Interproximal Tunneling with a Customized Connective Tissue Graft: A Microsurgical Technique for Interdental Papilla Reconstruction

Damien Feuillet, DDS1*
Jean-François Keller, DDS, PhD2*
Kevimy Agossa, DDS, PhD3

Interdental papilla reconstruction is one of the most challenging clinical procedures in periodontal plastic surgery. Several surgical approaches have been proposed but have varying degrees of success. It has long been acknowledged that the narrowness of the interdental papilla and the limited blood supply are major impediments to achieving predictable outcomes. Advances in microsurgery could offer an opportunity to overcome these anatomic and biologic barriers. The authors propose an original microsurgical technique based on interproximal tunneling combined with utilization of a customized tissue graft for interdental papilla reconstruction. Int J Periodontics Restorative Dent 2018;38:833–839. doi: 10.11607/prd.3549

Esthetics is a major concern in modern dentistry, which finds itself at the crossroads of continuous technical advances and increasing demands from patients. Dental esthetics is composed of two complementary aspects, namely white and pink esthetics, which refer to the natural and pleasant aspects of the tooth and the surrounding hard and soft tissues, respectively. Periodontal plastic surgery encompasses a wide range of procedures intended to correct or prevent innate or acquired gingival defects in order to improve pink esthetics.1 Short- and long-term clinical data support the effectiveness and high predictability of these procedures for improving pink esthetics, especially for root coverage.2,3 However, the treatment outcomes of some specific problems, including black triangles caused by interdental papilla (IP) loss, remain unpredictable. IP absence/loss, especially with respect to anterior teeth, is associated with obvious esthetic impairment and functional discomfort,4 which is why much attention has been devoted to this topic in recent decades. IP loss may result from infectious periodontal diseases, local traumatic factors, or tooth malposition. Etiologic therapy should thus be performed before a corrective approach is undertaken. This includes the control of plaque-induced
inflammation, the correction of traumatic oral hygiene procedures, and the placement of well-shaped restorations and/or orthodontics. Both restorative/prosthetic and periodontal procedures can be implemented to treat lost IP. Restorative and prosthetic devices, such as veneers and crowns, only allow for the artificial coronal displacement of the papilla by reducing the interdental space. On the other hand, the goal of periodontal procedures is to restore ideal papilla height and volume using surgical and nonsurgical techniques. Nonsurgical approaches include repeated papilla curettage and, more recently, the injection of a micronized acellular dermal matrix. Several surgical approaches have been described, with limited evidence in terms of success rates and predictability. Since the preservation of a sufficient blood supply is of concern for optimal IP healing post-surgery, it can be assumed that the inconsistent outcomes from previously reported procedures are linked, at least in part, to suboptimal flap design. Zabalegui et al described tunnel subepithelial connective tissue graft for the treatment of multiple gingival recessions. This procedure—which preserves the vascularization of flaps—provides highly predictable outcomes, with the specific advantage of promoting early initial healing due to the absence of external incisions. The introduction of microsurgical concepts in periodontal plastic surgery offers the opportunity to expand the limits of current treatments.

This paper describes an original microsurgical procedure for the reconstruction of lost IP by interproximal tunneling (IPT) with subepithelial connective tissue grafts.

Materials and Methods

Preparation of the Recipient Site

Articaine/epinephrine (1:100,000) was injected in the vestibulum and palate of the surgical site by local infiltration. Transpapillary and intrasulcular injections were not used in order to limit vasoconstriction of the IP and avoid physical trauma from the needle. A ×4 magnifying loupe was used to optimize the view of the surgical site. First, straight and curved microsurgical instruments (Deppeler) were used to create a mucoperiosteal tunnel on the buccal side without disrupting the papilla. The full thickness tunnel was extended laterally and apically around half of the adjacent teeth and beyond the mucogingival line to avoid any stress (Fig 1a). On the palatal side, two vertical 7- to 10-mm parallel releasing incisions were made halfway along the scalloped gingival margin, and a split-thickness dissection was performed through the incisions (Fig 1a). A 2-mm tunneling instrument (Deppeler) was then used to connect the buccal and palatal recipient sites with a supraperiosteal tunnel created under the IP to achieve complete relaxation. Papillary mobility is essential for the formation of a recipient space under the papilla, the positioning of
the connective tissue graft, and the coronal placement of the papilla.

**Preparation of the Donor Site**

A thick connective tissue graft was harvested from the maxillary tuberosity using the distal wedge procedure. It was precisely contoured to the dimensions of the expected papilla and was partially split lengthwise to create a T shape with two lateral wings and a main body (Fig 1b).

**Sutures**

Three stabilizing sutures were used to maintain the custom-made T-shaped graft under the papilla (Fig 1c). Two buccal sutures were inserted, one on each side of the bottom of the papilla triangle. The needles were inserted underneath the vestibular envelope, exited through the sulcus of the same adjacent tooth, entered the corresponding lateral sides, and returned to the starting point. Similarly, for the palatal suture, the needle was guided through the tunnel from the palatal to the buccal side, exited in the same sulcus as the previous sutures, penetrated the graft tissue, and returned to the palatal side. The entrance of the graft should always be on the buccal side, and the needles should exit in the same sulcus before penetrating the corresponding wings. The graft was gently inserted under the papilla by pulling the sutures and was secured using a simple square knot. Lastly, a vertical double-cross mattress suture suspended at the contact point was used to coronally displace the papilla, as previously described by Zuhr et al.17

**Postoperative Care**

No oral hygiene procedures were allowed on the surgical site for 4 weeks. A 0.12% chlorhexidine rinse was prescribed twice daily during the early healing phases. The patients were instructed to take analgesics. The sutures were removed 3 days postsurgery, and regular follow-up visits were scheduled. Following the procedure, the patients were told that it would be preferable to use gentle flossing rather than an interdental brush to avoid potential trauma from oversized interdental brushes.

**Results**

Three nonsmoking, systemically healthy patients were included in this case series report to determine the efficacy and medium- and long-term outcomes of the IPT procedure. Two of the patients (one male and one female) presented an esthetic complaint related to IP loss. The third patient was initially referred for the treatment of an intrabony defect on the maxillary right central incisor; following the regenerative procedure, papilla atrophy was observed, and IPT was performed in a second phase to improve the soft tissue profile. All patients received instructions

---

**Table 1 Additional Data for Case 1: Baseline and Postoperative Values for PPD, REC, CAL, and the Papilla Index**

<table>
<thead>
<tr>
<th>Papilla index</th>
<th>Maxillary right canine</th>
<th>Maxillary right lateral incisor</th>
<th>Maxillary right central incisor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PPD (mm)</td>
<td>REC (mm)</td>
<td>CAL (mm)</td>
</tr>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
<td>Before</td>
</tr>
<tr>
<td>MB</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>DB</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>ML</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>L</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>DL</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

PPD = pocket probing depth; REC = gingival recession height; CAL = clinical attachment level; MB = mesiobuccal; B = buccal; DB = distobuccal; ML = mesiolingual; L = lingual; DL = distolingual.
for adequate oral hygiene before the surgery. An initial periodontal therapy was performed to reduce the inflammation of the periodontal tissues. A low full-mouth plaque score (FMPS < 20%) and the absence of bleeding on probing at the recipient site were required. Alternative therapeutic solutions were discussed with the patients, and their consent was obtained before the surgery. Pocket probing depths (PPD), recession heights (REC), and clinical attachment levels (CAL) were determined using a calibrated periodontal probe (UNC15), and embrasure fill was assessed using Jemt’s papilla index18 (Tables 1 to 3).

The first patient, a 42-year-old man, received IPT for the reconstruction of the papillae between the maxillary right central and lateral incisors and between the maxillary right lateral incisor and canine. The step-by-step procedure and outcomes are shown in Figs 2a to 2g.

The second patient, a 37-year-old woman, was referred for a single median interincisal papilla reconstruction. Baseline and 2-year views are shown in Fig 3.

The third patient, a 45-year-old man, received IPT as a second-step treatment after a regenerative procedure (Bio Oss, Emdogain) for an intrabony defect on the maxillary right central incisor. Baseline, 1-year, and 2-year views are shown in Fig 4. The increase in papillary height was limited due to the presence of the diastema, but a clear improvement in the IP tissue profile could be observed.

Discussion

This clinical report describes an original microsurgical procedure (IPT) that provided a successful long-term reformation of the IP and a substantial esthetic enhancement in the maxillary anterior area. IPT, a tunnel-modified technique, is minimally invasive and allows the blood supply of the IP to be preserved since the base of the papilla remains attached to the surrounding tissues on both the buccal and palatal sides. The two vertical parallel incisions on the palatal side were essential to achieve sufficient mobility of the flap and coronal repositioning of the papilla with minimal impairment of wound healing, as the primary vascular pedicle at the base of the papilla was not sectioned. Also,
it should be emphasized that the tunnel on the palatal side is a key variable for this approach. The maxillary tuberosity area was chosen as the donor site to ensure a fibrous, dense connective tissue graft, which was expected to be less prone to tissue retraction and to yield more stable outcomes than a palatal graft.\textsuperscript{19,20} The T-shape design of the graft ensured greater stability under the papilla and prevented twisting when completing the sutures. Given that IPT is a microsurgical technique, specific instruments are required, and the surgeon’s experience level is of the utmost importance. In most cases, the postoperative phase is

---

**Fig 2** Case 1. (a) Preoperative view. Note the papilla loss between the maxillary right central and lateral incisors and between the lateral incisor and canine. (b) Preoperative view of the palate. Note the parallel vertical incisions near the middle of the palatal faces of the central incisor and canine. (c) Preoperative view of the partially split connective tissue graft. Note the T shape. (d) Preoperative view of the sutures. Note that all the sutures exit in the same sulcus before penetrating the connective tissue graft. (e) Note the coronal advance of the papilla after suturing. (f) One-month postoperative view showing improvement in the height of the papilla. (g) One-year postoperative view showing the outcome’s stability and the absence of clinical inflammation.

---

**Fig 3** Case 2. (a) Preoperative view showing papilla loss between the right and left maxillary central incisors. (b) Baseline radiograph showing the interdental bone level. (c) Two years after the surgery. Note the complete recovery of the papilla.
uneventful and rapid wound healing occurs within 1 to 2 weeks. Based on the authors’ experience, necrosis of the papilla may occur, especially when the two palatal vertical incisions are too close together. As such, a minimum distance of 8 mm between incisions is recommended. This complication does not worsen the initial situation, and the procedure can be repeated once the soft tissue has recovered. Since the restored papilla showed no clinical sign of inflammation over time, the increase in height and volume of the soft tissue was likely not caused by an inflammatory process. However, patients and sites should be selected with care. IPT should preferentially not be performed on smokers or patients who present systemic risk factors for impaired wound healing. Large papillae and thick gingival biotypes should be preferred in order to achieve consistent results. As reported by Tarnow et al, there is an anatomic limit to the height of the papilla, which is determined by the morphology of the adjacent teeth and underlying bone. The presence of diastemata, the misalignment of crowns, or severe bone loss may jeopardize the outcome.

Fig 4 Case 3. (a) Before the etiologic treatment. Note the accumulation of plaque and the inflammation of the gingiva. (b) After the etiologic treatment. Note the overall decrease in interdental papilla height due to the decrease in edema. (c) Severe intrabony defect on the maxillary right central incisor (pocket probing depth = 9 mm). (d) Bone healing 1 year after the regenerative procedure. (e) Atrophy of the papilla following the regenerative procedure. Note the misalignment of the scalloped gingival margin. (f) Two years after the papilla reconstruction. Note the slight improvement in papilla height due to the diastema as well as the clear improvement in the gingival contour, which improves the overall esthetics.
of this procedure. Nonetheless, IPT can help improve the soft tissue profile even if complete papilla regeneration is not achieved.

Conclusions

Interdental papilla reconstruction is one of the most challenging clinical procedures in periodontal plastic surgery. To overcome such a clinical challenge, the authors propose an original microsurgical technique based on interproximal tunneling combined with customized connective tissue graft. The preliminary results obtained by using IPT for the reconstruction of interdental papilla are promising. The authors thus suggest that IPT can be used to treat one or two atrophied papillae during the same procedure. Larger, long-term clinical follow-up case series will be necessary to establish the predictability of IPT for interdental papilla reconstruction. The combination of IPT with biomaterials, such as amelogenins or mineralized collagen bone substitutes, may also improve the outcome of this technique.

Acknowledgments

The authors gratefully acknowledge Mrs Susan Becker and Prof Olivier Huck for revising the manuscript. The authors declare no conflicts of interest related to this work.

References