Augmentation of Interdental Papilla at Implant/Tooth Sites with the Tunneling Technique and a Pedicle Graft: Technique and Case Report

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It is not uncommon for patients to present with unacceptable esthetics due to gingival deficiencies in the interproximal area within the esthetic zone after implant replacement of a single tooth (Figs 1a and 1b). In addition to the esthetic concern, the interproximal soft tissue deficiency results in food and plaque retention and can lead to peri-implant and periodontal disease. This type of soft tissue deficiency may challenge even an experienced implant surgeon if they are without extensive training and experience in root coverage procedures via tunnel preparation.¹ Without such surgical skills, treatment of an interproximal deficiency at implant sites might worsen the situation dramatically.² The literature shows limited evidence for protocols to create sufficient interdental tissues when needed.³⁻⁵

A possible method for improving papillary augmentation might include a palatal pedicle connective tissue graft (CTG). Vascularized palatal pedicle CTGs have been previously reported for soft tissue augmentation of deformed alveolar ridges. The maintenance of blood supply to the graft via the pedicle has been credited for improved survival of the CTG and improved reconstruction of the ridge deficiency. This concept has been demonstrated by Mathews,⁶ and later Romanos et al,⁷ with pediculated grafts from...
the palate for implant site development and soft tissue reconstruction in the esthetic zone prior to implant placement.6,7 This report presents a technique for combining palatal pedicle CTGs with a tunneling procedure for augmentation of papillae between implants and teeth.

Technique and Case Report

In 2014, a nonsmoking 57-year-old woman in good health presented herself with a major esthetic deficiency of black triangles between teeth 11 and 21 (FDI tooth-numbering system) and between 21 and 22 after second-stage surgery healing following implant placement at site 21 (Fig 1a). All teeth had full-coverage provisional crowns with a pontic at missing site 21. A high lip line called for management of the patient’s esthetic concerns.

Radiographic analysis (Fig 1b) revealed an 8.5-mm distance from the interproximal bone crest to the contact point mesial and distal to the implant site, indicating a high probability (> 90%) of papillae deficiency after second-stage surgery.8,9

After explaining treatment options to the patient, she was instructed in the use of dental floss10 (Reach Dentotape unflavored, Johnson & Johnson) and an interdental brush in order to avoid food impaction and papillae infection prior to surgery. In this way, tissues were more keratinized, were free of infection, and had healthy collagen fibers, and thus were more easily managed in microsurgery (Fig 1c).

A tunnel preparation was initiated facial to the implant and each adjacent tooth (Figs 2, 3a, and 3b), with an intrasulcular incision extending to the alveolar crest facially and proximally. This was followed by blunt subperiosteal dissection, relieving the vestibular mucosa vertically, approximately 8 mm apical to the level of the cementoenamel junction (CEJ), and laterally to the distal line angles of the teeth adjacent to the implant. In the same fashion,
the palatal mucosa and both of the papillae were dissected subperiosteally using an Allen Intraratalular Knife, Microsurgical Elevator, and Modified Orban Knife (Hu-Friedy).11 No superficial incision was used to mobilize the area, thus minimizing interruption of the blood supply and reducing potential wound contraction. The tunnel dissection was extended supraperiosteally in the apical and lateral directions, ensuring sufficient mobility, with a Modified Orban Knife.

A 3-mm–wide bridge of tunneled mucosa was created on the palatal aspect of the teeth to connect with pedicle donor sites (Fig 3a). Using a no. 15 surgical blade, bilateral palatal pedicle flaps were raised with an extra 5 mm of length to accommodate for the turn of the flap (Fig 2b), which amounted to a total length of approximately 18 mm and a width of 6 mm, as measured prior to incision (Fig 2). The pedicle flaps were deepithelialized with high-speed, ball-shaped diamond burs prior to flap elevation. Care was taken to save every part of the fat-free collagenous tissue in the superficial part of the flap in this palatal area. Once elevated by blunt dissection with a periosteal elevator, the pedicle flaps were drawn under the papillae and to the vestibular side with a suture (Seralene 6/0 DS-15, Serag-Wiessner), entering from the vestibular side and beneath the palatal mucosal bridge to engage the tips of the pedicle flaps (Fig 3b). Tissue stability was aided by the customized acrylic abutment (chairside fabrication), with two interproximal, ear-shaped acrylic supports

Fig 2  The required length of pedicle graft was measured (a) crestally and (b) palatally with calipers, adding 5 mm to accommodate 90-degree turn of the palatal flap.

Fig 3  (a) Prepared deepithelialized pedicle graft prior to insertion underneath the palatal bridge and papilla, into the labial vestibule. The tunnel extended well into the vestibule and to the mesiodistal line angles of teeth 11 and 22. (b) The pedicle graft was anchored, undergoing the tunneled palatal bridge, distal papilla, and vestibule, and sutured under the mesiolabial line angle of tooth 22. (c) Two donor sites with running sutures. A customized abutment interproximal shaper with ear-shaped papilla supporters was placed. Note the crucial palatal “bridge,” which has been entirely tunneled as well. (d) Buccal view of both augmented papillae prior to placement of provisional crowns with an enlarged convexity. Note the acrylic supports of the customized abutment.
for the papillae on one side and the provisional crowns of the neighboring teeth on the other (Figs 3c and 3d). Care was taken to avoid any pressure from the provisional pontic by keeping it clear from the customized abutment and the tissues. Healing was uneventful. After suture removal 2 weeks later, provisional restorations were adjusted in convexity between the abutment and the contact point. This allowed additional papillae height by adding contour prior to the impression-making appointment (1 month later) and placement of final restorations (Fig 4a). The papillae still showed a minor vertical deficiency prior to delivery of the final crowns. Contours of the definitive crowns between the contact point and papilla tip were slightly widened, lowering the contact point in comparison to the provisional restorations and thus improving closure (Fig 4b).12

Follow-up and Maintenance
The patient was seen every 3 to 4 months over 5 years for maintenance, with charting done every other appointment. The patient was re instructed in correct daily brushing methods and the use of dental floss only (no interdental brushes; Fig 4c), resulting in keratinization13 and complete closure of the interdental spaces (Fig 4d) 5 years after active therapy.14

Requirements for Success
For this technique to be surgically manageable, the width of the papilla base should be at least 3 mm and the height no less than 2 mm (Fig 5). The col area of interproximal gingival sites requiring periplastic surgery, like papilla augmentation or guided tissue regeneration, commonly present with nonkeratinized...
epithelium prone to gingival inflammation. Patients should therefore be advised and instructed to use dental floss and gentle brushing daily in order to produce well-keratinized and resistant tissues prior to surgery\textsuperscript{10} (Fig 5a).

**Discussion**

The calculable gain of papillary height was approximately 3 to 4 mm in the present case. Similar outcomes have been achieved with this technique in other tooth-to-implant cases in the anterior maxilla. Due to neighboring crowns with no markable CEJ, papillary deficiencies in the present case of tooth replacement with an implant should probably be classified as Nordland/Tarnow category II to III papillary defects,\textsuperscript{8,9} with minor loss of interdental bone and/or attachment to the teeth.

Vertical augmentation of interproximal papillae has been shown to be successful in studies using a free CTG (FCTG) harvested from the palate and placed beneath the deficient papilla.\textsuperscript{1,4,5,15,16} Access is gained with a flap either from the buccal or the palatal side, thus compromising the blood flow. However, this kind of procedure is unpredictable when it comes to real vertical gain of the augmentation.\textsuperscript{2,3} While Carranza and Zogbi’s approach seems to cut off less of the blood supply with a vestibular vertical incision access method,\textsuperscript{15} others elevate the papilla through a horizontal incision that compromises blood flow even more.\textsuperscript{16}

With its lack of surface incisions, the tunnel technique provides a more favorable vascular environment. In the present technique, a pedicle graft from the palate is placed under the tunneled papilla and adjacent labial and palatal mucosa. This resolves two problems: loss of nutrition to the graft and compromised palatal marginal tissue. This is accomplished by leaving the bridge of tunneled marginal mucosa between each 90-degree turning anchor of the pedicle grafts on the palate (Fig 3c). With a thin phenotype, care must be taken not to perforate the flap when developing tension-free tunnels. At the same time, it is advised to convert the thin phenotype at the labial gingiva into a thick one simultaneously with papilla augmentation by placing an additional FCTG labially. In this way, there is a positive influence towards an even greater papilla augmentation during the healing process.\textsuperscript{3} To facilitate access for this kind of tunnel preparation in thin phenotype sites, the papilla access tunnel technique has been advised\textsuperscript{17} to reduce risks of perforation during tunnel dissection.

The described papilla augmentation technique may also be valid for tooth-to-tooth or implant-to-implant papillary augmentation. In case of lacking tissue thickness and/or tissue quality in the palatal area designated for future graft elevation, a pouch augmentation procedure could be performed with an FCTG collected from a posterior area some months prior to the described pedicle graft intervention.

**Conclusions**

This case report demonstrated successful papilla augmentation at a
site with a significant deficiency between a tooth and an implant. The outcome was accomplished by the enhanced blood supply from the pedicle graft, optimal tissue quality of the graft and overlying papillary tissue, adequate thickness of surrounding gingiva, tension-free tunnel flap, and minimized surgical trauma. Multiple well-documented case studies will be necessary to bring this single case of successful papilla augmentation to a standard method in perioplastic surgery.

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References