

Restorative Dentistry and Papilla Reconstruction in Reduced Periodontium

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Restoring the loss of periodontal soft and hard tissues represents a unique challenge for the dental team. The interdental papillae in the esthetic zone can be a dilemma for both the patient and the therapist. A multidisciplinary approach is critical for the successful treatment of lost papillae. This article reports on the successful long-term papillae reconstruction using a combined approach: Plastic surgery and restorative dentistry in one case and restorative dentistry alone in another case.

Key words: papilla reconstruction, reduced periodontium, esthetic outcome, bone morphology, gingival morphology

Esthetics has become a major concern in periodontal plastic surgery and in restorative therapy. The reconstruction, in patients with a high lip line smile, of the lost interdental papilla in the esthetic zone, due to loss of periodontal support, periodontal disease or surgical pocket elimination in the esthetic zone is one of the most difficult goals for the practitioner. Restoring teeth in the presence of a normal periodontium is relatively simple with today's knowledge of restorative materials together with the collaboration of skilled and talented dental technicians. Optimal esthetic results can be achieved where the restoration appearance is comparable to that of natural teeth.

The literature on papilla reconstruction is limited to case reports (Azzi et al, 1998; Azzi and Etienne, 1998; Azzi et al, 1999; Azzi et al, 2001; Azzi et al, 2002; Beagle, 1992; Han and Takei, 1996; Shapiro, 1985) but very few papers describe reconstruction in a reduced periodontium. Previous studies reported that the alveolar bone crest acts as a scaffold to support the overlying gingival tissues (Sanavi et al, 1998). The bone anatomy follows the configuration of the cemento-enamel junction in the interproximal region. This creates a pyramidal form in the interproximal re-

gion that enables the dental papilla to fill the interproximal space. Thus, to a certain degree, it is the scalloped shape of the bone that establishes the papillary form. According to Becker and colleagues (1997), the scalloped osseous anatomy in the maxillary anterior region, averages 3 mm in height from facial to interproximal, with a range of 2.1–4.1 mm. On the buccal aspect, the dento-gingival complex unit measures 3 mm above the osseous crest. This comprises the connective tissue attachment (1 mm mean height), the epithelial attachment (1 mm mean height) and the sulcus (average depth 1 mm). For the interproximal gingiva, the height is comprised between 4.5–5 mm (Kois, 1994). This may be explained by the increased sulcus depth (normally between 1.5 mm and 2.5 mm) while the biologic width (epithelial attachment plus connective tissue attachment) remains constant circumferentially within a variation of 0.5 mm (Gargiulo et al, 1961; Vacek et al, 1994).

The long-term stability of the papilla depends on the anatomic environment. The level of the interdental gingiva relies on an appropriate support from the underlying bone; the presence of a complete papilla is observed when the distance is

equal to 5 mm or less. Tarnow et al (1992) stated that the papilla is present 100% of the time when the distance from the incisal contact point to the crest of the interdental bone is 5 mm or less, whereas the papilla is present 56% of the times when the distance is 6 mm, and 27% when the distance is 7 mm. In addition to the underlying bone support, the dimensional discrepancy can be attributed to different factors. The presence or absence of papilla depends on the following parameters:

- The distance between the contact point and the alveolar crest (Tarnow et al, 1992).
- The patient's specific biologic width ranging from 0.75 mm to 4.33 mm (Vacek et al, 1994).
- The biotype of periodontium (Olsson and Lindhe, 1991).
- The gingival embrasure form (Kohl and Zander, 1961) and attachment level (Spear, 1999).
- The morphology of the crowns.

Orthodontic or prosthodontic treatment can help to improve a deficient papilla by closing the diastema or reducing the embrasure space. This allows the compression of the interproximal gingiva and the displacement of the papilla tip in the incisive direction. By changing the shape of the crowns, the contact point is displaced towards the gingiva and a more esthetic papilla between two teeth can be obtained despite alveolar bone loss. The purpose of this paper is to present two approaches to reconstruct interdental papillae in a reduced periodontium.

CASE 1

A Combined Perio-prosthetic Treatment

A 48-year-old woman was referred by her periodontist following periodontal pocket elimination, for 'cosmetic' treatment. The patient was in excellent systemic health and was a non-smoker. Her chief complaint was a poor esthetic appearance in the anterior region. This was caused by old ceramic crowns, gingival recessions on the anterior teeth (# 13, 12, 11, 21, 22, 23) and more importantly loss of papillae between the central and lateral incisors as well as between the lateral incisors and the canines. Recession was around 3 mm on

the facial aspect of teeth # 13 to 23, and periodontal probing depth on the buccal aspect was 3 mm. The patient presented a moderately high lip line. Thus, it was imperative to change the gingival level and to create papillae between adjacent teeth in order to achieve the desired esthetic goal. The radiographic examination revealed an extensive alveolar bone loss in most of the maxillary anterior teeth consistent with the observed clinical attachment loss.

A diagnostic wax-up was performed in order to determine the objectives of periodontal and restorative treatment. The treatment plan included:

- Surgical soft tissue recontouring with crown lengthening combined with restorative dentistry in order to improve the crown-root ratio and the esthetic outcome. This would allow changing the patient's reduced periodontium into a healthy situation.
- Equigingival preparation of teeth #13, 12, 11, 21, 22, 23 without taking into consideration the presence of crowns. No attempt was made to remove the old crowns or posts in order to limit the risks of root fracture.
- Preparation of provisionals. An acrylic temporary fixed bridge was placed on the maxillary anterior region, with the splinting of teeth #13 to 23.

The diagnostic wax-up was used to fabricate a surgical guide that would facilitate the crown lengthening procedure by identifying the future location of the restoration's margins.

Surgical Phase

With a 3 mm sulcus depth, as in the present case, a crown lengthening of 2 mm as determined by the surgical guide was sufficient. The surgery was limited to an internal beveled gingivectomy thereby reducing the thickness and height of the gingiva (of the initial 3 mm gingival height, 2 mm was removed resulting in a 1mm sulcus depth). An internal beveled incision designed in a scalloped fashion was performed around the teeth to outline the new location of the gingival margin at the predetermined location. A collar of gingiva was removed from the mesial line angle to the distal line angle on the facial aspect of each tooth without the need of a second incision. Caution was exerted to preserve the papillary areas and to avoid the destruction of the papillae during the surgery (Fig. 1c).



Fig. 1a Pre-operative view illustrating the lack of papillae and the inadequate restorations.

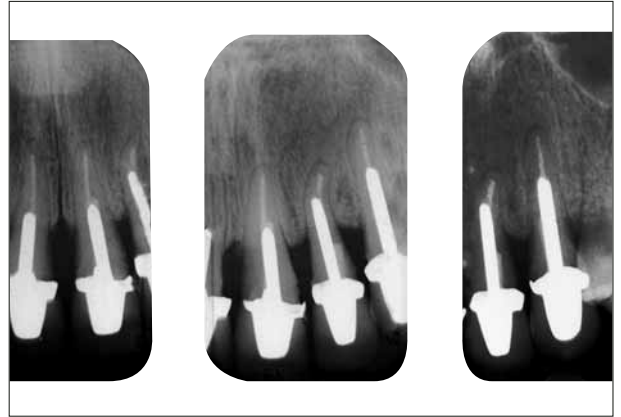


Fig. 1b Radiographs showing advanced bone loss.



Fig. 1c Provisional bridge following plastic surgical recontouring.

Restorative Phase

Teeth were prepared with the cervical limit placed at the level of the new gingival margin after completion of the crown lengthening procedure on the buccal aspect of teeth # 12–22. Immediate provisional restorations were relined using a direct method. This phase of treatment is extremely important. The marginal fit, the contour and the surface finish of the temporary restorations must be appropriate in order to maintain the position of the gingiva and preserve the health of the tissues until the placement of the final restorations. Special attention should be given to the development of the proper emergence profile of the provisional restorations buccally, lingually and interproximally. Whenever possible, the finish line of the provisional restoration should closely correspond to the margin of the final restoration. When preparing the teeth, the tip of the bur should follow the gingival margin of the anatomic configuration of the cement-

enamel junction. Hence, the interproximal margins are more coronal than the buccal and lingual margins. This will help to insure an adequate biological width and healthy and intact interproximal papillae. When full coverage restorations are indicated, placing the margins intra-crevicular should be avoided. However, in the anterior regions, it is frequent that margins have to be positioned within the sulcus for esthetic reasons. In these cases, margins should be placed in such a way to squeeze and sculpt the interproximal gingiva (on the facial aspect, the margins are equigingival, no more than 0.2 mm into the sulcus, apical to the free gingival margin). Interproximally, since the sulcus depth is deeper, the tooth preparation can extend more apically (but should never impinge on the biologic width) for better support of the soft tissues. It is important, particularly on the front teeth, that the interproximal crown preparation is not too flat; otherwise there is a risk of violating the biologic width. Failure to respect the integrity of the dento-



Fig. 1d Clinical view 6 weeks post-surgery showing gingival healing and papilla reconstruction.



Fig. 1e Final restorations with papillae reconstruction.



Fig. 1f Pre-operative view.



Fig. 1g Post-operative view.

gingival junction will likely result in chronic inflammation and subsequent attachment loss; this in turn will be accompanied of adverse esthetic consequences (Ingber et al, 1977; Lang et al, 1983; Maynard and Wilson, 1979; Parma-Benfenati et al, 1985; Tarnow et al, 1986; Wilson and Maynard, 1981).

Proper embrasure space must be restored to promote periodontal health and esthetic appearance. Following the placement of the provisionals with the desired contour and embrasure form (Fig. 1c), tissues are allowed to heal for 6 weeks before providing the laboratory with the information on tissue contour for the final restorations (Fig. 1d). The gingival tissues act like a waterbed: it can be pushed and molded with the use of provisionals that can

be modified repeatedly to induce creeping papillae prior to the definitive restorations. Following placement of provisionals, the flat gingiva that was initially present (Fig. 1a) evolves into an interdental papilla (Fig. 1c). Tissues should be handled gently during impression-taking.

The maxillary teeth were restored using porcelain fused to metal crowns. By recontouring the shape and outlines of the prosthetic restorations, the interdental spaces were closed and a natural gingival contour, including interdental papillae, was achieved (Fig. 1e). The patient was placed under strict recalls, and oral hygiene compliance was excellent. Fig. 1f and Fig. 1g illustrate the pre-operative and post-operative situations.

CASE 2

Prosthetic Treatment

A 65-year-old man was referred for perio-prosthetic treatment (Fig. 2a). The patient was in good general health and a non-smoker. The patient's chief complaint was a poor esthetic appearance in the anterior region associated with severe recessions, loss of the interdental papillae and wear around the neck of the teeth because of traumatic interproximal cleaning. The patient had a moderately high lip line. There was no need for gingival recontouring (Fig. 2e). Oral hygiene was excellent and gingival tissues were free of inflammation. Probing depths ranged between 2 and 3 mm. Dental mobility was not significant. Radiographic evaluation indicated severe bone loss affecting 66% of the root length.

The patient wanted to keep his teeth and to have, if possible, the esthetic of the 'white' (teeth) and 'pink' (gingival framework) parts reconstructed. He had been told previously that nothing could be done to improve the esthetic of the anterior region. It was even suggested to the patient that he should have 'strategic' teeth extractions with immediate placement of fixtures for a fixed bridge on implants.

A diagnostic wax-up was performed to determine the desired outcome of the prosthetic treatment. Restorative procedures were discussed with the patient. A decision was made to splint the upper arch teeth with a fixed bridge using ceramic backed on a zircon metal-free framework. The interproximal spaces between the teeth were narrow. The use of zircon allowed placement of the cervical margins in an ideal position in order to achieve an acceptable esthetic result.

Tooth preparation was equi-gingival for most of the parts, depending on the wear around the collar of the teeth (Fig. 2b). An immediate temporary fixed bridge was cemented using 'Temp Bond'® cement.

The equi- or supra-gingival location of the preparation margins prevents interference with the biological width and helps maintain a healthy periodontium around the teeth. A squarer tooth form is often required to compensate for the loss of a portion of the interdental papilla. The 'wear' that is present on the roots and the crowns must be reconstructed in order to obtain an adequate mor-

phology in the cervical area. Proper positioning of the two adjacent teeth helps the creation of a papilla due to the physical displacement of the interproximal tissues coronally, and favors gingival creeping to some degree.

The maxillary teeth were restored using porcelain fused to a metal-free framework. By giving the prosthetic restorations the proper shape and outlines, it was possible to close the interdental spaces and to achieve a natural gingival contour and papillae reconstruction. Figs. 2a and 2e show the pre-operative views. Fig. 2d illustrates the final restorations when they were placed and Figs. 2d and 2f the situation 3 years later. The patient was placed under strict recalls, and oral hygiene compliance was excellent.

DISCUSSION

A comprehensive diagnosis is essential for the establishment of a treatment plan that will produce optimal results with long-term stability in a predictable way.

The presence and the height of the interproximal papilla depends not only on the size of the embrasure between the teeth but also on the bone architecture and attachment apparatus. In cases where the contact point is 5 mm or less from the crestal bone the papilla is always present (Kois, 1983; Tarnow et al, 1992). When the contact point is 6 mm from the bone crest the papilla is present 56% of the time, whereas when the contact point is 7 mm from the crest the papilla is present only 27% of the time (Tarnow et al, 1992). How can the presence of papilla be explained when the distance is 7 mm? The answer may be a biologic width of 4.5 mm and a sulcus depth of 2.5 mm. In such a case the papilla can be kept with the presence of a long attachment apparatus. If the biologic width is only 2 mm, then the sulcus depth would be 5 mm! In this instance, there is a chance that the papilla may disappear if tissues are traumatized during tooth preparation, impression-taking, etc.

In papilla reconstruction it is well known that there is a requirement for individual variability to the biological width. Therefore, it is important to determine the lowest point of the interproximal contact in relation to the epithelial attachment. The ideal contact point should be 2–3 mm coronal to the at-



Fig. 2a Pre-operative view showing abraded roots and crowns.



Fig. 2b Equigingival tooth preparation.



Fig. 2c Immediate placement of ceramic-zircon crowns.



Fig. 2d Three years post-operative view showing a harmonious situation between the crowns and the reconstructed papillae.



Fig. 2e Pre-operative smile with moderate high lip line.



Fig. 2f Post-operative smile with reconstruction of the white and pink esthetics.

tachment, i.e. values that coincide with the average interproximal sulcular depth. Van der welden (1982) studied tissue regeneration by surgically removing the interdental papillae using apically positioned flap procedures in healthy sites on 7 patients. Tissue regeneration was measured in follow-ups for up to 3 years. Results showed an average of 4.3 mm (4–4.5 mm) papillae regeneration with a mean sulcus depth of 2.2 mm (2–2.5 mm). In the first case presented in this report, the preservation of a 1 mm sulcular depth did not alter the biologic width and the rebound of the gingival margin was limited.

The shape of the papilla is related to the morphology of the interdental space created by the adjacent tooth surfaces (Kohl and Zander, 1961). Since soft tissues are supported by the proximal contours of the crowns, the closer the crowns are, the more accentuated is the papilla. In the presence of open contacts and/or reduced periodontium, triangular tooth shape, tapered tooth shape, a deficient papilla can be improved with restorative dentistry. The crown's morphology should be

changed into a squarer form in order to move the contact point towards the papilla and eliminate the open embrasure. In the second case presented, cosmetic reconstruction of the cervical abrasions (due to aggressive toothbrushing and/or interproximal cleaning) together with changing from manual to sonic toothbrush allowed the re-establishment of oral health and the restoration of the papillae. It is of the utmost importance for patients to avoid aggressive tooth brushing that can result in abrasions and contribute to gingival recession. There is lack of data on the variations of the biologic width in reduced periodontium. Prosthetic soft tissue remodeling may be obtained in a healthy reduced periodontium in the absence of residual pockets; however, this may not be the case in the presence of residual pockets, as creeping attachment is not promoted. Proper contouring of the provisionals in the tissue-molding phase is critical to achieve the goals of an ideal gingival framework. It requires experience and skill from both the periodontist and the prosthodontist to arrive at a good and predictable aesthetic outcome.

CONCLUSIONS

Restorative dentistry and plastic periodontal surgery has entered a new era where outcomes can be obtained in a predictable fashion. This applies not only to the treatment of periodontal disease but also to the improvement of esthetics for the teeth as well as the periodontium.

The key factors for obtaining a healthy periodontium and achieving esthetic results are: proper placement of the margins during tooth preparation, gentle tissue management techniques during impression-taking and optimal provisionals as well as final restorations.

Successful restorative dentistry requires the preservation of a healthy periodontal attachment apparatus to provide a positive long-term prognosis for the restored teeth. In cases where the periodontium is reduced, prosthetic treatment should attempt to mimic a healthy situation by creating a papilla or providing the illusion of a papilla reconstruction.

REFERENCES

- Azzi R, Carranza F, Etienne D: Surgical reconstruction of the interdental papilla. *Int J Periodontol Rest Dent* 1998; 18: 467-473.
- Azzi R, Etienne D: Recouvrement radicaire et reconstruction papillaire par greffon conjonctif enfoui sous un lambeau vestibulaire tunnelisé et tracté coronairement. *J Parodontol Implant Oral* 1998; 17: 71-77.
- Azzi R, Etienne D, Sauvan JL, Miller PD: Root coverage and papilla reconstruction in classe IV recession: A case report. *Int J Periodontol Rest Dent* 1999; 19: 449-455.
- Azzi R, Etienne D, Takei H, Fenech P: Surgical thickening of the existing gingiva and reconstruction of interdental papillae around implant-supported restorations. *Int J Periodontol Rest Dent* 2002; 22: 71-77.
- Azzi R, Takei H, Etienne D, Carranza F: Root coverage and papilla reconstruction using autogenous osseous and connective tissue grafts. *Int J Periodontics Restorative Dent* 2001; 2: 141-147.
- Beagle JR: Surgical reconstruction of the interdental papilla. *Int J Periodont Rest Dent* 1992; 145-152.
- Becker W, Occhenbein C, Tibbets L, Becker BE: Alveolar bone anatomic profiles as measured from dry skulls. *J Clin Periodontol* 1997; 24: 727-731.
- Gargiulo AW, Wenz FM, Orban B: Dimensions and relations of the dentogingival junction in humans. *J Periodontol* 1961; 32: 261-267.
- Han TJ, Takei HH: Progress in gingival papilla reconstruction. *Periodontol 2000* 1996; 11: 65-68.
- Ingber JS, Rose LF, Coslet JG: The biologic width-A concept in periodontics and restorative dentistry. *Alpha Omega* 1977; 70: 62-65.
- Kohl JT, Zander HA: Morphology of the interdental tissues. *Oral Surg, Oral Med, Oral Path* 1961; 60: 287-295.
- Kois JC: Altering gingival levels: The restorative connection, Part I: Biologic variables. *J Esth Dent* 1994; 6: 3-9.
- Lang NP, Kiel RA, Anderhalden K: Clinical and microbiological effects of subgingival restorations with overhanging or clinically perfect margins. *J Clin Periodontol* 1983; 10: 563-578.
- Maynard JG, Wilson RD: Physiologic dimensions of the periodontium significant to the restorative dentist. *J Periodontol* 1979; 50: 170-174.
- Olsson M, Lindhe J: Periodontal characteristics in individuals with varying form of the upper central incisors. *J Clin Periodontol* 1991; 18: 78-82.
- Parma-Benfenati S, Fugazzotto PA, Ruben MP: The effect of restoratives margins on the post surgical development and nature of the periodontium. Part I. *Int J Periodontol Rest Dent* 1985; 5: 31-51.
- Sanavi F, Weisgold AS, Rose LF: Biologic width and its relation to periodontal biotypes. *J Esthet Dent* 1998; 10: 157-163.
- Shapiro A: Regeneration of interdental papilla using periodic curettage. *Int J Periodont Dent* 1985; 5: 27-33.
- Spear M F: Maintenance of the interdental papilla following anterior tooth removal. *Pract Periodontics Aesthet Dent* 1999; 11: 21-28.
- Tarnow D, Sthal SS, Magner A, Zamzock J: Human gingival attachment responses to subgingival crown placement-marginal remodeling. *J Clin Periodontol* 1986; 13: 563.
- Tarnow DP, Magner AW, Fletcher P: The effect of distance from the contact point to the crest of bone on the presence or absence of the interproximal papilla. *J Periodontol* 1992; 63: 995-1004.
- Vacek JS, Gher ME, Assad DA et al: The dimensions of the human dentogingival junction. *Int J Periodontol Rest Dent* 1994; 14: 154-165.
- Van der welden U: Regeneration of interdental soft tissue following denudation procedures. *J Clin Periodontol* 1982; 9: 455-459.
- Wilson RD, Maynard JG: Intracrevicular restorative dentistry. *Int Periodontol Rest Dent* 1981; 1: 34-49.

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