 24 months KG height/ mean baseline KG height

Ω KG augmentation
structures (teeth crowns) were measured using an accurate ruler, using millimeter as unit of measurement. First, the dental crown height of three teeth in the initial picture (preoperative) was obtained [Figure 2a and 3a]. On the same way, the height of the same teeth was measured in the final picture (postoperative) [Figure 2g and 3d]. An average of the three measurements was obtained for each picture. A distortion ratio was calculated by dividing the height obtained in final picture by the height obtained in the initial picture. The distortion ratio was used to normalize measurements of KG before comparing differences between time points.

**RESULTS**

A keratinized tissue 4.0 times wider in comparison to the initial clinical situation was observed after 24 months for Case 1 [Table 1]. Similarly, a keratinized tissue 4.4 times wider in comparison to the initial clinical situation could be observed for Case 2, after 30 days [Table 2]. Besides that, after 9 months, a keratinized tissue 1.32 times wider in comparison to the 30 days of postoperative could be also observed in Case 2 [Table 2]. Therefore, these results demonstrate the success of the surgical technique modification for keratinized tissue augmentation. Moreover, the patients were satisfied with the surgical results and reported no discomfort during toothbrushing due to the increase of the keratinized tissue after the grafts, resulting in reduced accumulation of bacterial biofilm in the recipient region.

**DISCUSSION**

Soft tissue augmentation with autogenous grafts has a wide clinical application. It is indicated to augment areas with...
Table 2: Width of keratinized tissue (mm) on the buccal face of each involved tooth in Case 2 at baseline, 30 days, and 9-month follow-up

| Tooth | KG average height (mm) | Baseline | 30 days | 9 months |
|-------|------------------------|----------|---------|----------|
| 42    |                        | 1.0      | 2.8     | 3.9      |
| 41    |                        | 0.3      | 2.9     | 3.8      |
| 31    |                        | 0.2      | 2.5     | 3.3      |
| 32    |                        | 1        | 2.8     | 3.8      |
| Mean  |                        | 0.6      | 2.8     | 3.7      |
| KG augmentation α | 4.40 |       |         |          |
| KG augmentation Ω | 1.32 |       |         |          |

KG – Keratinized gingival; Ω KG augmentation – Mean 30 days KG height/mean Baseline KG height; α KG augmentation – Mean 9 months KG height/mean 30 days KG height.

The results obtained in both cases showed that this technique succeeded to gain sufficient amount of KG using a smaller graft in the cases described [Tables 1 and 2]. Moreover, considering the initial and final width of keratinized tissue measures in the buccal face of each single tooth, the amount of tissue gain was not proportional to the initial tissue condition. Independently, the initial width of KG, the tissue augmentation was similar for all involved teeth in both cases [Tables 1 and 2]. Further on, the 2 years of follow-up presented in Case 1 showed that the modified technique presented longevity of the achieved clinical outcome similarly to the conventional FGG technique described in the literature.[29,30] However, additional clinical research studies need to be performed to confirm the data obtained in this case report.

In regard to the graft healing, based on the clinical observation, this process seems to be similar to conventional FGG technique. Nobuto et al.[31] described that after 3-4 days of postoperative, the recirculation to the graft begin by the anastomoses of the existing vessels in the graft with the vessels in the recipient area through new sinusoidal vessels that are formed in the graft-reipient area junction. Therefore, the immobilization of the graft with described sutures is essential to ensure the graft revascularization. Associated with that, the recipient site needs to be carefully cleaned of loose connective tissue and muscle attachments and the periosteum integrity needs to be preserved. The periosteum is highly vascularized, composed of dense collagen fiber, fibroblasts, and progenitor cell that shows an immense regenerative potential.[32,33] Receptor areas without periosteum were associated with a prolonged period of revascularization and delayed healing.[23] All together, these clinical cares ensure the revascularization of the graft even with the implementation of intercepted incisions on the graft.

Another important event observed during tissue remodeling after FGG is the creeping attachment. This is a postoperative migration of the gingival marginal tissue in a coronal direction after mucogingival procedures.[29,30] In a clinical study, FGGs were placed in the lower anterior buccal region of thirty patients. Two years after the surgeries, varying degrees of creeping attachment could be observed.[29] In the present case report, this tissue migration could be observed in Case 2. After 9 months, the width of keratinized tissue was 1.32 times larger in comparison to 30-day follow-up [Table 2].

Although commonly indicated, the FGG has limitations. An average shrinkage of 25% to 40% of the graft could be observed during the FGG healing.[25] This shrinkage needs to be considered to correctly plan the graft dimension according with the receptor area. Besides that, the donor area needs to provide a thin to intermediate thickness of grafts to ensure lower percentages of shrinkage.[26] However, the location of the palatal vessels and nerves limits the total amount of tissue available for grafting procedures.[24] In addition, the need for a second surgical site is associated with a prolonged healing time at the donor site and therefore to an increased patient’s morbidity.[14] Patients often complain about pain and numbness for several weeks after the surgical procedure.[24]

To overcome these issues inherent to autogenous tissue, alternative techniques and materials primarily of allogeneic origin have been developed. However, studies comparing different allografts materials and FGG techniques showed that tissue-engineered grafts presented statistically significant less gain in keratinized tissue than the autogenous tissue.[15-27] Then, based on the advantage of using autogenous graft in relation to the amount of keratinized tissue gain, this case report showed a modification in the FGG technique aiming to minimize the patient’s morbidity and risk of postoperative complications associated with this technique when treating extensive areas. The modification consists in executing interspersed incisions in the graft to increase its extension. Therefore, this approach allows creating a larger amount of attached gingiva through removing a smaller graft from the donor site. The previous study investigating the influence of the graft size in the patient morbidity demonstrated that postoperative pain and discomfort were related to the apical-coronal dimension and depth of the palatal surgical area.[11] Moreover, the use of a small graft was associated with less painful and more comfortable postoperative course with no difference in root coverage outcomes when compared to bigger grafts.[28]

Reduced width or lack of keratinized tissue, as well as to increase soft tissue volume.[10] The role of attached gingiva for maintenance of periodontal health is still controversial in the literature. A certain amount of keratinized tissue has been considered necessary to maintain periodontal health and to prevent gingival recession.[16,17] However, a study in dogs showed that gingival health could be established and maintained in sites exposed to careful plaque control, without sign of recession of the gingival margin or loss of attachment, independently of the presence or absence of attached gingival and of the width of KG.[18,19] Indeed, in several cases, the patients do not perform an adequate plaque control because of pain and discomfort, favoring gingival inflammation and recession progression. In these clinical conditions, the autogenous grafts could be indicated to create/increase attached gingival tissue and to enable careful plaque control. Besides that, recent systematic reviews indicated that the gingival augmentation could be performed to prevent future recession when restorative margins may interact with the periodontium and/or orthodontic treatment in thin biotype patients.[20,21] Therefore, the decision to augment the width of KG around the teeth still depends on clinician and patient choice and on global treatment planning.[10]
CONCLUSION

This modification of FGG technique can be considered an alternative to gain sufficient amount of KG using a smaller graft. A larger region could be treated in a single procedure reducing the number of surgical procedures, giving comfort, and increasing the chances of acceptance by the patient. Furthermore, creeping attachment and longevity of clinical outcome seem to be similar to the conventional free gingival technique.

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Conflicts of interest
There are no conflicts of interest.

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