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Interdental Papilla Reconstruction: Classification and Clinical Management

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ABSTRACT

Loss of interdental papillae in the maxillary anterior area is a significant esthetic problem. Missing papillae, due to malalignment of teeth, tooth shape or size, or location of the contact point, can at least partially be rectified by orthodontic and restorative procedures. The surgical reconstruction of interdental papillae has not been predictable. This paper reviews the classification of papillae loss and factors affecting the successful surgical reconstruction of interdental papillae. A multidisciplinary approach is recommended in many cases.

RÉSUMÉ

La perte de papilles inter-dentaires au niveau du maxillaire antérieur est un problème esthétique majeur. L'absence de papilles, en raison de dents mal alignées, de dents difformes ou de l'emplacement du point de contact, peut au moins être corrigée partiellement par traitement orthodontique ou de restauration. La reconstruction chirurgicale des papilles inter-dentaires est imprévisible. Cet article passe en revue la classification de la perte de papilles et des facteurs affectant la reconstruction chirurgicale réussie des papilles inter-dentaires. Une approche multidisciplinaire est recommandée dans plusieurs cas.



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Maxillary anterior esthetics is dependent upon the teeth and their framing by the lips and the gingival architecture.^{1,2} New restorative materials and refined periodontal surgical techniques have improved the success and predictability of esthetic enhancement procedures.³ Loss of the interdental papilla caused by trauma or periodontitis remains a significant esthetic challenge to dentistry. Tremendous progress has been attained in esthetic reconstruction of soft and hard tissues around implants.⁴⁻⁹ Many clinicians have tried over the years to reconstruct lost interdental papillae around natural teeth; however, a high level of success and predictability has not been achieved.¹⁰⁻¹⁶

The classification system for loss of papillary height¹⁷ has allowed clinicians to at least diagnose and communicate the potential for success to patients. This paper will discuss the classifications and the factors related to success and predictability of procedures for reconstruction of papillae. A step-by-step description of microsurgical reconstruction of interdental papilla is published elsewhere.¹⁸

Papilla Reconstruction – Multidisciplinary Management and Clinical Decision Making

Clinical management of the deficient papilla can involve surgical tissue addition, orthodontic root approximation, and/or alteration of tooth shape by restorative procedures.

The management of the embrasure space or “missing papilla” due to malalignment of teeth or orthodontic movement of teeth is

discussed in an excellent paper by Kurth and Kokich.¹⁹ A brief description and diagrammatic representation of various orthodontic and restorative treatments are presented here.

Long cylindrical teeth have a narrow cervical area and contact point located near the incisal edge.²⁰ To increase the chance for papilla formation, it may be advisable to move the contact point apically with restorative procedures. The adjustment of the mesio-distal width of teeth can also be accomplished restoratively, creating a wider crown with the addition of restorative material. This will allow some degree of closure of the embrasure space.^{21,22} Missing papillae caused by splaying of teeth due to loss of periodontal support have been successfully treated by a combination of periodontal surgery followed by immediate orthodontic intervention.²³

In adulthood, during orthodontic treatment in which overlapping of teeth is corrected, an interdental papillary space may open and also need to be fixed. Stripping of crowns and orthodontic root alignment can help to close the embrasure space. Similarly, with extrusion of teeth, the mesio-distal dimensions narrow and may have to be corrected by restorative procedures. Some important variables which may influence the presence of the papilla include: interproximal contact position, root angulation, crown form and embrasure areas¹⁹ (Figure 1).

A thorough periodontal assessment of the proposed treatment area should be

accomplished. Periodontal inflammation should be eliminated with thorough debridement, root planning, and adjunctive measures. The surgical site should also be free from any periapical pathology.

Factors Influencing Surgical Reconstruction of the Papilla

If the loss of the interdental papilla is not a result of tooth position, root angulation or tooth shape, then the surgical reconstruction of the papilla could be considered. Generally, if a papillary defect was caused by a surgical insult, then surgical addition of tissue can be the best choice of treatment modalities.

Extent of Tissue Loss

To facilitate the discussion of management of papillae loss, the Nordland and Tarnow¹⁷ classification is presented here.

The Nordland and Tarnow classification utilizes three anatomical landmarks: the interdental contact point, the facial apical extent of the cemento-enamel junction (CEJ) and the coronal extent of the interproximal cemento-enamel junction (Figure 2.)

Normal

Interdental papillae fill embrasure space to the apical extent of the interdental contact point/area.

Class I

The tip of interdental papillae lies between the interdental contact point and the most coronal extent of the interproximal cemento-enamel junction (CEJ) (space present but interproximal CEJ is not visible; Figure 3).

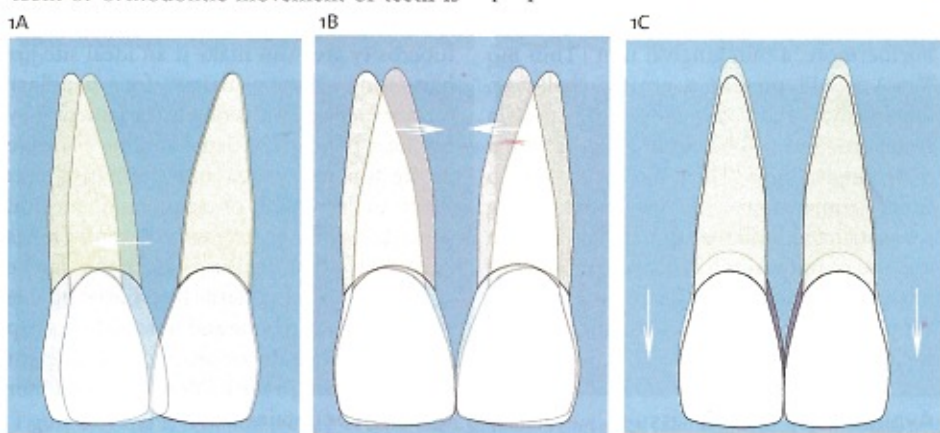


Figure 1. A, Overlap of maxillary central incisors with divergent roots and orthodontic movement to correct the overlap without addressing root alignment resulting in increase in embrasure space. B, Orthodontic correction of crown overlap and resultant increase in interdental space. With correction of root angulation (white arrows), the embrasure space can be partially closed. C, Orthodontic extrusion causing an increase in the interdental space. The shaded area on the mesial of incisors represents restorative addition to close the space by widening the crowns.

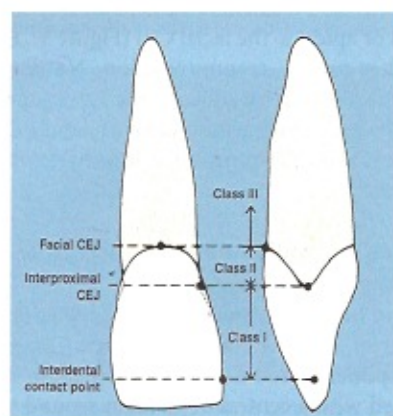


Figure 2. Anatomical landmarks used in the classification system for loss of papillary height (adapted from Nordland & Tarnow).¹⁶

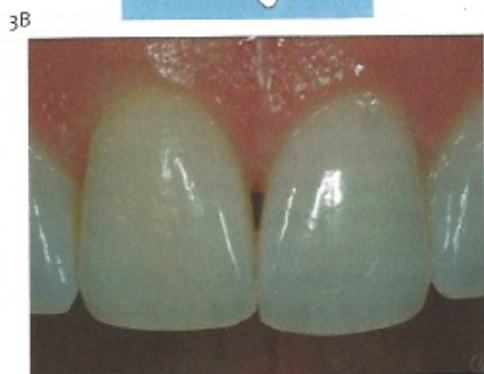
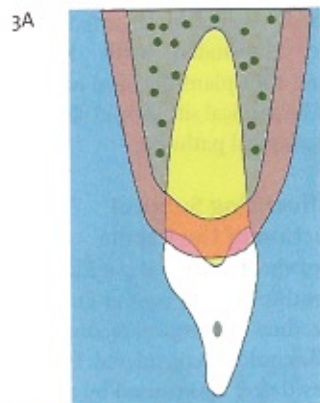


Figure 3. A, Interproximal view in class I papilla loss. B, Class I - Papilla has receded from the contact point; however, interproximal and facial CEJ are not visible.

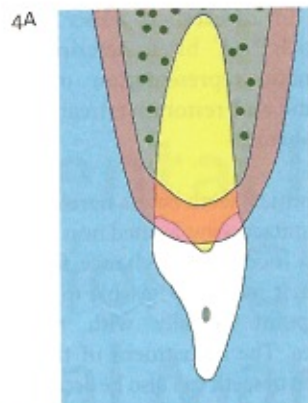


Figure 4. A, Interproximal view in class II papilla loss. B, Class II - Papilla is receded from the contact point and interproximal CEJ is partially visible.

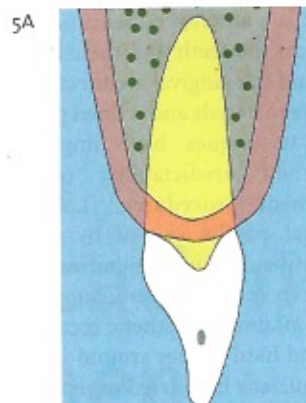


Figure 5. A, Interproximal view in class III papilla loss. B, Class III - Papilla is receded and both interproximal and facial CEJ are visible.

Class II

The tip of interdental papillae lies at or apical to the interproximal CEJ but, coronal to the apical extent of the facial CEJ (interproximal CEJ visible) (Figure 4).

Class III

The tip of the interdental papillae lies level with or apical to the facial CEJ (Figure 5). For further precise communication, Nordland and Tarnow¹⁷ have sub-classified the papilla loss by including measurement of papilla loss in mm from the above-mentioned reference points.

Anterior Papilla Anatomy and Tissue Biotype

It had been described, that in the maxillary anterior region, the labial and lingual component of the interdental papilla are joined with a central depression around the contact point creating what is termed a "col." Because of the small size and blood supply

pattern the interproximal papilla is, in effect, an end artery organ.²⁴ In fact, it has been shown recently that in the anterior maxillary region the papillae are of pyramidal shape, rather than "col" shaped.¹⁴ Thus the volume of an intact papilla can be determined by calculating the volume of a pyramid ($\text{Volume} = \text{Length} \times \text{Height} \times \text{Width} / 3$). Furthermore, a thin gingival unit (Thin Bio Type) would present a greater challenge. Obviously, the outcome of papilla reconstruction will be better in cases with a thick gingival unit (Thick Bio Type). Due to small dimensions of the area being reconstructed, microscopic magnification and use of microsurgical instruments can be of significant value. Ideally, existing vascular supply can be protected by avoiding releasing incisions.

Availability of Donor Tissue

The extent of tissue loss should be assessed and a careful determination should be made

of the availability of donor tissue. The surgeon must determine the size and quality of donor tissue needed to restore the lost papillary volume. Sometimes if the necessary volume is small, then palatal dense fibrous connective tissue can be used as the donor source. If a larger volume is required, then the presence of thick fibrous tissue in the tuberosity area can make it an ideal site for harvesting donor tissue for papillary reconstruction. Occasionally the patient may not have the desired tissue volume available in the tuberosity area and alternative sites must be explored or sequential surgical procedures may be necessary. Recently, it has been shown that thicker palatal tissue can be created by inserting sterile lyophilized bovine collagen between bone and full-thickness flap at a prospective donor site. Following eight weeks of healing a substantially thicker donor tissue can be obtained.²⁵

Because the interdental papilla has a

pyramidal shape, its volume can be determined using the equation: pyramid volume = Length \times Height \times Width / 3. Accordingly, large loss of tissue volume accompanies the loss of papillary height. For example with 1 mm loss of papillary height, the volume loss equals 0.33 cubic millimeters. However the volume loss escalates rapidly and as the papillary height loss increases to 5 mm, the volume of the lost tissue equals 41.6 cubic millimeters.

Distance between the Interproximal Alveolar Bone to Contact Point

Much confusion exists over the influence of the underlying alveolar bone on the presence or absence of the interdental papilla. Tarnow et al.²⁶ showed that the presence of the interdental papilla decreases as the distance from the contact point to alveolar bone increases. This paper also showed that the interdental papilla is almost always present when the distance is 5 mm or less. Even at a distance of 9 mm, the papilla can still be present but with less frequency (25%). This suggests that the presence of interdental alveolar bone is desirable, but not essential for papilla reconstruction.

Surgical Management of Missing Papilla

Seibert's onlay graft technique was originally targeted towards the correction of ridge deformities by transplanting a thick epithelized graft from the palate.^{27,28} Ovate pontics were used to modulate the healing of tissue to form a papilla between edentulous areas and natural teeth.

The details of this surgical technique and the coordination of surgical and prosthetic procedures are discussed by Seibert.²⁸ This method of ridge augmentation and papilla formation is very technique sensitive and leaves a large palatal wound at the donor site, and the colour match at the recipient site may not be ideal. However, in cases where large ridge augmentation along with papillae reconstruction are required, this technique may be considered appropriate.

Many clinicians have proposed surgical techniques for reconstruction/preservation of interdental papilla with varying degree of success.^{10-16, 29-39} All these techniques rely on a releasing incision in the surgical area. The success of microsurgical techniques are

dependent on preservation of blood supply and minimal tension on wound closures.³⁰ Nordland and Sandhu³⁹ have proposed a microsurgical technique, which is a combination of the tunnel technique¹⁸ and the coronally positioned flap³⁹ with significant modifications. Since microsurgical instruments are used under magnified fields, no releasing incisions are made. This protects the blood supply to the grafted tissue from the overlying flap. Contact points are closed with resin bonding and suspensory sutures are used to stop the relapse of tissue to its original position. The step-by-step details of this technique are discussed in a separate paper.³⁹

Conclusion

This case demonstrates a patient who was referred for closure of embrasure between lateral and central incisors. In addition to the class I papilla loss, there is bilateral ridge deficiency present. Patient was treated with microsurgical closure of embrasure space and ridge augmentation (Figure 6).

Disclosure

No conflicts declared.

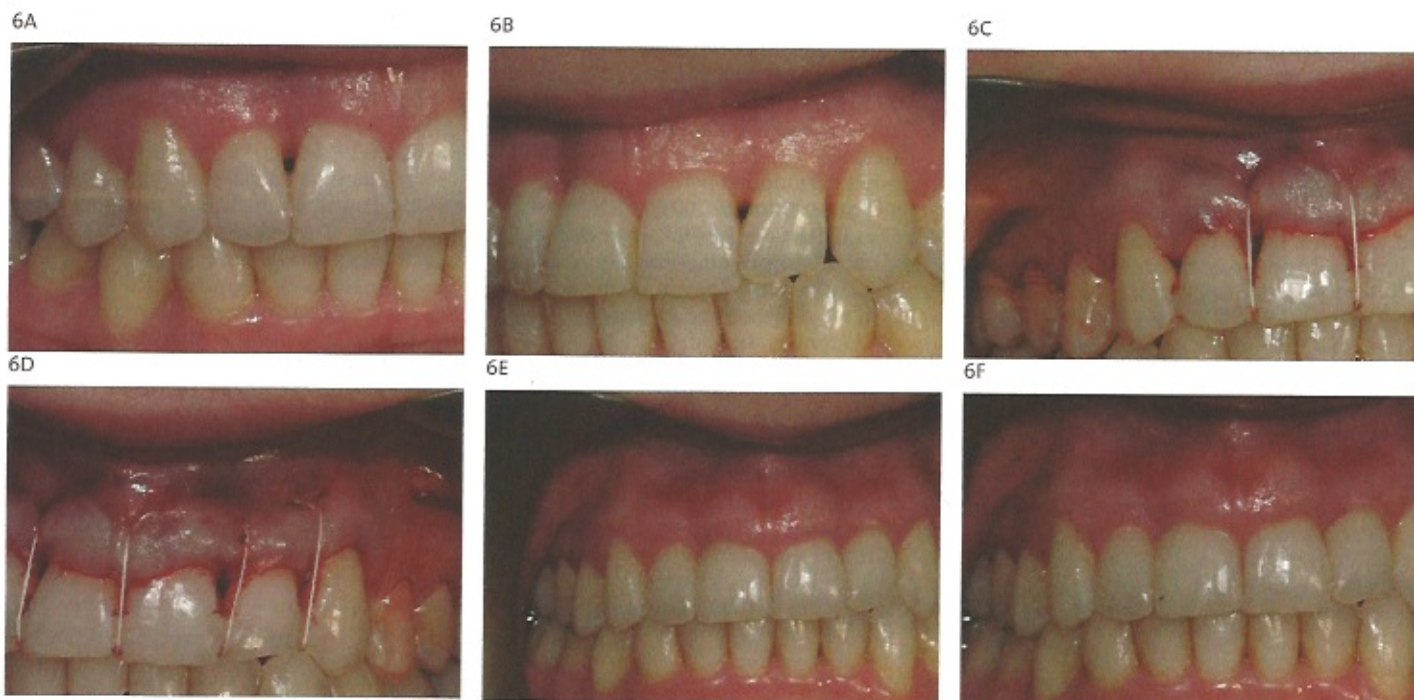


Figure 6. A and B, A clinical picture of class I loss of papilla (between lateral and central incisors) selected for surgical and restorative correction. C and D, Surgical view showing a connective tissue graft sutured under the flap, and the flaps coronally positioned and held with suspensory sutures. E and F, Six months post operative views following minor restorative correction and showing complete closure of embrasure spaces.

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