

Peri-implant Papillae Reconstruction at an Esthetically Failing Implant



Martina Stefanini, DDS, PhD¹
 Matteo Marzadori, DDS¹
 Lorenzo Tavelli, DDS²
 Pietro Bellone, DDS¹
 Giovanni Zucchelli, DDS, PhD¹

This case report aimed to describe a soft tissue approach to restore a buccal soft tissue dehiscence (BSTD) combined with the loss of peri-implant papillae and loss of periodontal attachment on the adjacent teeth. The first step of the proposed approach was the removal of the crown and abutment to leave the interproximal soft tissue to fill the space previously occupied by the crown. After 3 months, during which time the patient was wearing a provisional restoration (a temporary Maryland bridge), the implant site was treated as an edentulous area with a soft tissue augmentation procedure: the most substantial modification with respect to the original connective tissue platform technique was the use of the wide mesial and distal papillae of the implant, once de-epithelialized on the occlusal surface, as a "partial" connective platform to suture the connective grafts and submerge the implant. At the 4-month reevaluation visit, a minor soft tissue defect remained in both apico-coronal and buccolingual dimensions, and thus a second surgery was performed to obtain further soft tissue augmentation. A flapless punch procedure was used to expose the implant head, and after conditioning the augmented peri-implant soft tissue with a new provisional crown, the definitive restoration was delivered. Complete coverage of the BSTD was achieved, and both papillae entirely filled the interproximal spaces. The results were well maintained up to the 5-year follow-up visit.

Int J Periodontics Restorative Dent 2020;40:213–222. doi: 10.11607/prd.4296

Implant success should be determined by using composite outcome measures, including patient-reported outcome measures, peri-implant tissue health, and functional and esthetic outcomes related to implant-supported reconstruction.¹ The most common peri-implant esthetic complications are the buccal soft tissue dehiscence (BSTD), with a prevalence that can range up to 64% in immediate implants,² and the presence of inadequate papilla.³ The etiology of a soft tissue defect is related to many predisposing and precipitating factors that may include a buccally positioned implant, osseous dehiscence or fenestration at the buccal bone, a thin gingival biotype, a lack of or minimal keratinized mucosa, vigorous toothbrushing, inflammation, and an over-contoured prosthesis.⁴ Recently, many surgical procedures have been proposed to treat these defects, and some encouraging long-term results are also reported.^{5,6} Conversely, although the problem with inadequate papilla has been identified and attempts have been made to correct the problem with various surgical techniques, the regeneration of the papilla adjacent to the dental implant is still difficult to perform and often unpredictable.³ When an implant is placed adjacent to a tooth, the bone level and the interproximal

¹Department of Biomedical and Neuromotor Sciences, Bologna University, Bologna, Italy.

²Department of Periodontics & Oral Medicine, University of Michigan School of Dentistry, Ann Arbor, Michigan, USA.

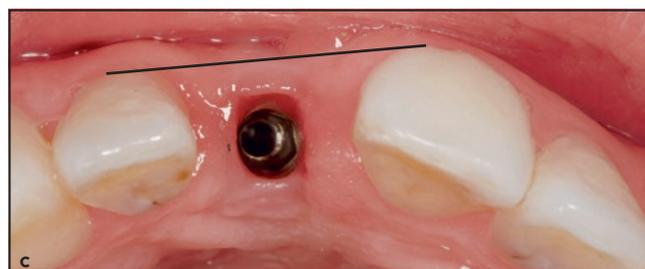
Correspondence to: Dr Martina Stefanini, Department of Biomedical and Neuromotor Sciences, Bologna University, Via San Vitale 59, 40125 Bologna, Italy.
 Email: martinastefanini3@gmail.com

Submitted January 15, 2019; accepted March 2, 2019.

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Fig 1 (a) Baseline clinical situation showing the buccal soft tissue dehiscence and the lack of peri-implant papillae. (b, c) After crown removal, it is possible to evaluate the implant position that is inside the imaginary line that connects the gingival margin of the adjacent teeth.



papilla are maintained at their original levels by the supracrestal soft tissue attachment at the tooth side, as it remains undisturbed. Therefore, in the presence of bone and periodontal attachment loss on the adjacent teeth, papilla reformation is unlikely to be achieved. Only few case reports described the treatment approach to reconstruct interdental papilla between an implant and a periodontally compromised tooth.^{7,8}

This case report aimed to describe a soft tissue approach to restore a BSTD combined with the loss of peri-implant papillae and periodontal attachment on the adjacent teeth.

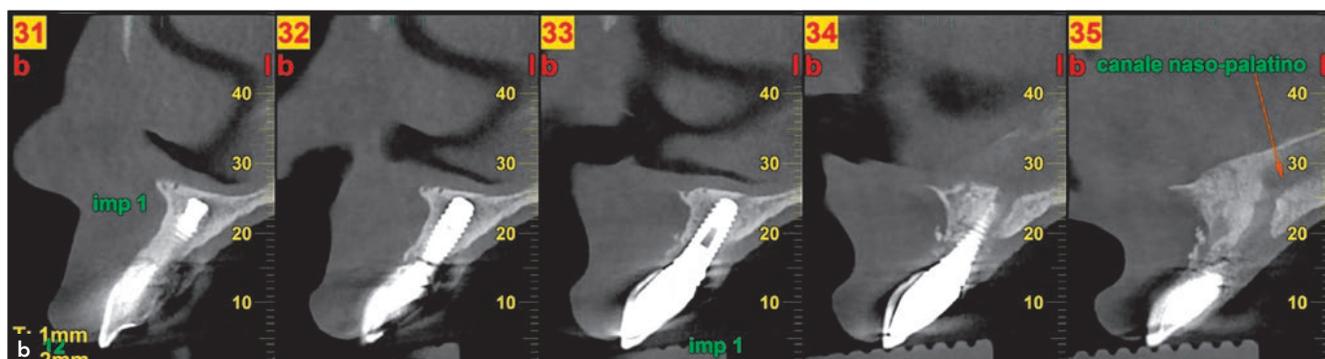
Materials and Methods

Case Presentation

A 38-year-old woman was referred to the Department of Biomedical and Neuromotor Sciences of Bologna University, Italy, for the evaluation of her implant replacing the maxillary right central incisor. Clinical examination revealed a BSTD associated with the loss of both mesial and distal papillae. Implant-supported crown profile was located outside the imaginary curve line, connecting the profile of the adjacent teeth at the level of the soft tissue margin. After crown removal, the position of the implant head was within the imaginary line that connects the vestibular profile of the adjacent teeth (Fig 1). The height of the distal papilla was

at the same level as the esthetically ideal position of the soft tissue margin of the implant-supported crown while the mesial papilla was slightly more coronal. Therefore, the defect could be defined according to the classification proposed by Zucchelli et al as a Class III subclass C.⁹ Moreover, the loss of the interproximal soft tissue height was associated with periodontal attachment loss on the adjacent natural teeth (moderate/severe on the lateral incisor and mild on the central incisor) where the interproximal and vestibular cemento-enamel junction was exposed. The intraoral radiograph showed the incorrect implant position in both apico-coronal (too deep) and mesiodistal (very close to the lateral incisor) directions and bone loss on the adjacent teeth (Fig 2a). No clinical or radiologic signs

Fig 2 (a) Periapical radiograph showing the implant malposition and a radiolucent round area mesial to the implant. Loss of attachment and bone resorption are detectable on both the lateral and central incisors. (b) Cone beam computed tomography scan showing the presence of a vestibular buccal bone wall and a broad nasopalatine canal.



of peri-implantitis were detectable. There was a radiolucent round area mesial to the implant. The three-dimensional radiographic analysis showed the presence of the buccal bone wall at the implant with the presence of nonresorbable biomaterial and a very broad nasopalatine canal that was responsible for the round radiolucency and probably for the mesiodistal malposition of the implant as well (Fig 2b). The patient's medical history revealed no systemic contraindications for dental treatment. The patient complaint regarded the presence of the black interdental triangles during smiling. Her smile line was, in fact, not particularly high and showed the lack of peri-implant papillae, not the vestibular dehiscence (Fig 3). The limited clinical data on the possibility of improving the height



Fig 3 Patient's smile at baseline.

of peri-implant papillae, especially when associated with bone loss and periodontal attachment loss of the adjacent teeth, suggested implant extraction. However, the authors were persuaded to treat the defect due to (1) the absence of clinical

and radiographic signs of peri-implantitis, and (2) the patient's strong motivation to maintain the implant, as she was a colleague who had declared herself willing to accept any treatment, even an unpredictable one.

Surgical Procedure

The clinical plan was to treat the implant site as if it were an edentulous area and to use a modification of the connective tissue platform technique^{10,11} to solve the horizontal and the vertical component of the peri-implant soft tissue defect. The most substantial modification compared to the original technique was to use the wide mesial and distal papillae of the implant, once de-epithelialized on the occlusal surface, as a "partial" connective tissue platform to suture the connective tissue grafts and submerge the implant. For this reason, the implant crown was removed 3 months before surgery, the abutment was replaced with a healing cap (screw), and a provisional restoration (a temporary Maryland bridge) was placed. This allowed further maturation of the interdental soft tissues that partially filled the space previously occupied by the abutment (Fig 4a).

During this period, the patient performed a roll brushing technique and a chemical plaque control with a mouthwash containing chlorhexidine applied locally twice a day.

The flap design consisted of a modification of the trapezoidal coronally advanced flap. Two horizontal incisions were performed mesial to the central incisor and distal to the lateral incisor. Two slightly divergent vertical incisions were made at the end of these horizontal incisions, reaching the mucosal lining of the lip. In the edentulous area, the horizontal crestal incision was positioned vestibularly. Flap elevation was performed split-thickness

at the level of the surgical papillae and full-thickness at the level of vestibular probing areas including the probable vestibular tissue at the implant site. Then, to allow the coronal displacement of the flap, a deep split-thickness incision (to detach muscles from the periosteum) and then a superficial split-thickness incision (to separate muscles from the alveolar mucosa) were performed (Fig 4b). At the palatal aspect of the edentulous area, a horizontal crestal incision was performed.

This incision connects the line angles of the central and lateral incisors and is parallel to the one previously performed at the vestibular aspect, thus delimitating an area of soft tissue representing the papillae mesial and distal to the implant head, called the "platform." The palatal incision was beveled to elevate the palatal split-thickness flap. The occlusal aspect of the platform was de-epithelialized so the exposed connective tissue could be used for anchoring the connective grafts.

The exposed and probable buccal aspect of the implant was decontaminated mechanically with the use of a titanium microbrusher (Sweden and Martina) and chemically with 24% ethylenediaminetetraacetic acid for 2 minutes and 1% chlorhexidine gel for 2 minutes. After mechanical and chemical treatment of the exposed buccal and interproximal root surfaces of the two adjacent teeth, Emdogain gel (Straumann) was applied in situ for 1 minute. Biomaterial particles used during previous bone regeneration surgery not clinically integrated into the buccal bone were eliminated

during the preparation of the recipient bed.

A first connective tissue graft (CTG), harvested from the tuberosity, was placed above the healing screw and stabilized with internal mattress sutures anchored to the occlusal surface of the connective tissue platform. This first graft was used to compensate for the apico-coronal difference in levels between the healing screw and the occlusal surface of the platform. A second CTG, deriving from the de-epithelialization of a free gingival graft, was applied buccally to cover the buccal exposure of the implant surface and fixed with single interrupted sutures at the vestibular aspect of the connective platform. The apico-coronal dimension of the vestibular graft was chosen in order to cover 3 mm of buccal bone (Fig 4c).

A third CTG, deriving from the de-epithelialization of a free gingival graft and with mesiodistal and buccopalatal dimensions corresponding to the connective tissue platform dimension, was positioned above the first graft harvested from the tuberosity and sutured with single interrupted sutures to the occlusal-vestibular surface of the platform. This graft had the purpose of obtaining a vertical increase in the soft tissue height with respect to the baseline position of the connective tissue platform (Fig 4d). The vestibular flap, previously released from the muscular insertions, was coronally advanced to cover the CTGs completely. To avoid excessive compression and palatal dislocation of the third occlusal graft, a complete closure by primary intention



Fig 4 Surgical procedure. (a) Clinical situation after the presurgical maturation phase. (b) Split-full-split-thickness flap elevation. (c) Fixation of buccal and occlusal connective tissue grafts. (d) Third graft positioned above the first occlusal one. (e) Flap closure. (f) Short provisional restoration to avoid tissue contact during healing.



was intentionally not accomplished. Simple interrupted sutures juxtaposed the two flaps at the level of the horizontal crestal incisions and left an occlusal part of the graft ex-

posed. Single interrupted sutures along the vertical releasing incisions and sling sutures suspended at the palatal cingulum of the teeth, delimiting the edentulous area, complet-

ed the closure of the vestibular flap (Fig 4e). The pontic element of the provisional restoration was reduced to avoid any contact with the soft tissue during healing (Fig 4f). Sutures



Fig 5 Clinical situation 4 months after surgery showing small residual soft tissue defects.



Fig 6 Second surgical procedure. (a and b) Connective tissue graft folded in two and fixed at the supracrestal connective tissue increased during the platform technique. (c) Flap closure.



were removed after 2 weeks, during which time the patient only performed chemical plaque control with the use of an antiseptic rinse with 0.12% chlorhexidine three times a day, applying it locally for 1 minute.

Afterward, the patient could begin to brush the treated area using a toothbrush with ultra-soft bristles while continuing to use the mouth rinse twice a day. The soft tissue maturation process was left undisturbed for 4 months. At the 4-month

reevaluation visit, a minor soft tissue defect in both apico-coronal and buccolingual dimensions remained, and thus a second surgery was performed to obtain further soft tissue augmentation (Fig 5). The buccal flap design was the same as the first surgery, but only a palatal split-thickness incision was performed at the level of the edentulous area. A CTG was harvested, deriving from the de-epithelialization of a free gingival graft. The length of the graft

was double the mesiodistal dimension of the edentulous area, so it was folded on itself to double the thickness (Fig 6a). The apico-coronal dimension of the graft was greater than the buccal-palatal dimension of the platform in order to extend the exceeding part of the graft more buccally and to compensate for the residual buccopalatal defect. The double graft was anchored to the connective platform with internal mattress sutures. Apical simple interrupted sutures improved the adaptation of the graft to the underlying buccal connective tissue (Fig 6b). The vestibular flap was coronally advanced to obtain a healing by first intention along the palatal incision line (Fig 6c). Sutures were removed after 2 weeks, and the same postsurgical instructions were suggested.

Restorative Phase

Three months after surgery, a punch flapless procedure was used to expose the implant head, and a narrow and thin abutment was applied with cemented short provisional crown. Healing was left undisturbed for 3 more months, during which the provisional crown was maintained short to avoid any contact with the vestibular and the interproximal soft tissues to allow complete maturation before the conditioning phase.

Soft tissue conditioning was performed with a screw-retained provisional crown. The final goal was to scallop the marginal soft tissue in order to make it as similar as possible to the gingival margin of the natural homologous tooth and

Fig 7 Clinical situation at the end of the conditioning phase.



Fig 8 The superimposition of the soft tissue at (a) baseline and (b) 1 year after final restoration, documenting an increase in papilla height ranging from 1 to 4 mm in relation to a different level of the interdental soft tissue at baseline (c).

to promote the coronal growth of the papillae through modifications of the interproximal profiles of the provisional crown and the coronal displacement of the contact points ("squeezing" effect) (Fig 7). The definitive restoration was delivered after 6 months, and the patient was included in an individually tailored supportive periodontal therapy.

Results

Complete coverage of the BSTD was achieved and both papillae entirely filled the interproximal spaces

(Fig 8) 1 year after the final restoration. Gingival recessions affecting the lateral and central incisors were also covered. The patient was very satisfied with the final esthetic outcome. The buccolingual increase in soft tissues enables the creation of a prosthetic crown with natural emergence profiles that resemble those of the adjacent teeth, making it easier to maintain from a hygienic point of view. An intraoral radiograph taken 1 year after definitive crown placement showed the stability of the bone level at the implant site and at the adjacent teeth (Fig 9). This, in addition to the absence

of clinical signs of mucositis or peri-implantitis, indicates a healthy status of peri-implant tissues. The 3- and 5-year follow-up visits revealed clinical and radiographic stability of the 1-year results (Figs 10 and 11).

Discussion

The presented case showed a successful reconstruction of peri-implant tissues, including reformation of lost interproximal papillae at periodontally compromised sites, using a soft tissue surgical approach. One year after definitive restoration,

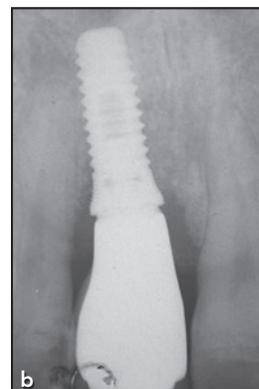


Fig 9 (a) Clinical and (b) radiographic views at 1 year after definitive restoration, showing the interproximal bone level stability. Restorative treatment performed by Carlo Monaco at Bologna University, Italy.



Fig 10 Clinical view at the 3-year follow-up visit.

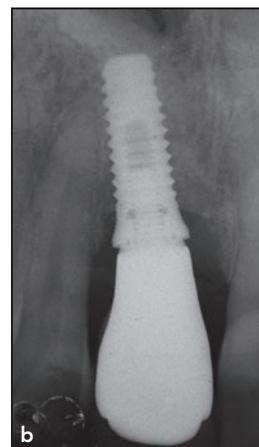


Fig 11 (a) Clinical view and (b) intraoral radiograph at the 5-year follow-up visit showing the interproximal bone level stability.

a successful esthetic outcome was accomplished with complete dehiscence coverage and complete fill of

the interproximal spaces. These results were maintained at the 3- and 5-year follow-ups.

Reconstructing the inter-implant papillae in the esthetic zone is one of the most challenging and

unpredictable procedures in implant therapy. A classic paradigm of regenerative surgery suggested that there is a biologic limit to papilla reconstruction that is determined by the level of the bone pick. When the distance from the contact point and the bone crest is > 5 mm, papilla reconstruction is unlikely, and therefore reconstruction of the missing interdental bone is essential to achieving papilla reformation.^{12,13} In the literature, various approaches for papillae reconstruction and strategies to prevent formation of black triangles during implant therapy in the esthetic zone have been described.³ To the best of the present authors' knowledge, only one case report addressed the issue of an esthetically failing implant with a soft tissue dehiscence and loss of papillae associated with loss of attachment at the adjacent teeth.

Urban et al⁷ described a multidisciplinary treatment approach to obtain papilla reformation between an implant and a periodontally compromised tooth using a surgical procedure and a customized abutment. The first step of the treatment plan was implant extraction to recreate an edentulous area. Then, the surgical procedure consisted of guided bone regeneration with autologous bone and Goretex membrane (Gore). After 6 months, during the reentry procedure and despite the presence of 4-mm vertical augmentation, there was still a loss of interdental bone that prevented papilla reformation, and therefore additional soft tissue grafting was performed to enhance soft tissue architecture. The two surgical procedures regenerated most

of the papillae, but a minor discrepancy still remained and a papilla-supporting abutment was created.

Despite the successful result reported by the authors, two criticisms can be raised: the first concerns the need to extract the well-osseointegrated implant. The second criticism is linked to the fact that guided bone regeneration should be performed in a single edentulous area in the presence of a loss of attachment on the adjacent teeth along with periodontal regeneration, and this is unfortunately highly unpredictable.⁸

The only possible alternative is to adopt a soft tissue–augmentation procedure able to increase the edentulous area even in the absence of bone-peak integrity and the level of attachment at the adjacent teeth. Then, the regrowth of the papillae is the result of the prosthetic conditioning of the augmented soft tissues. Among these procedures, the connective-tissue platform technique demonstrated in a single edentulous area the possibility of obtaining an increase in soft tissue volume independently of the presence of the bone peaks at the adjacent teeth.^{10,11}

Maintaining the well-osseointegrated implant and only removing the abutment using a healing screw, it was possible to turn the implant site into an edentulous area and increase the volume of the soft tissues independently of the loss of bone and attachment level on the adjacent teeth. The provisional prosthetic management had a critical role in the successful outcome of the presented clinical case. Undisturbed

soft tissue growth led to almost complete correction of the soft tissue defect. The development of interdental papillae with a shape and height similar to those of the contralateral healthy incisor indicated that the adopted delayed prosthetic soft tissue conditioning was able to achieve optimal esthetic outcomes.

The main concern of the adopted procedure was the creation of a transmucosal path not only at the implant site but also at the level of the adjacent teeth, thus increasing the risk of creating a periodontal pocket in case of plaque accumulation. The application of amelogenins along with the mechanical and chemical treatment of the exposed root surfaces of the lateral and the central incisors aimed to promote periodontal regeneration and to improve the attachment level. As the authors cannot provide histologic proof, we can only speculate that the adjunctive use of the amelogenins induced the formation of new attachment. This was clinically corroborated by the absence of pathologic probing pocket depth and bleeding during the 3- and 5-year follow-up visits. Indeed, a key aspect for the success was careful selection of the patient, who in the present case was strongly motivated, a nonsmoker, and had an optimal level of oral hygiene.

Lastly, the resolution of the gingival recession affecting the adjacent incisors also raises questions about the importance of the interproximal attachment loss in preventing root coverage, which opens up potential new scenarios on the possibility of covering the gingival recessions of Miller Classes III and IV defects.

Conclusions

The results from a case report study should always be interpreted with caution, and future studies are needed to ascertain long-term outcomes; nevertheless, the following conclusions can be drawn:

- A modification of the platform technique in the treatment of a BSTD associated with loss of interdental papillae and attachment level at the adjacent teeth was able to provide buccal and interproximal peri-implant soft tissue reconstruction.
- These successful results were maintained at 5 years, showing no signs of mucositis/peri-implantitis and no probing pocket depth on the adjacent teeth.
- Careful selection of the patient (good oral hygiene and an absence of periodontitis and smoking habits) was mandatory to obtain successful results. Strict postsurgical care and the patient's adherence to a tailored supportive periodontal therapy program was crucial to maintaining stable results.

Acknowledgements

The authors declare no conflicts of interest.

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