The Connective Tissue Platform Technique for Soft Tissue Augmentation

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The presence of a localized alveolar ridge defect, especially in the maxillary anterior dentition, may complicate an esthetic rehabilitation. The goal of this case report is to describe a novel subepithelial connective tissue graft technique for soft tissue augmentation in Class III ridge defects. Surgical intervention consisted of in situ maintenance of a connective tissue "platform" at the edentulous space, which facilitated the stabilization and suturing of the connective tissue grafts used for soft tissue augmentation. Adequate graft thickness to treat the deep horizontal soft tissue loss was obtained by doubling the width of a de-epithelialized free gingival graft that was subsequently folded on itself. The soft tissue conditioning at the level of the pontic began 9 months after surgery by shaping the soft tissue with a bur and filling the space with flowable composite resin applied above the pontic. The final prosthetic phase began 14 months after surgery. A reproduction of the anatomical cementoenamel junction in the provisional and definitive restorations was performed to improve the soft tissue emergence profile. Nine months after surgery, a soft tissue augmentation of 5 mm in the vertical and 4 mm in the horizontal dimension was accomplished. The suggested surgical technique was able to accomplish horizontal and vertical soft tissue augmentation in a single surgical step. (Int J Periodontics Restorative Dent 2012;32:665–675.)

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Postextraction alveolar ridge deformities complicate implant rehabilitations, and prosthetic treatment encounters several problems concerning functionality (phonetic and food impaction under the pontic), esthetics (scalloped outline alteration, loss of papillae and formation of "black" open interdental space, presence of gingival scar tissue, and difficult design of an esthetic pontic), and cleaning. Traditional restorative solutions to reduce the esthetic defect include a long fixed partial denture (FPD) pontic extending to contact the ridge or a long crown on the implant, gingival-like porcelain or acrylic resin on the pontic element or on the crown connecting to the implant, and a removable prosthesis that attempts to simulate the anatomical contour of the edentulous alveolar ridge. These prosthetic solutions may be acceptable from a functional point of view, but they frequently lack realism and are easily recognizable when the patient smiles. For this reason, surgical techniques to correct soft tissue defects have become of great clinical interest.

Fig 1 *Maxillary right lateral incisor at baseline showing a fistula in the buccal keratinized tissue, slight tooth extrusion, and gingival recession of the interdental papillae.*

Classification of the ridge defect should have great significance for estimation of the prognosis and degree of technical difficulty of the surgical intervention. According to Seibert,[1] ridge defects were described as Class I in the case of buccolingual loss of the ridge contour, Class II when the loss of ridge contour was apico-coronal, and Class III in the case of a combined loss of ridge contour. Allen et al[2] modified the Seibert classification in 1985 by introducing the assessment of the defect depth relative to the adjacent ridge. Defects were categorized as mild (< 3 mm), moderate (between 3 and 6 mm), or severe (> 6 mm). In 1997, Studer et al[3] proposed a new semiquantitative classification of localized ridge defects according to their severity (mild, moderate, or severe) in the vertical and horizontal dimensions as well as their extent (one, two, three, or four teeth). This classification completed the qualitative one[1] and permitted a preoperative prognosis of the tissue augmentation procedures.

An alveolar ridge defect may be corrected using autogenous bone graft,[4] guided bone regeneration with a barrier membrane[5,6] alone or in combination with bone graft materials,[7–9] or soft tissue augmentation.[1,10–23] An increase in soft tissue provides an esthetic mucogingival implementation, while guided bone regeneration with autogenous bone or bone substitute is required to augment the volume of bone necessary to achieve the successful placement of implants.[4,7] However, in the latter case, soft tissue augmentation may be necessary to improve the mucogingival esthetics around the implants Soft tissue augmentation techniques can be classified into four groups: *(1)* onlay grafts,[1,10,13,14] *(2)* pouch grafts or subepithelial connective tissue grafts (CTGs),[12,19,20] *(3)* interpositional grafts,[15–17] and *(4)* roll flaps.[11]

Langer and Calagna[12,19] and Garber and Rosenberg[20] described the subepithelial CTG technique, which guaranteed uniform and harmonious color, texture, and contour of the reconstructed ridge—objectives not easily achieved with other techniques. The recipient site was prepared in different ways,[2,21,22] but in most cases, a horizontal incision was made over the crest of the edentulous alveolar ridge connecting two vertical incisions that did not include the papillae. A partial-thickness flap was elevated and the CTG was placed beneath it in the desired position to augment the alveolar ridge. Miller[23] described a modified approach at the donor site consisting of a single vertical incision made at the most distal aspect of the ridge defect with the creation of a "tunnel" between the soft tissue and bone. Subepithelial CTGs are mostly used in mild or moderate Class I and II defects.

This case report describes a novel subepithelial CTG technique for soft tissue augmentation in Class III ridge defects and recommends a delayed approach for prosthetic soft tissue conditioning.

Case report

A 34-year-old woman was referred to the Department of Oral Science of Bologna University, Bologna, Italy, for diagnosis and treatment of a lesion affecting the maxillary right lateral incisor (Fig 1). Her chief complaints were the increase of mobility of the tooth and pain during function. The tooth showed degree 2 mobility.[24] Radiographic examination revealed

Fig 2 (right) *Periapical radiography showed a radiolucent area mesial to the middle portion of the root, a vertical bony defect at the distal aspect of the root, and an increase in the width of the periodontal ligament space mesial to the root. Both the lateral and central incisors were treated endodontically.*

Fig 3 *After tooth extraction, a provisional Maryland FPD was applied with care taken to not fill the alveolus with the pontic.*

Fig 4 *Three months after tooth extraction, a Class III soft tissue defect was formed. Moderate tissue loss (6 mm) in the vertical dimension was present.*

Fig 5 (above) *Three months after tooth extraction, moderate tissue loss (5 mm) was noted in the horizontal dimension.*

Fig 6 (right) *Lateral view demonstrating remarkable buccopalatal soft tisssue loss.*

the presence of a rounded radiolucent area mesial to the middle portion of the root of the maxillary right lateral incisor, a vertical bony defect at the distal aspect of the root, and an increase in the width of the periodontal ligament space mesial to the root (Fig 2); both the vertical bony defect and the enlargement of the periodontal ligament reached the rounded radiolucent area. The tooth was not vital, and preexisting root canal treatment was present. The clinical and radiographic examinations led to the diagnosis of an endo-perio lesion: Presumably, the lesion started as endodontic (subgingival fracture of the tooth) and then was complicated with periodontal involvement. The tooth was extracted. A provisional metal-ceramic Maryland FPD (Fig 3) was created using the Rochette concept.[25,26] The edentulous area was reevaluated 3 months later (Fig 4). At this time, the site showed a Class III defect with moderate tissue loss in the horizontal (Figs 5 and 6) and vertical dimensions (Fig 4).[1,2] The amount of soft tissue loss, calculated using the concept of Studer et al,[3] was 6 and 5 mm in the apico-coronal and buccopalatal dimensions, respectively. Three months after extraction, soft tissue augmentation was performed with the aim of reestablishing the height and thickness of the soft tissue in the edentulous area.

Fig 7 (left) *Baseline clinical situation after removal of the provisional Maryland FPD.*

Fig 8 (right) *Buccal flap elevation. A root coverage–like envelope split-full-split–thickness flap was raised with the goals of being advanced coronally and exposing the buccal connective tissue of the edentulous crest.*

Fig 9 (left) *The crestal soft tissue of the edentulous space between the buccal and palatal incisions was de-epithelialized to leave a connective tissue platform in situ.*

Fig 10 (right) *Split-thickness palatal flap elevation limited to the edentulous space and the connective tissue platform left in situ (occlusal view).*

Surgical procedure

The surgical approach consisted of two parallel horizontal incisions performed at the buccal and palatal edges of the occlusal surface of the edentulous area. The incisions were approximately 3 mm from one another. This allowed for in situ maintenance of a soft tissue "platform" after buccal and palatal flap elevation, which facilitated stabilization and suturing of the CTGs used for soft tissue augmentation.

The buccal incision continued with a design similar to a coronally advanced flap used for the treatment of multiple gingival recessions in soft tissue plastic surgery (Figs 7 and 8).[27,28] The rationale was to elevate an envelope buccal flap to be advanced enough coronally to reach the palatal incision of the edentulous area and obtain primary closure over the CTGs. The envelope-type buccal flap was extended from the distal surface of the left central incisor to the distal aspect of the right second premolar. Such extension allowed for adequate and passive coronal advancement of the buccal flap. Each submarginal incision at the interdental spaces neighboring the edentulous area was directed toward the midline and passed through the buccal surface of the canine.[27] The buccal flap was raised at the level of the horizontal incision of the edentulous area in a split-thickness manner up to the crestal bone; this allowed for the buccal connective tissue surface of the soft tissue platform to be exposed (Figs 8 and 9). Full-thickness flap elevation continued to expose 2 to 3 mm of buccal bone, and then split-thickness flaps were elevated to permit coronal advancement. Also, the flap was raised at the level of the other teeth included in the flap design with a split-full-split approach in the apico-coronal direction. The surgical papillae were dissected in a split-thickness manner up to the buccal bone crest, and the full-thickness flap was elevated to expose at least 2 to 3 mm of buccal bone. Finally, the most apical portion of the split-thickness flap was elevated to facilitate coronal displacement of the buccal flap. The remaining facial portion of the anatomical papilla was de-epithelialized to create connective tissue beds to which the surgical papillae of the coronally advanced buccal flap were secured at the time of suturing.

The palatal flap was raised in a split-thickness manner (up to the palatal crestal bone) at the level of the palatal occlusal incision and

Fig 11 (left) *After de-epithelialization, a double-length graft was folded on itself, and resorbable sutures were used to permit precise adaptation between the inner surfaces of the graft.*

Fig 12 (right) *The double-thickness CTG used to treat the horizontal component of the soft tissue defect.*

Fig 13 (left) *The double-thickness CTG was sutured at the buccal surface of the occlusal platform using interrupted single sutures. A horizontal mattress suture anchored to the periosteum apical to the graft facilitated graft stabilization.*

Fig 14 (right) *De-epithelialized graft positioned above the occlusal surface of the platform and sutured using interrupted single sutures anchored to the connective tissue of the platform. The grafts compensated for the horizontal and vertical components of the soft tissue defect.*

was limited to the edentulous area (Fig 10). This minimal flap extension permitted exposure of the palatal surface of the soft tissue platform only and allowed for independent suturing of the flaps with respect to that of the CTGs.

After flap elevation, the occlusal surface of the soft tissue platform in the edentulous area was de-epithelialized to create a full connective tissue platform acting as the recipient site for the CTGs (Fig 9). Two different CTGs were used to treat the horizontal and vertical components of the soft tissue defect separately. The grafts were derived from the de-epithelialization of free gingival grafts harvested from the palate,[29] which was performed using a blade. This technique was preferred to other CTG harvesting procedures[30–32] because of the limited thickness of the palatal fibromucosa and the absence of the soft tissue tuberosity. The palatal fibromucosa was so thin that even with the technique, the available connective tissue thickness would not have been adequate to compensate for the deep horizontal component of the soft tissue defect. For this reason, it was decided to double the mesiodistal length of the graft with respect to the dimension of the edentulous space. After de-epithelialization, the graft was folded on itself, and resorbable sutures were used to permit precise adaptation between the inner surfaces of the graft (Fig 11). This allowed for doubling the thickness of the CTG used to treat the horizontal component of the soft tissue defect (Fig 12). This double-thickness CTG was sutured at the buccal surface of the connective tissue platform using interrupted sutures. A horizontal mattress suture anchored to the periosteum apical to the graft permitted graft adaptation above the periosteum (Fig 13). The graft adequately compensated for the loss of buccopalatal soft tissue (Figs 13 and 14). The second graft was positioned above the occlusal surface of the platform and sutured using interrupted single sutures anchored to the connective tissue of the platform (Figs 13 and 14). This graft compensated for the vertical tissue defect.

Coronal advancement of the buccal flap was obtained by means of two split-thickness incisions: one deep, cutting the muscle insertions on the periostium, and one superficial, detaching the muscle inserting in the inner aspect of the mucosa lining the flap. This second incision allowed for coronal advancement of the flap.

Fig 15 (left) *Buccal flap with sling sutures anchored around the palatal cingula of the teeth included in the flap design.*

Fig 16 (right) *Single interrupted sutures were used to achieve complete closure between the horizontal buccal and palatal incisions of the edentulous space and primary intention wound healing above the CTGs used for soft tissue augmentation.*

Fig 17 (left) *Suture removal 14 days after surgery. The pontic and crestal soft tissues were almost in contact.*

Fig 18 (right) *Nine months after surgery. Clinical soft tissue maturation was almost complete.*

Flap mobilization was considered adequate when the buccal horizontal incision of the edentulous area reached the palatal horizontal incision without tension and when the marginal portion of the flap was able to passively reach a level coronal to the cementoenamel junction (CEJ) at every tooth included in the flap design.

Sling sutures suspended around the palatal cingula of the treated teeth were used to anchor the surgical papillae comprised in the flap design to the corresponding de-epithelialized anatomical papillae. These sutures were able to accomplish precise adaptation of the buccal flap on the dental crowns (Fig 15). Single interrupted sutures were performed to achieve complete closure between the horizontal incisions of the edentulous space and primary intention wound healing above the CTGs used for soft tissue augmentation (Fig 16). All sutures used were 6-0 Vicryl (Johnson & Johnson).

At the end of surgery, the pontic of the Maryland FPD was reduced to avoid contact with the soft tissue.

Prosthetic phase

The pontic was reduced to allow the postsurgical soft tissues to mature without interference by the prosthetic material (Fig 17). Control visits were scheduled every month. Preparation of the site to receive the pontic was initiated when no further soft tissue augmentation was observed between two consecutive control visits, which was noted 9 months after surgery (Fig 18) when an almost flat outline of the crestal soft tissue in the edentulous space was obtained and a 5-mm

Fig 19 (left) *Frontal view 9 months after surgery. Note the vertical soft tissue augmentation in relation to the neighboring teeth and the position of the soft tissue margin of the healthy contralateral lateral incisor.*

Fig 20 (right) *Occlusal view 9 months after surgery. Note the horizontal soft tissue augmentation.*

Fig 21 *Soft tissue preparation.*

Fig 22 (above) *Gingival adaptation of the provisional restoration.*

Fig 23 (right) *Lateral view of the pontic element with simulation of a CEJ on the provisional restoration.*

vertical (Fig 19) and 4-mm horizontal (Fig 20) soft tissue augmentation was achieved.[3]

The site receiving the pontic was prepared using rounded burs to wear the midpoint of the occlusal-buccal surface of the edentulous crestal soft tissue (Fig 21). The space shaped in the soft tissue was filled by adding flowable composite resin (Kerr) above the pontic until soft tissue compression was noted, and temporary ischemia was created when the Maryland FPD was placed (Fig 22). The creation of soft tissue wear and addition of composite resin to the pontic was repeated until good shape and growth of the interdental papillae were accomplished. Simulation of the CEJ (Fig 23) was performed at the vestibular aspect to cease growth of the tissue when the provisional restoration reached the gingival level of the contralateral lateral incisor. When no additional interdental papillary growth was recorded (14 months after surgery), the final prosthetic phase was initiated. A pressable lithium disilicate (e.max Press, Ivoclar Vivadent) was used to permanently cement the Maryland FPD at the missing lateral incisor site.


Figs 24a and 24b *Comparison of the patient's smile* (left) *3 years before tooth extraction and* (right) *1 year after cementation of the definitive Maryland FPD. The soft tissue contour of the replaced lateral incisor matched that of the adjacent teeth better than the healthy lateral incisor 3 years before tooth extraction.*


Figs 25a and 25b *Comparison of the frontal region* (left) *at time of surgery and* (right) *1 year after cementation of the definitive Maryland FPD. The soft tissue contour, color, and thickness at the replaced tooth were in harmony with those of the adjacent teeth and that of the contralateral lateral incisor.*

Results

Nine months after surgery, a soft tissue augmentation of 5 mm in the vertical and 4 mm in the horizontal dimension was accomplished. One year after the definitive Maryland FPD was cemented, a highly satisfactory esthetic outcome was achieved (Figs 24 to 26). The soft tissue contour (scalloped outline) of the replaced lateral incisor matched that of the adjacent teeth and the healthy contralateral incisor. The color and height of the keratinized tissue buccal to the lateral incisor were well integrated with the adjacent gingival tissue, and the mucogingival junction was perfectly realigned. The color and shape of the replaced tooth was in harmony with the adjacent teeth. The emergence profile of the replaced tooth was easy to clean and faithfully reproduced that of a healthy tooth. In fact, the emergence profile of the pontic was almost identical to that of the healthy adjacent and contralateral teeth.

Figs 26a and 26b *Comparison of the profile* (left) *at time of surgery and* (right) *1 year after cementation of the definitive Maryland FPD. The emergence profile of the replaced tooth faithfully reproduced that of the healthy adjacent teeth.*

Discussion

In this case report, a novel soft tissue augmentation surgical technique for the treatment of a Class III postextraction soft tissue defect was described. One year after cementation of the definitive FPD (more than 2 years after surgery), successful esthetic and periodontal outcomes were accomplished. The soft tissue contour, color, and thickness at the replaced tooth were in harmony with those of the adjacent teeth. Also, the emergence profile was easy to clean and replicated that of the neighboring healthy teeth.

The adopted surgical technique is included among the subepithelial CTG augmentation procedures, but various modifications have been proposed with the aims of obtaining both horizontal and vertical augmentations in a single surgical step and improving the esthetic outcome. The first and most important modification is related to the in situ maintenance of the connective tissue platform in the edentulous space. This facilitated the suturing of both CTGs: one compensating for the buccopalatal defect and one used to treat the vertical deficiency. Furthermore, by leaving the height of the crestal soft tissue intact (apart from the de-epithelialization), minimal thickness of the CTG was needed to compensate for the vertical soft tissue loss.

Another modification of the technique is the use of an envelope buccal flap similar to a coronally

advanced flap for the treatment of multiple gingival recessions in soft tissue plastic surgery.[27] Vertical releasing incisions may damage the blood supply to the flap and often result in unesthetic visible white scars.[33] The absence of vertical releasing incisions is important in the present surgical technique since the horizontal incision at the edentulous space had to be shifted palatally as well as coronally to reach the palatal horizontal incision. With such movement, the vertical releasing incisions would have been shifted mesially and be far from the adjacent firm soft tissues, with greater risk of damaging the blood supply to the flap and provoking gingival defects in the adjacent teeth. A covering flap might cause unesthetic graft exposure in the best situation or graft necrosis in the most unlucky circumstances. The liberalization of a wide envelope flap from the deep (periosteal) and superficial (submucosal) muscle insertions allowed for the horizontal incision at the edentulous area to passively reach the palatal incision despite the presence of the two grafts, with no damage to the flap or the adjacent teeth. On the contrary, gingival recessions presenting at the teeth neighboring the edentulous space could have been repaired by means of a coronally advanced flap.

A further characteristic of the present surgical approach is the technique used for harvesting the CTG. A free gingival graft that was subsequently de-epithelialized[34] was used instead of a CTG harvested using a trap door[30] or single incision harvesting technique.[31,32] Some advantages are derived from this choice. The connective tissue used for the graft was that closer to the epithelium, which is more dense and stable, compared to connective tissue closer to the bone, which is rich in fatty and glandular tissue.[29] This technique provides adequate connective tissue thickness for the graft independent of the quality and thickness of the palatal fibromucosa. Another advantage of the graft-harvesting procedure adopted in this study is that the adequate thickness to compensate for the deep horizontal soft tissue loss was not obtained by increasing the depth of the withdrawal. This would have increased postoperative discomfort and pain. In a recent study,[29] patients' intakes of anti-inflammatory drugs were positively correlated with the depth and apico-coronal height of the withdrawal. On the other hand, the mesiodistal width of the graft did not affect patient morbidity. This could explain why limited postoperative discomfort was reported by the patient in this study, despite having wide grafts harvested.

The provisional prosthetic management had a critical role in the successful outcome of the presented clinical case. Undisturbed soft tissue growth led to an almost complete correction of the vertical and horizontal component of the soft tissue defect. The development of interdental papillae with a shape and height similar to those of the contralateral healthy lateral incisor (control) indicated that the adopted delayed prosthetic soft tissue conditioning was able to achieve optimal esthetic outcomes.

Another peculiar aspect of the prosthetic phase of this clinical case was related to the reproduction of the anatomical CEJ in the provisional and definitive restorations. This allowed the augmented soft tissue to adapt to the scalloped and overhanging outline of the prosthetic CEJ in the same manner as the soft tissue margin would adapt to the anatomical CEJ. This contributed to an esthetic buccal appearance and emergence profile undistinguishable from those of the adjacent and contralateral healthy teeth.

Conclusions

Within the limitations of this case report study, some conclusions can be drawn:

- The suggested technique was able to accomplish a 4-mm horizontal and 5-mm vertical soft tissue augmentation in a single surgical step.
- In the absence of a sufficiently thick and wide retromolar tuberosity, the mesiodistal dimension of a de-epithelialized free gingival graft should be doubled.
- Delayed (9 months) soft tissue conditioning at the level of the pontic is indicated in surgically augmented narrow (single) edentulous spaces.

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