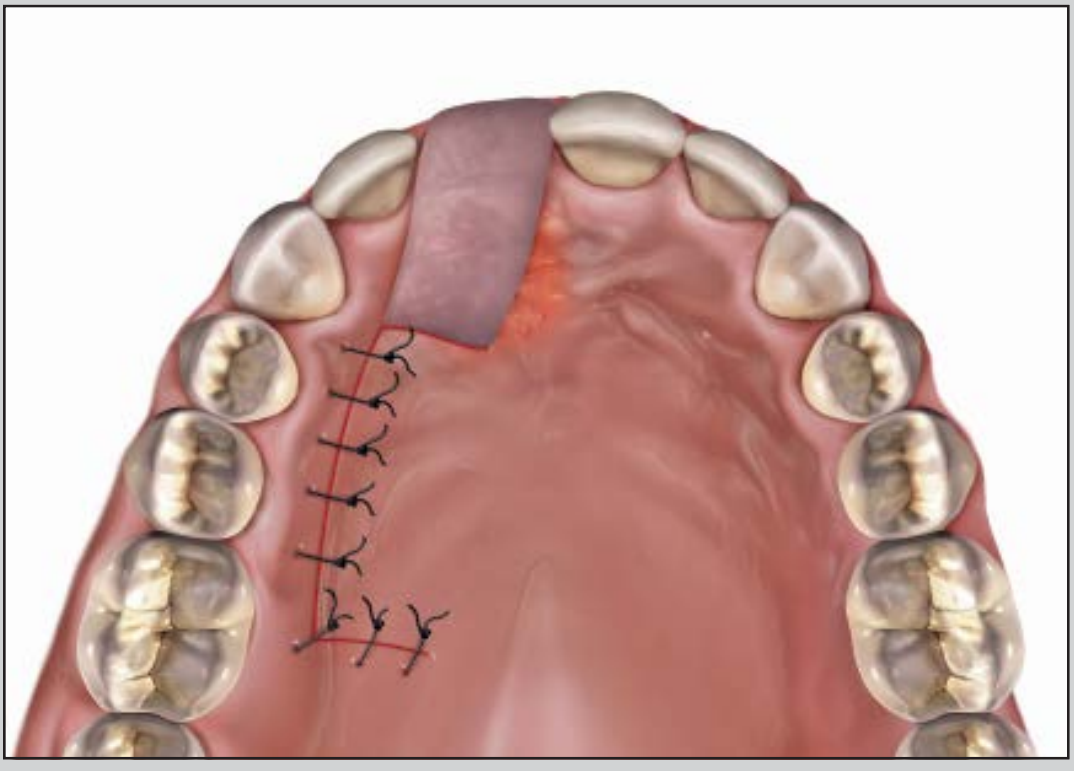

Soft Tissue Closure of Grafted Extraction Sockets in the Anterior Maxilla: A Modified Palatal Pedicle Connective Tissue Flap Technique

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Localized ridge resorption, the consequence of socket collapse, following tooth extraction in the anterior maxilla can adversely affect esthetics, function, and future implant placement. Immediate grafting of extraction sockets may help preserve natural ridge contours, but a lack of available soft tissue can compromise the final esthetic outcome. The presented modified rotated palatal pedicle connective tissue flap is a useful technique for simultaneous soft tissue coverage and augmentation of grafted sockets to improve esthetic outcome. This article delineates its advantages through the presentation of a four-case series using this new technique.
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Soft tissue esthetics surrounding implants and fixed restorations are a major concern for the contemporary patient population. While new materials and techniques have greatly improved treatment predictability and esthetic outcomes, tooth extraction in the esthetic area remains a clinical challenge. Difficulties include fracture or loss of the buccal plate, progressive vertical and horizontal ridge resorption, soft tissue recession, and loss of adjacent papilla.[1–3] Many techniques, such as ridge augmentation and soft tissue grafts, have been developed to correct postextraction deficiencies.[4–8] Multiple surgical procedures can be traumatic, and correction of defect formation is not always predictable as repeated surgical handling of soft tissue can lead to scar formation, a decrease in vascularity, and a decrease in elasticity.[9] Atraumatic extraction, site preservation, and extraction in conjunction with membrane-guided ridge augmentation are some techniques that aim to prevent ridge deformities.[10,11] These approaches have their downfalls, as they can be difficult to employ and focus mainly on preservation of bone rather than soft tissue. For example, achieving primary closure is challenging when performing guided bone regeneration in an extraction site, and leaving a membrane exposed can cause

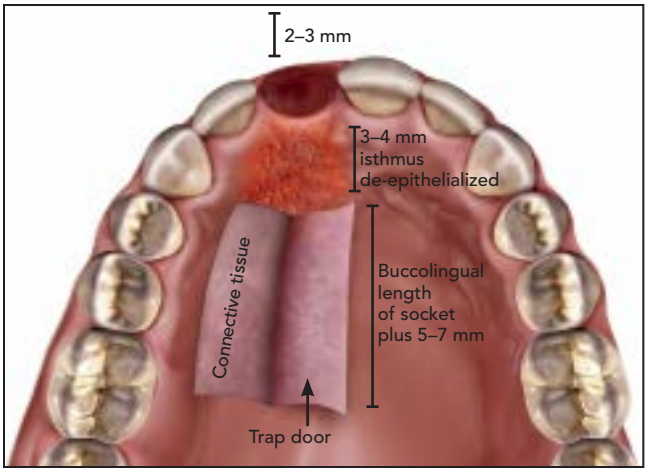

Fig 1 *Following atraumatic extraction, the dimensions of the pedicle graft were determined. The width was determined by measuring the mesiodistal dimension plus 1–2 mm to account for graft shrinkage. The length was determined by adding the buccolingual dimension of the socket plus 2–3 mm to allow tucking in of the graft underneath the buccal gingiva. The measurement for the length was initiated 3–4 mm distal to the extraction socket.*

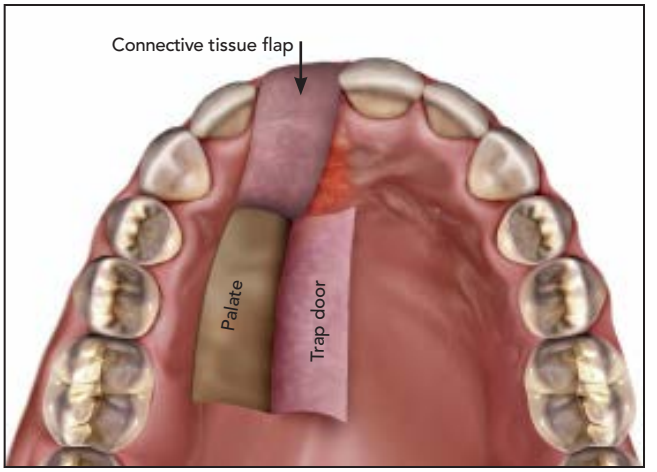

Fig 2 *The donor site for the pedicle graft began approximately at the distal side of the canine and ended at the midpalatal surface of the first molar, approximately 3–4 mm medial to the free gingival margin of the hard palate. The 3- to 4-mm area between the base of the pedicle and the extraction site was de-epithelialized. The extraction was filled with bone graft material.*

plaque and bacterial buildup in a wound.[12,13] The presented modified rotated palatal pedicle connective tissue flap is a valid technique for simultaneous soft tissue coverage and augmentation as it allows for primary closure over grafted sites, preserves gingival scallop, and augments soft tissue to improve esthetic outcomes. Subepithelial connective tissue grafts (CTGs) have been used for root coverage and to increase the width and height of ridges prior to restoration.[4,14–16] The original techniques using free grafts to augment soft tissue ridge defects were modified and presented for use around implant restorations.[17–19] The decreased vascular bed around implants when compared with natural teeth and the ability to reposition soft tissue around implants during second-stage surgery led to the development of pediculated CTGs such as the roll technique, rotated pedicle CTGs, the vascularized interpositional periosteal connective tissue flap, and modifications of these techniques.[14,17,18,20] The rotated palatal pedicle connective tissue graft (RPPCTG) presented here is a modification of previously described techniques used concomitantly with site preservation following anterior tooth extraction. The aim of this study is to present this technique for site preservation with simultaneous soft tissue augmentation and portray its advantages through a case series presentation.

Materials and methods

Patients were prophylactically placed on a 1-week course of antibiotics beginning a day prior to treatment as well as 1 week of oral rinse beginning 24 hours after the procedure. Immediately before the procedure, patients were peri- and intraorally disinfected. Flapless atraumatic extraction was performed to preserve the remaining hard and soft tissue and the blood supply to the papilla, buccal plate, and interproximal bone.

Following extraction, intraoral measurements are taken to aid in the execution of this pedicle flap technique (Fig 1). The length necessary for the pedicle flap was calculated by adding the buccolingual width of the extraction site, 3 to 4 mm for the gap between the palatal edge of the extraction site and the base of the pedicle, and an additional 2 to 3 mm to facilitate tucking the flap underneath the buccal gingiva of the extraction socket. Keeping the base of the pedicle 3 to 4 mm from the extraction site is recommended

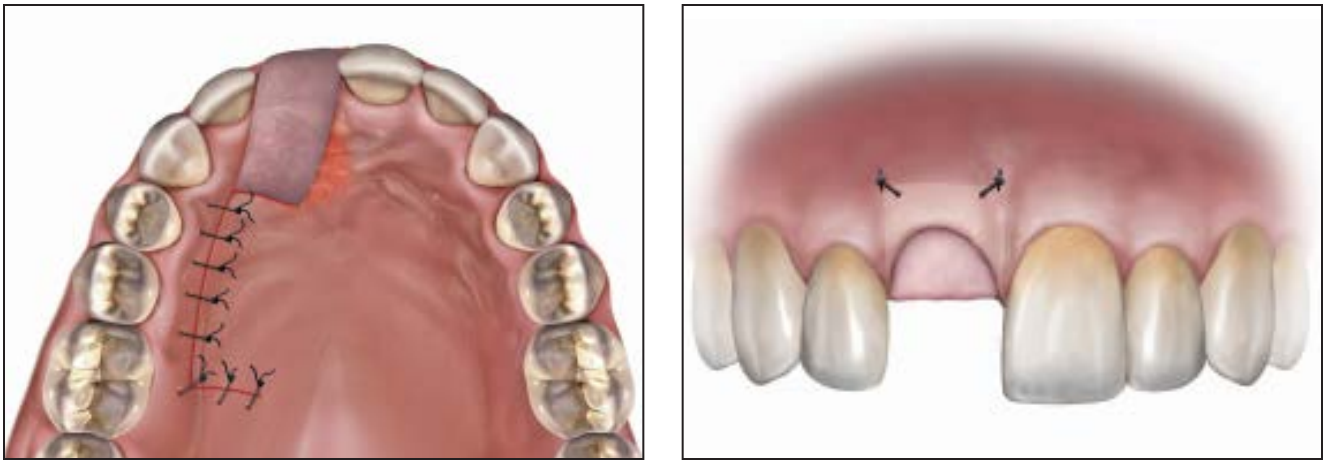

Fig 3 *The connective tissue was flipped parallel to its short side and then folded over the grafted extraction site. The donor site was closed with interrupted sutures. The distal free end of the connective tissue pedicle was tucked under the buccal gingiva of the extraction socket and secured with two horizontal mattress sutures.*

to maintain the blood supply to the base of the pedicle graft.[9,21] The width of the pedicle flap was determined by measuring the mesiodistal dimension of the extraction site and adding 1 mm to account for graft shrinkage.[22] The recommended donor site for the pedicle graft is from the distal side of the canine to the midpalatal side of the first molar approximately 3 to 4 mm medial to the free gingival margin (FGM) of the hard palate.[23] The 3- to 4-mm distance from the FGM of the existing dentition is recommended to prevent tissue sloughing and recession on the teeth adjacent to the donor site.

After measurements were completed, an incision was made down to the osseous structure, beginning 3 to 4 mm from the edge of the extraction socket in the area between the canine and first molar and extending it to the calculated length. A full-thickness envelope flap, as described by Langer and Calanga[23] in 1980 as a means of harvesting connective tissue, was then elevated and extended medially to the measured width of the pedicle graft. Next, the connective tissue was harvested from the pedicle flap, releasing the distal and medial segments of the flap. Care was taken to maintain the medial attachment and blood supply to the pedicle flap. The isthmus area between the base of the pedicle and the extraction site was de-epithelialized. The extraction socket was filled with bone graft material, and the pedicle flap was flipped and folded passively over the extraction site (Fig 2). The free end of the pedicle flap was tucked into the buccal aspect of the extraction site and secured with horizontal mattress sutures (Fig 3). The trap door created on the palatal donor site was sutured into place with interrupted or continuous sutures. If the clinicians felt it was necessary, a resorbable wound dressing for the purpose of aiding in hemostasis or reduction of dead space was placed under the flap prior to closure. To avoid compression of the graft and the palatal donor site, an Essix retainer, resin-bonded prosthesis, or traditional temporary bridge relieved in the cervical area of the graft site was used as a means of provisionalization.

Case presentations

Case 1

An otherwise healthy 22-year-old woman presented with a hopeless maxillary left central incisor with a

Fig 4 *A 22-year-old woman presented with a hopeless, extruded, rotated, and mobile maxillary right central incisor with severe periodontal bone loss. Note the patient's thin biotype as well as the 3- to 4-mm gingival margin discrepancy between the hopeless tooth and the adjacent central incisor.*

Fig 5 *Initial periapical radiograph portraying the severe bone loss in the area of the maxillary central incisor. The patient's facial piercing could not be removed and the apex of the central incisors were captured in the full-mouth series.*

Fig 6 *Immediately postoperative palatal and buccal views. The patient was temporized with a relieved Essix retainer.*

thin biotype and a gingival-buccal margin 3 to 4 mm apical to that of the adjacent central incisor (Fig 4). Radiographic evaluation demonstrated severe bone loss both mesially and distally (Fig 5). It was decided to augment the soft tissue at the time of site preservation due to the thin biotype, existing gingival recession, and interproximal tissue loss. Atraumatic tooth extraction was performed, followed by debridement and grafting of the socket with small-particle mineralized cancellous bone allograft (Puros, Zimmer). Primary closure and soft tissue augmentation were achieved with the previously presented modified pedicle palatal connective tissue flap. Due to the existing recession of the gingival margin, an additional 3 mm of tissue was needed to cover the extraction site and achieve primary closure. A connective tissue pedicle was harvested from the palatal tissue. Once harvested, the pedicle was flipped, folded, and secured buccally by a horizontal mattress suture (Fig 6). The donor site was closed with interrupted sutures (Fig 6), and the postoperative period was uneventful (Figs 6 and 7). Immediately postoperatively, the patient was provisionalized with a modified Essix retainer. After 6 weeks, a fixed provisional prosthesis was placed and soft tissue molding, via the provisional, was initiated (Fig 8). After 12 weeks, the soft tissue had healed completely and a resin-bonded prosthesis was

Fig 7 *Palatal and buccal views at 14 days postoperative. The vicryl 5.0 sutures are still retained and healing is within normal limits.*

Fig 8 *At 6 weeks postoperative, the patient was temporized with a resin-bonded prosthesis, and tissue sculpting with the pontic was initiated.*

Fig 9 *At 8 months postoperative, the palate in the donor area had healed with normal tissue architecture restored. The temporary pontic was in this image to portray the soft tissue gain from the graft. Note the symmetric scallop and interdental papilla.*

delivered. In this particular case, the challenge was not only the thin biotype and loss of interproximal bone but also the recession of the buccal gingival margin. In spite of these challenges, the use of the presented technique led to an esthetically acceptable outcome. The patient reported minimal postoperative discomfort and was satisfied with the esthetic outcome. An 8-month postoperative image with the resin-bonded prosthesis removed is shown in Fig 9.

Case 2

A healthy 46-year-old woman with no reported history of smoking presented with failed root canal treatment of the maxillary right central incisor. The right central incisor was planned for extraction. Due to the patient's thin biotype, highly scalloped gingiva, and scar tissue from a history of previous surgical treatment in the area, the RPPCTG and socket preservation technique was employed. Following atruamatic extraction and debridement, the socket was grafted with a mixture of small-particle mineralized cancellous and cortical bone allograft (Puros, Zimmer). The patient was temporized with a three-unit bridge that was relieved in the area of the soft tissue graft. Healing was uneventful and the patient reported minimal postoperative pain. The preoperative, immediately postoperative, and 10 months postoperative images can be seen in Fig 10.

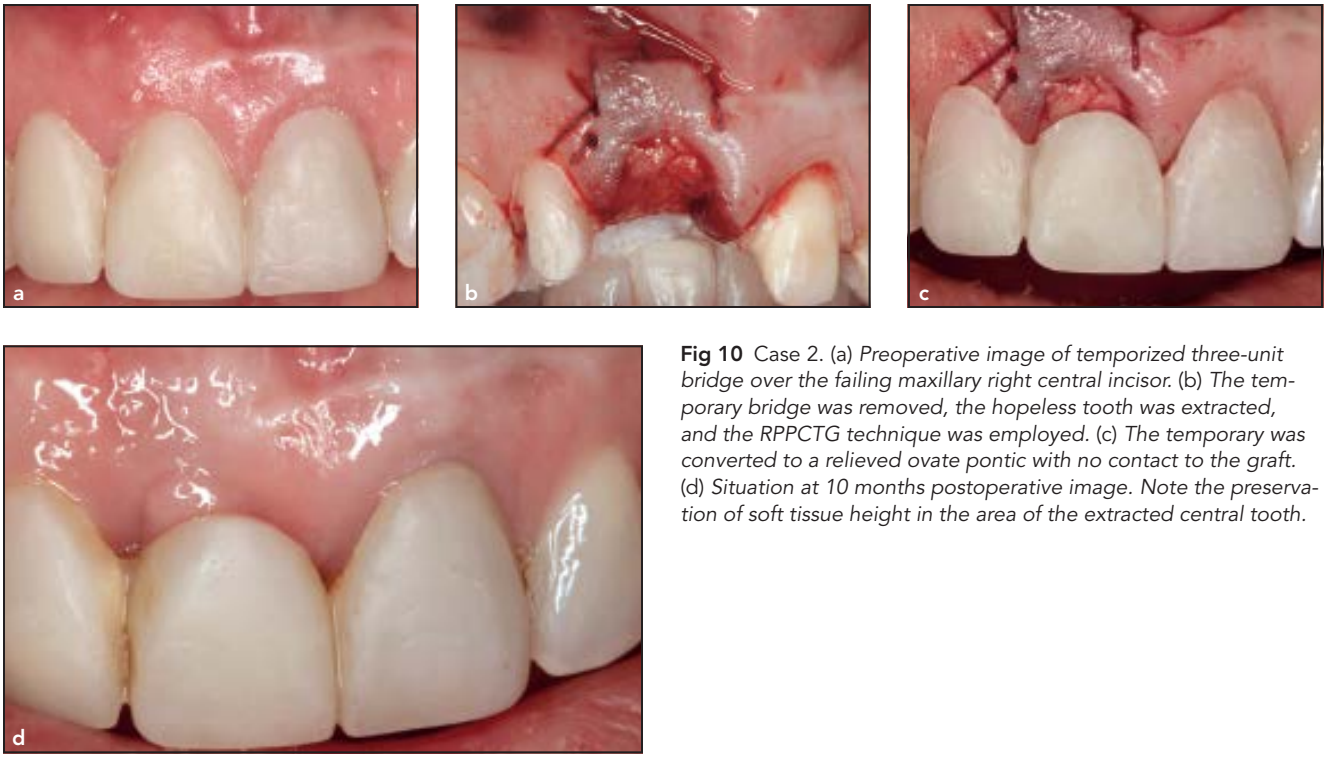

Fig 10 Case 2. (a) *Preoperative image of temporized three-unit bridge over the failing maxillary right central incisor.* (b) *The temporary bridge was removed, the hopeless tooth was extracted, and the RPPCTG technique was employed.* (c) *The temporary was converted to a relieved ovate pontic with no contact to the graft.* (d) *Situation at 10 months postoperative image. Note the preservation of soft tissue height in the area of the extracted central tooth.*

Case 3

A healthy 55-year-old woman with no history of smoking presented with a previously endodontically perforated and hopeless maxillary left central incisor. Clinical and radiographic examination revealed a thin biotype and an average palatal vault. The adjacent lateral incisor was an existing implant that was used to support a modified pontic provisional, relieved in the cervical region, following extraction. The hopeless tooth was atraumaticaly extracted, and the site was debrided and grafted with a mixture of small-particle mineralized cancellous and cortical bone allograft (Puros, Zimmer). Soft tissue augmentation and primary closure of the grafted site were achieved with the technique described above. The patient underwent healing without complication. Preoperative, immediately postoperative, and 2 months postoperative images can be seen in Fig 11. The soft tissue gained in the area of the extraction site was molded, manipulated, and contoured to conform to the final prosthesis.

Case 4

A healthy 57-year-old male with poor oral hygiene and no reported history of smoking presented with a failing maxillary left central incisor due to an endo-perio lesion. There was a complete loss of the buccal plate, and site preservation along with soft tissue augmentation via RPPCTG was performed following the atraumatic extraction. The site was then debrided and grafted with a mixture of small-particle mineralized cancellous and cortical bone allograft (Puros, Zimmer). Soft tissue augmentation and primary closure were achieved with the technique described above, and the patient was temporized with an Essix retainer relieved in the area of the soft tissue graft. The patient underwent healing without complication. Preoperative, immediately postoperative, and 6 months postoperative images are shown in Fig 12.

Fig 11 Case 3. (a) *Preoperative image. Note the loss of soft tissue and papilla height distal to the maxillary left central incisor.* (b) *The connective tissue pedicle and the palatal trap door during surgery prior to suturing.* (c) *Immediate postoperative image.* (d) *Situation at 2 months postoperative.*

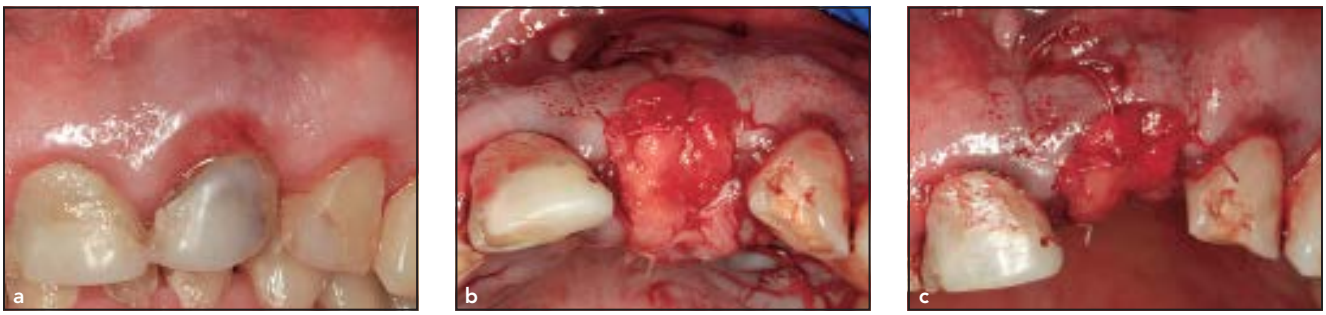

Fig 12 Case 4. (a) *Preoperative image prior to extraction of the maxillary left central incisor.* (b) *Palatal view immediately postoperative.* (c) *Buccal view immediately postoperative.* (d) *Situation at 6 months postoperative. Note the poor oral hygiene and gain of soft tissue in the final image.*

Discussion

Following tooth extraction, dimensional reduction of the hard tissue and therefore of the supported soft tissue is inevitable. Reconstruction of both hard and soft tissues in a site following these dimensional changes can be difficult and unpredictable. The presented modified rotated palatal pedicle connective tissue flap is an effective means of achieving graft containment, primary closure, and soft tissue augmentation in a single surgical procedure.[24] Use of a bone graft material in the socket minimizes the loss of hard tissue during healing of the extraction site.[10] While use of a membrane is advised in large areas of guided bone regeneration, this is not always necessary in smaller defects such as extraction sites. Some authors who have presented simultaneous soft and hard tissue augmentation techniques note that flipping a pediculated graft places the periosteum directly over the bone graft material. These authors hypothesize that the periosteal side of the flap against the augmented site serves as a barrier, but there is no current research to validate this point.[18,25] It is the belief of the present authors that the lack of a barrier membrane in the cases reported here allowed the opportunity for increased blood supply to the pedicle flap through direct contact of the flap with the blood supply found between graft particles and supported by the bony walls of the socket. The choice of whether or not to use a barrier membrane in conjunction with this technique is left to the discretion of the clinician and the protocol suggested for the chosen bone graft material.

Other techniques have been presented for the use of pedicle CTGs simultaneously with site preservation and immediate implant placement.[18,25,26] The concept of using connective tissue to augment ridges and improve esthetics in the area of prosthetics is not unique. Use of a full-thickness flap on the palate to harvest donor connective tissue was reported by Langer and Calanga[23] in 1980 and Matthews[18] in 2008. The most notable difference between previously presented rotated pedicle CTG approaches and this case report is not the harvesting technique but the donor site for the connective tissue pedicle. In this modification the suggested donor site is between the distal side of the canine and the midline of the first molar. Results of a recent human cadaver study on the thickness and quality of the palatal masticatory mucosa suggest, based on measurements of tissue thickness, the location of palatal neurovascular bundles, adipose content, and connective tissue content, that the most appropriate donor site for gingival autogenous grafting is the region 3 to 9 mm below the cementoenamel junction between the distal side of the canine and the midline surface of the first molar.[27] The donor site may begin in the area of the canine because, unlike with a free gingival graft, a CTG is taken internally and is not limited by the palatal rugae.[28] The use of a thick donor tissue simplifies manipulation of the graft and helps maintain its vascularity, and selection of donor tissue with a minimal adipose content may allow for a more direct diffusion into the graft.[29,30] Another important aspect of this method is leaving a space of 3 to 4 mm between the edge of the extraction socket and the beginning of the pedicle flap. This distance allows for harvesting of the graft from the advised area of the palate and provides a large base and blood supply for the pediculated CTG.[9] The de-epithelialization of the isthmus leaves the blood supply to the base of the pedicle intact while allowing blood supply to the overlaid pedicle graft.

Reconstruction of the soft and hard tissue is imperative for natural-looking restorations, and use of the presented RPPCTG provides an effective solution to achieve primary closure and preserve the natural gingival scallop to achieve an esthetic result. While the presented final surgical outcomes of the RPPCTG are esthetic and more predictable surgical outcomes and healing can result from the enhanced blood supply and ease of harvesting thicker CTGs, the technique is still one of many treatment options. The RPPCTG is not an ideal treatment for all patients, and as always, surgical skill and execution are as important as case selection. Patients with extensive palatal tori or very small palatal vaults, smokers, those with uncontrolled diabetes, and those with other medical comorbities are not ideal candidates for the presented treatment.

Conclusions

The RPPGTG is a useful technique to achieve primary closure combined with soft tissue augmentation over a grafted maxillary anterior extraction site. This technique can be used to preserve ridge contours for delayed implant placement and for site development in future pontic sites in traditional fixed prostheses. Further study is needed to compare the esthetic outcome of this technique with that of those currently employed.

Acknowledgments

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