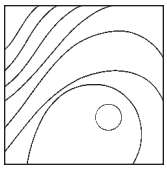
Soft Tissue Volume Augmentation Using Connective Tissue Grafts via Apical Pouch: Technical Considerations and Case Reports



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The success of dental implant therapy in the esthetic zone requires not only functional osseointegration but also favorable esthetic results. The greatest challenge in the esthetic zone is to establish harmony, balance, and continuity of gingival form between implant restorations and the adjacent natural teeth. In the esthetic zone, a localized ridge defect or loss of a peri-implant papilla is common and can be corrected via soft tissue augmentation. This case report describes a novel surgical technique using connective tissue grafts via an apical pouch to increase soft tissue volume over an alveolar ridge defect or around natural teeth or implants in the maxillary anterior area. The described surgical technique successfully achieved the desirable esthetic outcomes in the reported cases. Int J Periodontics Restorative Dent 2016;36:e95–e102. doi: 10.11607/prd.2892

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A localized alveolar ridge defect refers to a volumetric deficiency in bone and/or soft tissue in the alveolar process.[1] The presence of a localized alveolar ridge defect in the esthetic zone may compromise the final esthetic outcome. Augmentation is often required to enhance the alveolar ridge contour for an optimal result. Not only the lost portion of the alveolar process must be restored, but also the associated soft tissue. Soft tissue augmentation procedures are commonly used to increase tissue volume around implants and in partially edentulous regions.[2] The success of a dental implant is determined not only by achievement of osseointegration, but also by an esthetically pleasing restorative outcome. Peri-implant soft tissue contour and stability are important factors in determining optimal implant restoration outcomes.[3]

The dentogingival junction consists of the junctional epithelium (epithelial attachment) and connective tissue fiber attachment.[4] The peri-implant mucosa has many features in common with gingival tissue surrounding teeth.[5] In a natural tooth, the connective tissue fibers inserted into the cementum are oriented perpendicularly or obliquely to the tooth surface.[6] Around an implant, the supra-alveolar connective tissue serves to retain soft tissue attachment on the implant surface.[7]

The peri-implant supra-alveolar connective tissue attachment, between the most apical cells of the junctional epithelium and the bony crest, includes collagen fibers arranged parallel to the implant surface, forming a collar without insertion into the implant itself.[5] However, the connective tissue fibers do insert into the alveolar crest. This different attachment of the gingiva to the implant is thought to manifest itself through a high incidence of recession in the first 6 months after dental implant final restoration, with > 1 mm in apical movement.[6] The complications associated with peri-implant soft tissue recession can dramatically affect the esthetic appearance of the patient with a high lip line.[8]

Periodontal plastic and mucogingival surgery has been reported to address peri-implant soft tissue discrepancies.[9] Free gingival grafts (FGGs) and connective tissue grafts (CTGs) are most often used for soft tissue volume augmentation in the oral cavity.[10] Nevertheless, CTGs have been demonstrated to be the best-documented and most successful method for soft tissue volume gain at implant sites and partially edentulous areas.[2] CTGs appear to be superior in terms of soft tissue volume gain when compared with FGGs for the correction of a localized alveolar ridge defect in a single-tooth pontic space.[11] Furthermore, CTGs are generally preferred over FGGs, especially in areas with high esthetic demands due to their greater predictability in obtaining root coverage and better esthetic outcomes (ie, more optimal color match and contours).[12,13] The patient-based outcomes in terms of postoperative donor site pain and analgesics usage are also more favorable for CTG than for FGG procedures.[14]

The present case report describes a novel surgical technique utilizing CTGs via an apical pouch to increase soft tissue volume for alveolar ridge and peri-implant soft tissue defects in the maxillary anterior area. The surgical procedure presented in these cases demonstrates successful vertical soft tissue augmentation in a single surgical step.

Apical pouch technique

We are introducing a modified tunnel technique, the apical pouch technique (APT), which uses a horizontal incision with a tunneled flap apical to sites with soft tissue deficiencies. The versatile APT, described and illustrated in this report, can be used individually or in combination for root coverage on natural teeth, coverage of exposed implants, papillae augmentation, and pontic site development. There are four specific steps in performing a successful APT (Fig 1).

Step 1: Horizontal incision

A horizontal incision, directed coronally, is made at least 3 to 5 mm apical to the gingival line and extending 3 mm lateral to the defects around a dental implant and/or a natural tooth (Fig 1b).

Step 2: Coronal flap elevation

A partial-thickness flap is prepared from the horizontal incision line using a 15C blade (Hu-Friedy) and is extended coronally toward the gingival margin. A sulcular incision is made around the affected tooth and/or implant. The mucosal flap preparer (PPS 1300D, devemed) is then used for supraperiosteal dissection, creating a tunnel between the periosteum and the mobilized superficial tissue (Fig 1c). This allows enough room to permit placement of a CTG for volume augmentation to correct marginal tissue recession around a tooth and/or a dental implant. For pontic site development, a tunnel is prepared from buccal to occlusal and then slightly palatal by way of a three-dimensional elevation to increase the buccal volume and the vertical height (Fig 1c). The mucosal flap preparer is used to advance the partial-thickness dissection toward the palate to form a wrap-around tunneled space for insertion of CTGs.

Step 3: Graft stabilization

The CTGs can be harvested from the hard palate or from the maxillary tuberosity region. A minimum CTG thickness of 2 mm is optimal. For marginal tissue recession around a tooth or dental implant, the CTG should extend an additional 3 mm in lateral and apical directions from the defect. Similar extension to the palate is desirable in pontic site development for papillae and convexity augmentation. Immobilization of the graft subjacent to the flap is a key element of success. The entry point of the suture needle should be at the most remote recipient site away from the incision to secure the farthest end of the graft by first

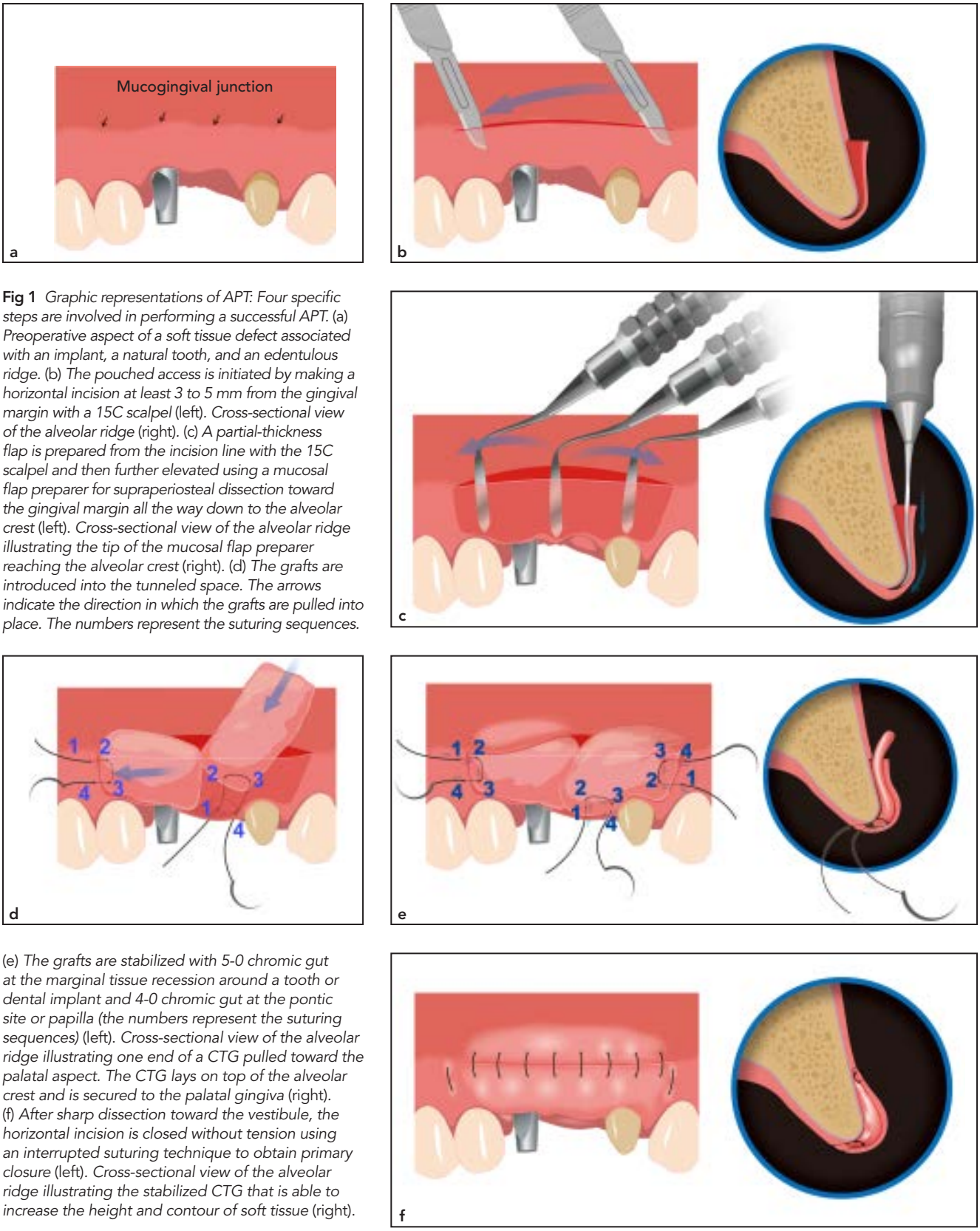

Fig 1 *Graphic representations of APT: Four specific steps are involved in performing a successful APT.* (a) *Preoperative aspect of a soft tissue defect associated with an implant, a natural tooth, and an edentulous ridge.* (b) *The pouched access is initiated by making a horizontal incision at least 3 to 5 mm from the gingival margin with a 15C scalpel* (left). *Cross-sectional view of the alveolar ridge* (right). (c) *A partial-thickness flap is prepared from the incision line with the 15C scalpel and then further elevated using a mucosal flap preparer for supraperiosteal dissection toward the gingival margin all the way down to the alveolar crest* (left). *Cross-sectional view of the alveolar ridge illustrating the tip of the mucosal flap preparer reaching the alveolar crest* (right). (d) *The grafts are introduced into the tunneled space. The arrows indicate the direction in which the grafts are pulled into place. The numbers represent the suturing sequences.* (e) *The grafts are stabilized with 5-0 chromic gut at the marginal tissue recession around a tooth or dental implant and 4-0 chromic gut at the pontic site or papilla (the numbers represent the suturing sequences)* (left). *Cross-sectional view of the alveolar ridge illustrating one end of a CTG pulled toward the palatal aspect. The CTG lays on top of the alveolar crest and is secured to the palatal gingiva* (right). (f) *After sharp dissection toward the vestibule, the horizontal incision is closed without tension using an interrupted suturing technique to obtain primary closure* (left). *Cross-sectional view of the alveolar ridge illustrating the stabilized CTG that is able to increase the height and contour of soft tissue* (right).

placing a mattress suture (Fig 1d). A 5-0 chromic gut suture (Hu-Friedy) is used to secure the graft covering marginal tissue recession on a tooth or an implant, and 4-0 chromic gut suture (Hu-Friedy) is used for wrapping the graft around a pontic site or papilla (Fig 1e).

Step 4: Wound closure

Following graft placement, a partial-thickness flap from the incision line toward the vestibule should be raised. The flap should be sufficiently freed up to allow for tension-free closure of the augmented sites. The horizontal incision is closed without tension via interrupted sutures to obtain primary closure (Fig 1f).

Case reports

Case 1: Soft tissue augmentation around a dental implant and edentulous site

The patient was a healthy 24-year-old woman who presented with an implant-supported fixed cantilever provisional restoration in the area of the maxillary right central incisor. Clinical examination revealed pink acrylic on the apical aspect of the provisional restoration at the maxillary central incisors to improve esthetics (Fig 2a). Marginal tissue recession was identified on the implant prosthetic abutment at the left central incisor, with discolored gingival tissue. Lack of papillae was also noted at the mesial aspect of both the implant and the left lateral incisor (Fig 2b). Following the protocol for the previously mentioned APT, a horizontal incision was placed and extended 3 mm laterally from the implant and the left lateral incisor (Fig 2c). Sulcular incisions were performed around the implant and the left lateral incisor. A partial-thickness flap was extended coronally from the horizontal incision until continuity was established between the horizontal and sulcular incisions. The flap coronal to the horizontal incision was tunneled and advanced coronally to cover the implant abutment and increase the vertical height of the gingival tissue around the edentulous region. One CTG and one FGG, each 2 mm in thickness, were harvested from the hard palate and the maxillary tuberosity area, respectively. The epithelium of the FGG was removed, and access to position each graft in the tunneled space was ascertained. The coronal flap was sufficiently extended to make certain that the gingival margin over the implant could be coronally advanced at least 1 mm beyond the implant-abutment interface. To increase the vertical height of the soft tissue in the edentulous region, the flap was freed up a minimum of 2 mm vertically and slightly palatally from the alveolar ridge to create a tunnel space for positioning grafts. The grafts were introduced subjacent to the coronal flap and secured to the palatal gingiva with horizontal mattress sutures (Fig 2d). The grafts were further secured subjacent to the flaps by horizontal mattress sutures from the distal aspect of the marginal tissue recession defect on the implant. Following sharp dissection from the horizontal incision line toward the vestibule, the flap apical to the horizontal incision was coronally advanced and closed by interrupted sutures (Fig 2e). At 6 months after surgery, correction of marginal tissue recession on the implant at the site of the maxillary right central incisor, coverage of the exposed root on the maxillary left lateral incisor, and augmentation of soft tissue contour and height at the pontic site were achieved (Fig 2f). The permanent restoration, consisting of an implant-supported cantilever bridge (Fig 2g), was finalized 1 year following the surgery. An excellent esthetic outcome was accomplished with APT.

Case #2: Soft tissue augmentation around multiple teeth and edentulous site

The patient was a healthy 32-year-old man who had previously received two unsuccessful surgical procedures for implant site development at the edentulous area (the maxillary central incisors). Because of previous surgical trauma, the maxillary lateral incisors had additional recession that had been worsened by the loss of the mesial papillae (Fig 3a). This made the areas unfavorable for root coverage due to Miller Class IV recession[15] as indicated by crestal bone loss (Fig 3a). A Seibert Class III[16] ridge defect was found with insufficient papillary height for the pontic area at the maxillary central incisors (Fig 3b). Periodontal plastic surgery was indicated for pontic site development to restore the lost papilla at the maxillary central incisors and to cover the gingival recession on the lateral incisors. A horizontal incision

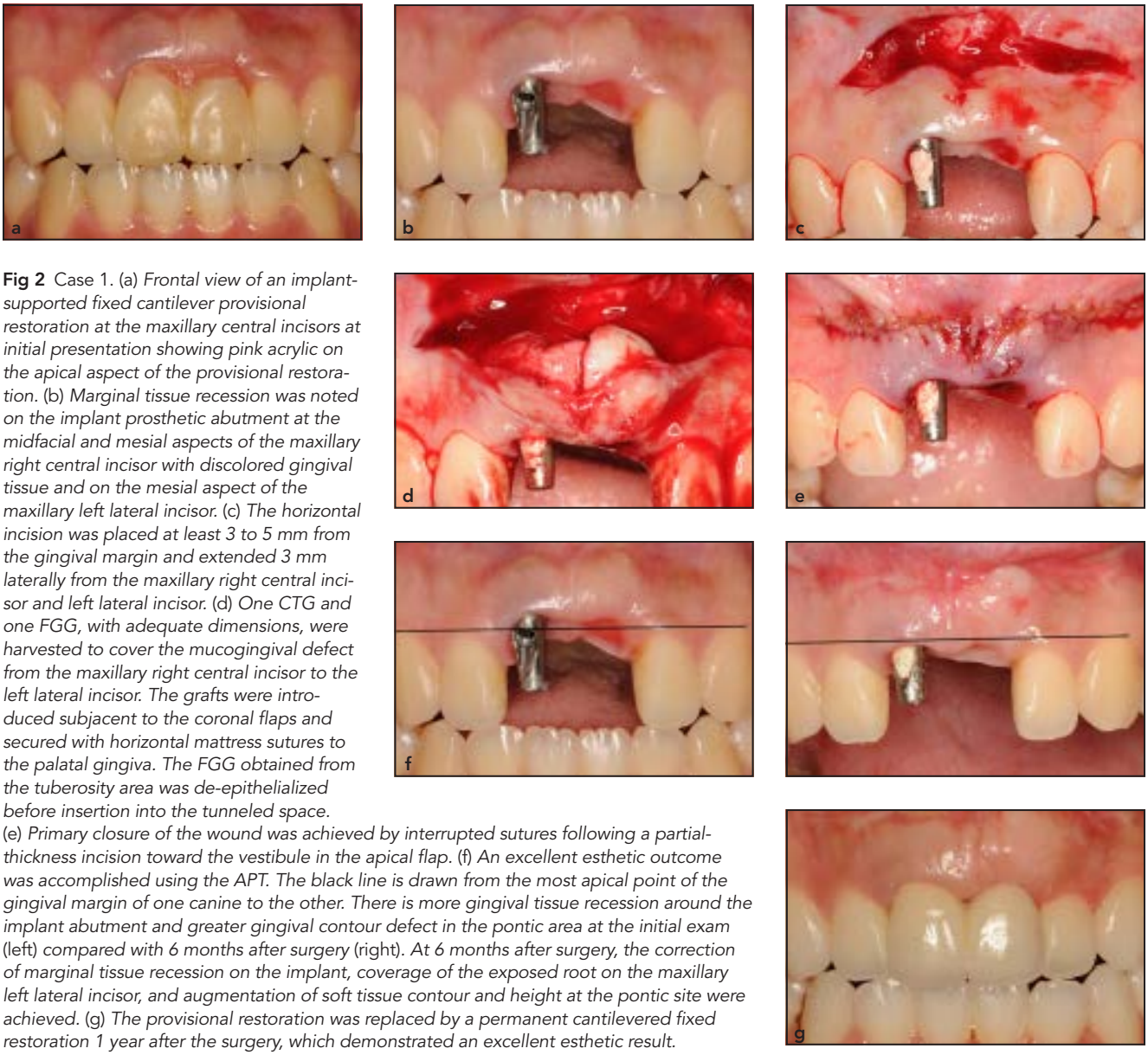

Fig 2 Case 1. (a) *Frontal view of an implant-supported fixed cantilever provisional restoration at the maxillary central incisors at initial presentation showing pink acrylic on the apical aspect of the provisional restoration.* (b) *Marginal tissue recession was noted on the implant prosthetic abutment at the midfacial and mesial aspects of the maxillary right central incisor with discolored gingival tissue and on the mesial aspect of the maxillary left lateral incisor.* (c) *The horizontal incision was placed at least 3 to 5 mm from the gingival margin and extended 3 mm laterally from the maxillary right central incisor and left lateral incisor.* (d) *One CTG and one FGG, with adequate dimensions, were harvested to cover the mucogingival defect from the maxillary right central incisor to the left lateral incisor. The grafts were introduced subjacent to the coronal flaps and secured with horizontal mattress sutures to the palatal gingiva. The FGG obtained from the tuberosity area was de-epithelialized before insertion into the tunneled space.* (e) *Primary closure of the wound was achieved by interrupted sutures following a partial-thickness incision toward the vestibule in the apical flap.* (f) *An excellent esthetic outcome was accomplished using the APT. The black line is drawn from the most apical point of the gingival margin of one canine to the other. There is more gingival tissue recession around the implant abutment and greater gingival contour defect in the pontic area at the initial exam* (left) *compared with 6 months after surgery* (right). *At 6 months after surgery, the correction of marginal tissue recession on the implant, coverage of the exposed root on the maxillary left lateral incisor, and augmentation of soft tissue contour and height at the pontic site were achieved.* (g) *The provisional restoration was replaced by a permanent cantilevered fixed restoration 1 year after the surgery, which demonstrated an excellent esthetic result.*

was made about 1 mm coronal to the mucogingival junction. The incision was laterally extended 3 mm distal to the lateral incisors. Sulcular incisions were made on the lateral incisors. A partial-thickness flap was prepared coronal to the horizontal incision and extended until continuity between the gingival sulci of the lateral incisors and the horizontal incision was established. The overlying gingival flap was undermined in three dimensions to ensure coronal flap advancement for coverage of the gingival recession around the lateral incisors and increase the soft tissue vertical height at the edentulous ridge (Fig 3c). Two CTGs were harvested from the palate. One CTG was placed subjacent to the flap and initially secured to the palatal tissue

of the maxillary left central incisor by horizontal mattress sutures. The other CTG was placed and secured similarly at the right central incisor (Fig 3d). The CTGs, subjacent to the flap, were then sutured together side by side. The free end of the grafts were each then rotated 90 degrees distally, inserted subjacent to the overlying gingival flap, and secured by mattress sutures to cover the exposed roots of the maxillary right and left lateral incisors, respectively. The flap apical to the horizontal incision was undermined toward the vestibule with sharp dissection, allowing for coronal flap positioning while achieving tension-free primary closure. The gingival margins were repositioned coronally and sutured coronal to the contact points of the provisional fixed prosthesis by suspensory sutures (Fig 3e). The increased soft tissue volume was apparent and the tissue underwent maturation uneventfully, reaching dimensional stability in 2 months (Fig 3f). Starting 2 months after surgery, a provisional restoration with ovate pontics at the maxillary central incisors was made to mold the soft tissue for papilla formation. Ovate pontic sites were developed in the grafted ridge by the provisional restoration for 1 year (Fig 3g).

Discussion

The improvement of esthetic outcomes in localized alveolar ridge defects and marginal tissue recession around dental implants and natural teeth in the esthetic zone is critical.[17] Unlike the vestibular incision subperiosteal tunnel access (VISTA)[18] approach, where a vertical vestibular incision is made, the access incision for the APT is through a long horizontal incision. Furthermore, a supraperiosteal tunnel is prepared in lieu of a subperiosteal tunnel to create space for the insertion of a CTG. An important feature of the APT is the partial-thickness dissection that favors graft survival by providing bilaminar vascular supply to the grafts. Nevertheless, the APT has several features in common with the VISTA approach. Both techniques overcome limitations of intrasulcular tunneling techniques by making broader access for graft insertion, and both use an anchored suturing technique to stabilize the new position of the coronally advanced gingival tissue using the provisional prosthesis.

Different from the semilunar (also known as semicircular) coronally repositioned flap,[19] the APT uses a straight and longer horizontal access incision. The length of the horizontal incision enables coronal positioning of the gingival margin by as much as 2 to 3 mm to correct marginal recession defects around an implant and a tooth. The location of the horizontal incision at least 3 to 5 mm from the gingival margin permits broader coverage of the inserted CTGs and reduces the risk of graft exposure during coronal advancement of the overlying gingival flap. Similar to the semilunar coronally repositioned flap, the APT prepares a split-thickness dissection to create a supraperiosteal tunnel between the intrasulcular incision and the horizontal incision.

Like the connective tissue platform technique for soft tissue augmentation in a Seibert Class III ridge defect,[20] the APT is able to accomplish horizontal and vertical soft tissue augmentation in a single surgical step. Both the APT and the connective tissue platform technique make use of a horizontal incision. The absence of vertical releasing incisions in both techniques is important for obtaining a highly satisfactory esthetic outcome, as vertical releasing incisions may result in unesthetic scars.[21] In contrast to the connective tissue platform technique, which consists of two parallel horizontal incisions, the APT uses only one horizontal incision.

Conclusions

The APT described in this report demonstrates the feasibility of using autogenous CTGs for the correction of marginal tissue recession around dental implants and natural teeth, as well as the augmentation of soft tissue volume around an alveolar ridge defect, which allows for molding of papillae and buccal convexity in the esthetic zone. The APT optimizes successful esthetics because of its ability to provide bilaminar vascular supply, which favors graft survival and helps attain tension-free primary wound closure. However, cases with longer follow-up are needed to determine whether the increased soft tissue volume achieved by APT can be maintained over time.

Fig 3 Case 2 (a) *Gingival recession on both maxillary lateral incisors with a Seibert Class III ridge defect was noted, as demonstrated by a fixed provisional prosthesis from the maxillary right lateral incisor to the left lateral* (left). *A periapical radiograph showed bone loss on the mesial aspects of both lateral incisors* (right). (b) *Pretreatment photos show a Seibert Class III ridge defect with* (left) *and without* (right) *the fixed provisional prosthesis in place.* (c) *A horizontal incision was made 1 mm coronal to the mucogingival junction. Following sulcular incisions on both maxillary lateral incisors with sharp dissection coronal to the horizontal incision, a partial-thickness flap was raised for coronal advancement of the overlying gingival flap.* (d) *One CTG was introduced subjacent to the overlying gingival flap and secured to the palatal gingiva at the area of the maxillary left central incisor with horizontal mattress sutures. The other CTG was placed and secured similarly at the edentulous area around the right central incisor.* (e) *After sharp dissection of the apical flap, the horizontal incision was closed with interrupted sutures. The gingival margins were coronally positioned and secured by suspensory sutures coronal to the contact point of the provisional fixed prosthesis.* (f) *Tissue maturation with dimensional stability was noted at 2 months after surgery.* (g) *A mature pontic site was developed with the use of a provisional restoration with ovate pontics at the maxillary central incisors 1 year after surgery* (left). *An excellent esthetic result was shown with the new provisional restoration 1 year after surgery* (right).

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