The Full-Thickness Palatal Graft Technique: Description of an Original Surgical Technique and 15 Case Reports

Michele Paolantonio, DDS, MD
Paolo De Ninis, PhD
Lorenzo Secondi, MD
Beatrice Femminella, DDS, PhD

Gingival thickness plays a pivotal role in both the etiology and treatment of gingival recessions. When treating gingival recessions by different periodontal plastic surgery techniques, a relationship has been reported between the thickness of the tissue used to cover the exposed root surface and the recession reduction. This case series illustrates a technique making use of a very thick graft, which consists of the entire thickness of the palate in its central part, from the periosteum to the epithelium, to obtain complete root coverage with high predictability. At 12 months, the treatment resulted in 100.22% ± 6.95% root coverage, and 14 of the 15 treated teeth (93.3%) were completely covered.


The Glossary of Periodontal Terms defines a gingival recession (GR) as the location of the gingival margin apical to the cementoenamel junction (CEJ). Although it was reported that in the absence of gingival inflammation, areas with recessions and small amounts of keratinized tissue may remain stable over long periods of time, a recent meta-analysis concluded that untreated GR defects in patients with good oral hygiene have a high probability of progressing during long-term follow-up. The 10th European Workshop on Periodontology reported esthetic discomfort, root sensitivity, impaired oral hygiene, and carious/noncarious dental root lesions as the indications for surgical treatment.

Complete root coverage (CRC) is commonly deemed the best indicator of success for the surgical treatment of GR. However, there is not a generally accepted definition for CRC. In fact, CRC was originally defined as a condition in which the position of the gingival margin corresponds to the CEJ; conversely, it was recently suggested that the root-coverage surgical procedure was completely successful only when the gingival margin and the depth of the gingival crevice are coronal to the CEJ.

CRC is considered the true goal of treatment because only complete root coverage assures recovery from the esthetic defects and
hypersensitivity associated with recessions. In particular, a negative correlation between hypersensitivity and CRC was reported by Nieri et al., although a recent systematic review concluded that there is not enough evidence to conclude that surgical root coverage procedures predictably reduce hypersensitivity. Rotundo et al., evaluating the esthetic perception of root-coverage procedures, showed that CRC is considered the most important outcome by patients, dentists, and periodontists.

Cairo et al. proposed a score system for evaluating the esthetic outcome following root-coverage surgery; although a number of esthetic aspects, such as color match, alignment of the mucogingival junction, scarring, and tissue texture, were considered for esthetic evaluation, CRC was the most important clinical parameter to obtain a high esthetic score.

Gingival thickness seems to play a pivotal role in both the etiology and treatment of GR. Müller et al. suggested that one of the most important factors that increases the risk for gingival recession may be a thin marginal tissue covering the root surface; more recently, Maroso et al. found that the lower the gingival thickness, the higher the degree of gingival recession. On the other hand, when treating GR by the free gingival graft technique, Miller emphasized the need for thick palatal grafts to obtain better results in dental root coverage. Additionally, when using the coronally advanced flap technique, Baldi et al. reported a direct relationship between flap thickness and recession reduction.

On the basis of such considerations, the purpose of the present article is to describe an original periodontal plastic surgery technique based on the use of a very thick mucoperiosteal graft to obtain CRC with a high level of predictability: the Full-Thickness Palatal Graft Technique (FTP G T).

Materials and Methods

Fifteen patients (9 women), aged from 29 to 48 years (mean: 37.7 ± 5.5 years) were selected on a consecutive basis among patients complaining of dental hypersensitivity and esthetic discomfort referred to the Unit of Periodontology, Department of Medical, Oral and Biotechnological Sciences, “G. D’Annunzio” University of Chieti-Pescara, Italy, from January to September 2011. Each patient participated in the study with a single tooth and gave their written consent to participate in the study. This study’s protocol was approved by the university’s ethical committee. The inclusion criteria for this study were as follows: (1) systemic factors: no systemic diseases, coagulation disorders, medications affecting periodontal status in the previous 6 months, or pregnancy or lactation; (2) behavioral factors: no smoking habits; and (3) dental and periodontal factors: at least one Miller Class I or II gingival recession, a full-mouth plaque score (FMPS) and a full-mouth bleeding score (FMBS) lower than 20% at the time of surgery, no previous periodontal surgery on the experimental sites, and no inadequate endodontic treatment at the site of surgery.

Presurgical Treatment

All selected patients underwent a session of professional tooth cleaning with instruction in proper oral hygiene measures. The use of an electric toothbrush with controlled pressure (Oral-B Pro 6000 Cross Action, Procter & Gamble) with extra-soft head (Oral B Sensitive EBS17, Procter & Gamble) was recommended. Surgical treatment of the recession defects was not scheduled until the patient could demonstrate an adequate standard of supragingival plaque control (FMPS/FMBS < 20%).

Clinical Measurements

At baseline and 1 year posttreatment, the following clinical parameters were measured on the midbuccal point of the experimental exposed root surface: GR was measured as the distance between the CEJ and the most apical point of the gingival margin; pocket depth (PD) and clinical attachment level (CAL) were measured as the distance from the bottom of the pocket to the most apical portion of the gingival margin or CEJ, respectively; the width of keratinized tissue (KT) was measured from the most apical point of the gingival margin to the mucogingival junction; gingival thickness (GT) was determined at a midbuccal location about 1 mm apical to the PD level with a #15 endodontic reamer. The reamer was inserted perpendicular to the mucosal surface, through the soft tissue with light pressure until a hard surface was felt. The silicon disk stop was then placed in tight con-
tact with the soft tissue surface and fixed by a drop of cyanoacrylic adhesive; after careful removal of the reamer, the penetration depth was measured with a caliper accurate to the nearest 0.1 mm.

The number of recession sites that had undergone complete coverage was recorded. A gingival recession was considered completely covered when the root surface was undetectable at the clinical examination with a CEJ invisible on visual inspection. Measurements were taken with a PCP UNC-15 periodontal probe and recorded to the nearest millimeter. The root-coverage esthetic score (RES) was recorded to evaluate the effectiveness of the FTPGT to obtain a satisfactory esthetic result. The time needed to observe a complete re-epithelialization of the palatal wound (CWE) was recorded to evaluate the healing characteristics of the donor area. CWE was evaluated clinically by the peroxide test. This test is based on the following principle: if the epithelial barrier is intact, H$_2$O$_2$ does not diffuse into the connective tissue; the enzyme catalase, which is present in underlying connective tissue, acts on H$_2$O$_2$ to release water and oxygen. This is clinically shown by the production of bubbles on the surface of the wound. The area to be evaluated was dried, and 3% H$_2$O$_2$ was sprinkled by means of a syringe on the palatal wound, waiting for the appearance of bubbles. This identified the surgical site as not completely epithelialized. CWE was recorded as a dichotomous variable (yes/no). Furthermore, postoperative pain during the first week was evaluated by recording the patients’ mean analgesic (ibuprofen) consumption (in mg). In particular, patients were instructed to take ibuprofen only if they felt significant pain. Changes in the patients’ feeding habits (CFH) as a consequence of the presence of the palatal wound were described by each patient on a 100-mm visual analogic scale (VAS; score ranging 1 to 10) at the end of the first postoperative week.

Surgical Technique

Recipient Site

At the surgical site (Fig 1), after local anesthesia, the initial intrasulcular incision (Fig 2) is made, beginning from the distal line-angle of the second tooth preceding the gingival recession to be treated and extending to the mesial line-angle of the second tooth subsequent the recession. The palatal donor area is anesthetized by block anesthesia of the greater palatine and nasopalatine nerves. The primary incision on the palate is made by a #15 scalpel blade positioned perpendicular to the long axis of the teeth, approximately 2 to 3 mm apical to the gingival margin (Fig 3). The depth of the incision reaches the bone surface, while the mesiodistal length of the incision measures from the distal line-angle of the cuspid to the mesial line-angle of the first molar. A U-shaped incision about 1 mm deep is made in the center of the first incision, starting and ending
on the incision itself, with the convex side of the incision oriented towards the palatine vault. The width of the U-shaped incision is equal to the width of the gingival recession being covered while the length is greater by about 1 mm, and they are reported on the palate through a PCP UNC 15 probe. The angle of the blade is 90 degrees to the bone. Afterwards, the blade is angled approximately parallel to the alveolar process, and an undermining preparation starts from one extremity of the primary incision toward the median palatal vault (Fig 4a), extending for a length equal to the recession size plus 2 to 3 millimeters, depending on the palatal shape. When the blade reaches the first side of the U-shaped incision, the undermining elevation continues along the U-incision edges (Fig 4b), then the split-thickness elevation continues to the end of the primary incision itself (Fig 4c). The underlying tissue is then separated from the surrounding connective tissue by making subepithelial perpendicular incisions to bone on the mesial (Fig 5a), distal (Fig 5b), and medial (Fig 5c) sides of the graft, according to the technique suggested by Hürzeler and Weng. The graft is then removed by detaching it from the bony surface with a #1 Ochsenbein periodontal chisel (Hu-Friedy) (Fig 6). A hemostatic collagen sheet is then inserted into the donor zone, and the wound margins are sutured along the primary incision by interrupted sutures. An X-shaped compression suture is then positioned to compress the donor area (Fig 7).
immediate and/or delayed bleeding from the submucosal donor site, two vertical mattress sutures are made mesial and distal to the tissue-harvesting site. The ligatures are made with a 2-0 silk suture by a semicircular needle. The needle is inserted about 0.5 mm coronal to the primary horizontal incision and 2 mm distal or mesial to the ends of the same incision. The needle is left to slide on the bony surface of the alveolar process and is more apically resurfaced, beyond the apical edge of the donor site.

This tissue-harvesting method produces a graft that is composed in its central part by the full thickness of all palatine tissues: epithelium, gingival chorion, submucosal, and periosteum. On both sides and apically in the central area, the graft is composed of the subepithelial connective tissue and the periosteum (Fig 8).

**Grafting and Suturing**

The graft is then placed under the overlying partial-thickness flap at the recipient site. To facilitate the graft positioning, an absorbable suture drags the graft inside the tissue envelope: the needle enters at the most apical part of the partial-thickness flap, passes underneath the flap itself, and comes out of the gingival margin of the recession site. Therefore, the needle engages the graft with a mattress suture at its central part, in the de-epithelialized area apical to the U-shaped epithelialized portion. Finally, the needle enters beneath the flap from the gingival margin and comes out buccally next to the entrance site. Then, the suture is tensioned and knotted, and the graft is held below the flap so that the epithelialized part exactly covers the exposed root surface as an inlay enters its seat (Fig 9). The interdental papillae are replaced using interrupted sutures. An X-shaped horizontal compressive suture is placed over the surgical area (Fig 10). A periodontal dressing is placed over the donor and the recipient sites.
postsurgical care

Statistical Analyses

A computer program was used for all statistical analyses (SPSS version 13, IBM). A subject-level analysis was performed for each parameter. Descriptive statistics were performed using mean ± standard deviation (SD) for quantitative variables and percentage for qualitative variables. The primary outcome was CRC at the 1-year examination. Secondary outcomes were changes in the other clinical parameters. Shapiro-Wilk test, followed by skewness, kurtosis, and outliers’ detection using the median absolute deviation, were used to rule out a data distribution incompatibility with parametric tests. Multivariate analysis of variance (MANOVA) test was conducted on the 1-year follow-up scores to compare all parameters at once. Finally, the detected proportion of CRC in the series was compared with the 95% confidence interval (CI) upper-bound proportion reported in Chambrone et al’s20 meta-analysis by means of an exact test. A value of $P < .05$ was considered statistically significant.

Results

No postoperative complications were reported by the patients. The FMPS and FMBS remained < 20% throughout the entire study. Fifteen recessions were treated, one for each patient; 6 were classified as Miller Class I, and 9 were classified as Class II. Six incisors, seven canines, and two premolars were treated.

The results obtained in this study are summarized in Table 1. The mean differences between scores (in mm) at 1 year were as follows (average, 95% CI): GR 5.07, 4.62 – 5.51; CAL 5.00, 4.49 – 5.51; PD –0.07, –0.46 – 0.32; KT 4.20, 3.09 – 5.31; and thickness of gingival tissue (GT) 1.73, 1.33 – 2.14. The overall MANOVA test comparing the differences was significant ($P < .000$).

As the CI points out, the univariate comparisons of all parameters except PD are significant ($P < .001$). The comparison was statistically significant ($P = .002$; one-tailed exact test) between the CRC proportion in the present case series (93.3%) and the upper-bound 95% CI of the CRC proportion reported in a recent meta-analysis20 (56%). At baseline,
the mean recession depth (REC) was 4.9 ± 0.59 mm with a mean CAL amounting to 6.1 ± 0.74 mm. One year following the root coverage procedure, CRC was obtained in 14 of 15 treated recessions (93.3%; Fig 11); the mean residual REC was negative (-0.13 ± 0.51 mm), accounting for 100.22% ± 6.95% root coverage (P < .001) and showing that, in one case, the position of the gingival margin considerably exceeded that of the CEJ (Fig 12). Compared to baseline conditions, PD remained almost unchanged over time, and CAL gain was 5.00 ± 0.926 mm (P < .001). On average, the KT width increased from 1.20 ± 1.207 mm to 5.40 ± 2.23 mm at the 12-month examination, and this difference was statistically significant (P < .001). GT’s increase of 1.73 ± 0.72 mm was also significant (P < .001), more than doubling baseline values.

The median RES score was 8 (range: 5 to 9). CWE was observed after an average of 4.8 weeks (range: 4 to 6 weeks), mean analgesic consumption during the first week was 272 ± 98.6 mg (range: 160 to 400 mg), while patients’ median CFH VAS score during the first week was 4 (range: 2 to 6).

**Discussion**

The present prospective case series reports that in 15 patients treated with the FTPGT, 14 (93.33%) achieved CRC, with root coverage exceeding 100% on average.

In this regard, it is interesting to note that the present authors’ definition of CRC is consistent with
exists between GR and GT. In the case of surgical coverage of exposed roots, it is appropriate to increase the dimensions (width and thickness) of the tissue to prevent recurrence of the recession. In fact, the coronally advanced flap (CAF) procedure is reported to be an effective surgical technique to cover exposed roots; however, following the CAF procedure, a long-term follow-up showed a high percentage of GR recurrence (39%). On the contrary, when the CAF technique was used in association with a connective tissue graft, it produced a significant increase of tissue thickness and enhanced root coverage during a 5-year period. Similarly, the thickness of the tissue used to cover exposed roots in periodontal plastic surgery procedures seems to play a pivotal role in obtaining clinical success: In a recent systematic review, Hwang and Wang reported a positive association between flap thickness and mean CRC. Baldi et al, in a 19-case series of gingival recessions treated by CAF, reported a direct, significant relationship between flap thickness and recession reduction; similarly, Huang et al investigated the factors affecting the outcomes of CAF procedures and concluded that initial GT was the most significant factor associated with CRC. When treating GR using guided tissue regeneration, Harris observed low percentages of root coverage in areas of thin tissue. McFall listed tissue thickness in the receded area and the donor site as key factors in the treatment of recession defects. When clinicians use free or pedicle flaps in periodontal plastic surgery, the procedure’s success depends on the survival of the flap: In this regard, Clodius and Smahel demonstrated in pigs that thick flaps survived twice as often as thin flaps. Because flap survival depends on blood supply, the survival of thick tissues is encouraged by their greater vascularity, which strongly favors wound healing by enhancing oxygenation, regenerative mechanisms, and the clearance of toxic products. Mörmann et al demonstrated that thicker grafts undergo a smaller degree of shrinkage during the healing process. In fact, when analyzing the factors associated with incomplete root coverage, Miller underlines that grafting for root coverage requires a thick graft: the greater the thickness of the connective tissue, the more intact is its vascular system. This vascular network could allow for immediate circulation within the graft without the need for a “plasmic circulation” phase, as described by Sullivan and Atkins. In this regard, Mörmann described through fluorangiography the revascularization in free gingival grafts as early as 24 hours after surgery. The existence of the largest possible number of capillaries in the graft is assured due to its great thickness and mesiodistal dimension. In fact, the nonepithelialized part of the graft extends from the distal area of the cusp to the mesial surface of the first molar, despite only needing to cover a single root surface. Miller argues that an adequate graft thickness is best obtained by leaving a very thin layer of submucosa on the underside of the graft where possible. In the FTPGT, vertical incisions are not made in order to promote more rapid healing and to, above all, avoid compromising the blood supply of the overlying tissue. It can be postulated that vertical incisions greatly reduce
shown that periosteal cells release a vascular network, and it has been demonstrated that the periosteum has a highly rich supply of osteo-odontal ligament fibers and bone. The periosteum contains numerous stem cells that retain the ability to differentiate into fibroblasts, osteoblasts, chondrocytes, adipocytes, and myocytes, while the outer layer is composed of dense collagen fiber and fibroblasts. This provides the periosteum with a very important regenerative potential: the tissues produced by these cells include cementum with periodontal ligament fibers and bone. The periosteum has a highly rich vascular network, and it has been shown that periosteal cells release vascular endothelial growth factor. Melcher suggested that osteoperiosteal flaps, with fibrogenic and osteogenic capacities, may provide optimal donor tissue in periodontal surgery. The high biologic potential of periosteum, further increased by a previous mechanical stimulation, was utilized by Goldman et al to propose a periodontal plastic surgery technique. They hypothesized that stimulated osteoperiosteal flaps would enhance the bridging of exposed root surfaces treated by pedicle grafts. However, one must remember that there is no clear evidence in the literature that the biologic properties of the periosteum are maintained when this tissue is completely detached from the donor area. The FTPGT does not require an acid conditioning of the root surface because the literature reports that the use of root modification agents (ie, citric acid) did not provide superior gains in clinical outcomes.

Another important factor for FTPGT success may be the presence of periosteum in the graft. The use of periosteum in medicine and dentistry is not new. The periosteum is made up of two layers: an inner cellular layer and an outer fibrous layer. The inner layer contains numerous stem cells that retain the ability to differentiate into fibroblasts, osteoblasts, chondrocytes, adipocytes, and myocytes, while the outer layer is composed of dense collagen fiber and fibroblasts. This provides the periosteum with a very important regenerative potential: the tissues produced by these cells include cementum with periodontal ligament fibers and bone. The periosteum has a highly rich vascular network, and it has been shown that periosteal cells release vascular endothelial growth factor. Melcher suggested that osteoperiosteal flaps, with fibrogenic and osteogenic capacities, may provide optimal donor tissue in periodontal surgery. The high biologic potential of periosteum, further increased by a previous mechanical stimulation, was utilized by Goldman et al to propose a periodontal plastic surgery technique. They hypothesized that stimulated osteoperiosteal flaps would enhance the bridging of exposed root surfaces treated by pedicle grafts. However, one must remember that there is no clear evidence in the literature that the biologic properties of the periosteum are maintained when this tissue is completely detached from the donor area. The FTPGT does not require an acid conditioning of the root surface because the literature reports that the use of root modification agents (ie, citric acid) did not provide superior gains in clinical outcomes.

Another important factor for FTPGT success may be the presence of periosteum in the graft. The use of periosteum in medicine and dentistry is not new. The periosteum is made up of two layers: an inner cellular layer and an outer fibrous layer. The inner layer contains numerous stem cells that retain the ability to differentiate into fibroblasts, osteoblasts, chondrocytes, adipocytes, and myocytes, while the outer layer is composed of dense collagen fiber and fibroblasts. This provides the periosteum with a very important regenerative potential: the tissues produced by these cells include cementum with periodontal ligament fibers and bone. The periosteum has a highly rich vascular network, and it has been shown that periosteal cells release vascular endothelial growth factor. Melcher suggested that osteoperiosteal flaps, with fibrogenic and osteogenic capacities, may provide optimal donor tissue in periodontal surgery. The high biologic potential of periosteum, further increased by a previous mechanical stimulation, was utilized by Goldman et al to propose a periodontal plastic surgery technique. They hypothesized that stimulated osteoperiosteal flaps would enhance the bridging of exposed root surfaces treated by pedicle grafts. However, one must remember that there is no clear evidence in the literature that the biologic properties of the periosteum are maintained when this tissue is completely detached from the donor area. The FTPGT does not require an acid conditioning of the root surface because the literature reports that the use of root modification agents (ie, citric acid) did not provide superior gains in clinical outcomes.

In the FTPGT, the flap from the receiving site does not fully cover the graft; this is not to be considered a limit, as the literature demonstrates that complete graft coverage does not produce a significant reduction in GR compared to a graft that is not fully covered.

In the present case series, the authors observed a noticeable mean increase in KT width (4.2 mm). According to other authors, this may be due to the presence of an epithelialized tissue at the exposed portion of the graft.

The median RES score recorded in this case series was rather high (8 out of a maximum of 10; range: 5 to 9) with a satisfying blending of the tissue (Fig 11). This may seem surprising if one considers that the central part of the graft used in FTPGT is epithelialized and remembers that the techniques using epithelialized graft, like the epithelialized free gingival graft technique, frequently result in compromised esthetics with a “patch-like” appearance. This difference is potentially explained by the fact that the epithelialized part of the graft represents only a limited portion of the tissue and that the large part of the graft is positioned in the subepithelial site.

The main limitation of the technique described herein is the wide and deep wound that is produced on the palate when (1) harvesting a graft that has a thickness equal to that of the whole palatine soft tissues and subsequently (2) leaving the bone surface to heal by second intention. In fact, the present data show that the wound epithelialization time is noticeably longer than conventional harvest techniques (ie, gingival graft, trap door). A recently published paper reported that the time needed to obtain CWE after epithelialized free gingival graft harvesting treated by a gelatin sponge bandage was noticeably shorter (3.4 weeks) than that observed in the present case series (4.8 weeks). However, this slower healing was not associated with more pain or greater CFH in the first postoperative week compared to the previous study; furthermore, no patient reported painful palatal healing. This finding is in disagreement with an observation from the literature, which relates postoperative pain to the dimensions and depth of the palatal withdrawal. This disagreement can be explained by the present study’s accurate wound bandaging and the complete removal of the submucosa and periosteum containing the injured sensitive structures exposed by surgery.
Conclusions

Although the authors treated a limited number of patients, the results obtained in the present study were promising. According to the 95% CI values of a recent meta-analysis, the FTPGT was an effective and predictable periodontal plastic surgery technique for obtaining CRC with very high success rates. Furthermore, this technique increased KT, thus making it suitable for treating Class II recessions. Additionally, FTPGT produced a great increase in PGT produced a greater discomfort for the patient. This does not lead to a greater discomfort for the patient. Randomized and controlled clinical trials will be needed to confirm the effectiveness of this new surgical technique.

Acknowledgments

This study was supported by a grant from the Italian Ministry of University and Scientific Research (ex 60% - 015). The authors report no conflicts of interest related to this study.

References