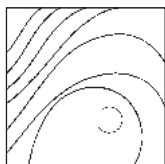


Interdental Papillary House: A New Concept and Guide for Clinicians



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Surgical and nonsurgical techniques have been proposed to regenerate interdental papillae. The results are influenced by the morphology of the interdental space, which is the housing for the papilla. The concept of the interdental papillary "house" has been established not only to allow diagnosis of the causes of papillary loss, but also to manage and predict reconstruction of the interdental gingival tissue. The adjacent teeth in contact, involving the proximal contact, contour and shape of the teeth, course of the cemento-enamel junction, interdental distance, and underlying bone crest, determine the outline of the house. Since the components are combined, an understanding of each allows adequate treatment planning involving interdisciplinary procedures. This new concept serves as a guide and teaching aid for the practitioner. (Int J Periodontics Restorative Dent 2011;31:e87–e93.)

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The presence and regeneration of the interdental papilla is one of the greatest challenges to improving the gingival contour in areas where esthetics is a major concern. Even though the anatomical and morphologic characteristics of the interdental gingiva are very well known and scientifically documented, predictable restoration of the lost interdental papilla remains an unsolved problem. Interdental gingival tissue is formed by a dense connective tissue covered externally by oral gingival epithelium and internally by junctional and oral sulcular epithelia. The architecture of this apparatus not only acts as a biologic barrier in protecting the periodontal structures, but also plays a critical role in esthetics and phonetics.¹ From a facial point of view, the interdental papilla appears pyramidal in shape (Fig 1) and occupies a space created between two adjacent teeth in contact with one another. This space, comprising the contact point or area, proximal tooth surfaces, course of the cemento-enamel junction (CEJ), interdental distance,



Fig 1 (left) Clinical aspect of the interdental papilla. The interdental papilla extends from the incisal tip to a line tangent to the gingival margins of the two adjacent teeth in contact (dotted line). Its presence determines the scalloped outline of the gingival margin.

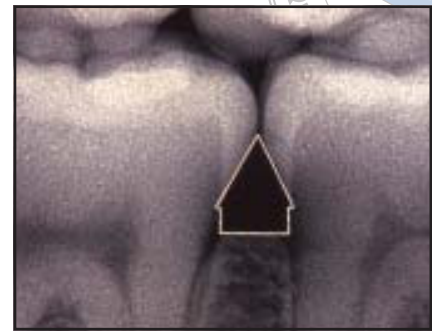


Fig 2 (right) The outline of the interdental space is similar to the shape of a house.

and bone crest, was considered by Takei² as the housing for the interdental papilla. When assessed radiographically, this space presents an outline in the shape of a house (Fig 2). The term "interdental papillary house" was chosen to understand all factors and conditions that may modify the morphology of the interdental papilla. Following this concept, components of the interdental papillary house are the apex of the "roof" (contact point or area), contour of the "roof" (proximal tooth surfaces), border between the "roof" and "wall" (CEJ), lateral "walls" (interdental distance), "floor" (bone crest), height of the house (measurement of the supracrestal gingival tissue), and cleanliness of the "roof" (plaque removal by the patient).

This review aims to discuss each component that influences the housing of the interdental papilla and to present a new concept to guide the management and reconstruction of the interdental papilla.

Apex of the roof: Position and extension of the contact point or area

The contact relationship between adjacent teeth represents the apex of the papillary house's roof and determines the shape of the tip of the interdental papilla. The proper width and location of the contact point or area in facial-oral and gingivo-occlusal dimensions maintains a stable dental arch, prevents food impaction in the interdental area, and creates the space needed for the interdental gingiva.² All teeth present contact areas facial to the central fossa line.³ The exception is between the maxillary molars, where the proximal contact appears from the midpoint contact area to the palatal third.² From a facial or oral view, the contact point or area is situated near the occlusal or incisal third.^{3,4} The only exception to this rule is between the maxillary molars, where the proximal contact may be between the occlusal and middle thirds.³ In the anterior region, the tip of the papilla is usually pyramid-shaped or may present a slight gingival col.²

The interdental gingiva of posterior teeth, especially molars, presents a prominent gingival col,⁵ since the facial-oral contact areas are broad.

The height of the roof relates to the position of the contact areas in the gingivo-occlusal dimension and influences the facial-oral contour of the interdental papilla. A contact area overextended in the gingival direction can impinge upon the interdental gingiva and reduce the height of the roof. With the lack of space, the papillary tissue becomes enlarged and inflamed, even if proper cleansing is performed. If the contact is too high incisally/occlusally, the height of the interdental papilla's roof is increased and the papilla does not fill the space completely. When there is visible space apical to the contact point (black space), the papilla is deemed missing, becoming an area of food retention and bringing about discomfort to the patient. For example, a mesiodistal divergence of roots can lead to coronal positioning of the contact point. By repositioning these roots and reshaping the mesial contour of the teeth, the contact point can



Fig 3a (left) The tip of the interdental papilla reveals a flat form due to the presence of diastema between the maxillary central incisors. Each side of the roof no longer comes into contact with the other.



Fig 3b (right) Orthodontic closure of diastema created a roof for the interdental papilla. This resulted in coronal creeping of the interdental gingival tissue and building up of the tip of the papilla to a triangular form.

be located more apically and the height of the roof can be reduced, eliminating the black space.⁶ In the presence of diastema, when the proximal contours of adjacent teeth are too far from each other, the interdental papilla may be visibly absent, creating both esthetic and phonetic problems (Fig 3a). If periodontal health is good, the interdental gingival tissue is firmly attached to the teeth and alveolar bone.⁶ A round or flat papillary tip is observed instead of a triangular shape.⁷ An orthodontic approach can reduce the diastema or create a contact point between the adjacent teeth (Fig 3b). In certain cases, appropriate restorative techniques can also create a contact point by recontouring the proximal shape of the teeth and allowing coronal displacement of the interdental tissue.

Contour of the roof: Contour of proximal tooth surfaces and axial line angles

The characteristics of the crown contour of two adjacent teeth in

contact, involving proximal surfaces and axial line angles, represent the roof of the papillary house and determine the location of the contact point or area. The contour of the proximal tooth surface between the proximal contact and the CEJ is flat or slightly concave in the gingivo-occlusal (Fig 4) and facial-oral dimensions.^{3,4} This shape should also be observed to the facial and oral line angles.

A line angle is formed by the junction of two surfaces along a line and derives its name from the combination of the two surfaces. For instance, on a tooth, the junction of the mesial and facial surfaces is called the mesiofacial line angle (Fig 5).^{8,9} Each individual tooth has four axial line angles (mesiofacial, distofacial, mesio-oral, and disto-oral), which are parallel with the long axes of the tooth. These line angles are straight between the proximal contact and the CEJ, except for the facial line angles (mesiofacial and distofacial) of maxillary incisors and the oral line angles (mesio-oral and disto-oral) of maxillary molars, where there may be a slight convexity.⁴

Several restorative procedures modify the roof of the papillary house, and there is a strong tendency to violate the principle of the straight line angle when a restoration is performed by making the line angles somewhat convex⁴ and, consequently, a convex crown design (Fig 6). Therefore, the contour of the roof directly affects the biologic and morphologic features of the interdental gingiva and the scalloped outline of the gingival margin (Figs 7a and 7b).

Border between roof and wall: Course of the CEJ

The gingival margin presents a natural scalloped outline, which is determined by the course of the CEJ and, consequently, by the bone level. Radiographically, the proximal CEJ represents the border between the roof and lateral wall of the interdental papillary house. The course of the proximal CEJ depends on the surface, type of tooth, and periodontal biotype. Seibert and Lindhe¹⁰ defined the existence of two markedly different periodontal

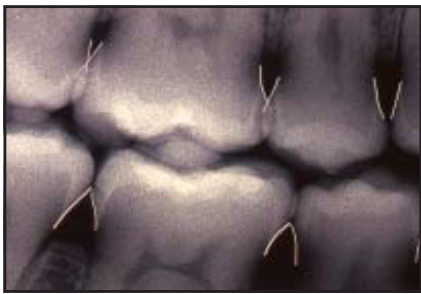


Fig 4 (top left) Radiographically, proximal contours of teeth are slightly concave or flat from the CEJ to the proximal contact.



Fig 5 (right) The mesiobuccal line angle of a mandibular molar is straight between the CEJ (white arrow) and the proximal contact (black arrow).



Fig 6 (bottom left) Radiographic view of overcontoured crowns without cervical adaptation in the posterior region. The convex contour results in an excessively wide contact area in the gingivo-occlusal direction, with lack of adequate space for the gingiva and occlusal embrasure.



Fig 7a (left) Provisional crowns without marginal adaptation allowed accumulation of plaque and alterations in the gingival contour at the region of the maxillary central incisors. The outline of the papillary roof is atypical.



Fig 7b (right) A natural scalloped contour of the gingival margin was conditioned with well-adapted provisional crowns. Proper contour of the roof was reestablished. Complete regeneration of the interdental papilla was achieved after 14 months.

biotypes: thin and thick. The combination of a proximal CEJ strongly convex toward the occlusal or incisal surfaces, sharply pointed bone crest, thin soft tissue and bony housing, more accentuated scalloped gingival contour, and tapered crown form with minute proximal contact areas are tooth characteristics related to the thin periodontal biotype (Fig 8). In the thick biotype, the tooth presents a flatter scalloped outline of the proximal CEJ facial-orally, associated with a flatter bone crest, less pronounced scalloped outline of the facial gingival margin, and short

but wide crown with relatively large proximal contact areas (Fig 9).

The CEJ is a component of the papillary house and cannot be modified by clinicians. Therefore, the dentist should identify the biotype before undertaking bone surgery¹¹ and restorative procedures. For example, one can wish to obtain a great reconstruction of the papilla in cases with a thick biotype; others can wish to have the contact area near the bone level when a more pronounced scalloped gingival contour is present (thin biotype).

Lateral walls of the house: Supracrestal interdental distance

Another issue is the physical distance between the approximating teeth, ie, the distance between the lateral walls of the house. On account of differences in the conformation of crowns and the inclination of teeth, interdental spaces vary in width. The supracrestal interdental distance is wider between bell-crowned teeth than between thick-necked teeth. Among anterior teeth, the interdental space is widest



Fig 8 (left) *Thin periodontal biotype presents a highly scalloped gingival contour (dotted line).*



Fig 9 (right) *Thick biotype relates to a less-pronounced scalloped gingival outline (dotted line).*

Fig 10 *Disappearance of the natural contour of the gingival margin due to lack of horizontal space for the interdental papillae. Separation of the roots using orthodontic methods might be beneficial to support a proper interdental gingival configuration.*



between the necks of the central incisors. The widest interdental distances are usually located between the molars.⁹

When the distance between the lateral walls of the house is large and there is no contact (diastema), the tip of the papilla does not assume a triangular shape (see Fig 3a). A close distance between the lateral walls of the papillary house results in a very narrow bone septum, creates inadequate space to maintain its proper shape, and impairs cleaning of the house (Fig 10). In these cases, a proper supra-crestal interdental distance to allow the presence or regeneration of the interdental papilla is best achieved with orthodontic therapy.

Floor of the house: Level of the bone crest

The level of the bone crest acts as a scaffold to support the overlying interdental tissue (the floor of the papillary house) and has direct influence on the configuration of interdental papillae.¹²

The most common reason for the loss of interdental papillae is the presence of plaque-associated lesions with interproximal bone resorption. In such cases, interdental papillary reconstruction is not the main goal of the comprehensive treatment plan. The first step is elimination of the marginal inflammation of the periodontal tissues. The presence of black spaces produced by the loss of interdental papillae as a result of periodontal disease (nonsurgical and surgical therapy) is frustrating for both patients and dentists. The

crestal bone has been recontoured through regeneration methods following the course of the CEJ. However, in cases of severe periodontal breakdown with great tissue loss and gingival margins at the same interdental level orally and facially (Figs 11a and 11b), surgical papillary reconstruction fails to reduce the height of the interdental papillary house and to regenerate papillae. It is very difficult to transform a duplex into a house. Interdisciplinary treatment is required to reduce this vertical discrepancy. Coronal displacement of the bone crest can be achieved through application of orthodontic force. Ideally, it would lead to creation of new papillae.¹³ The esthetic appearance might also be clearly enhanced by shortening the incisal edges of the affected teeth to apically displace the roof level. Orthodontic treatment, in conjunction with tooth

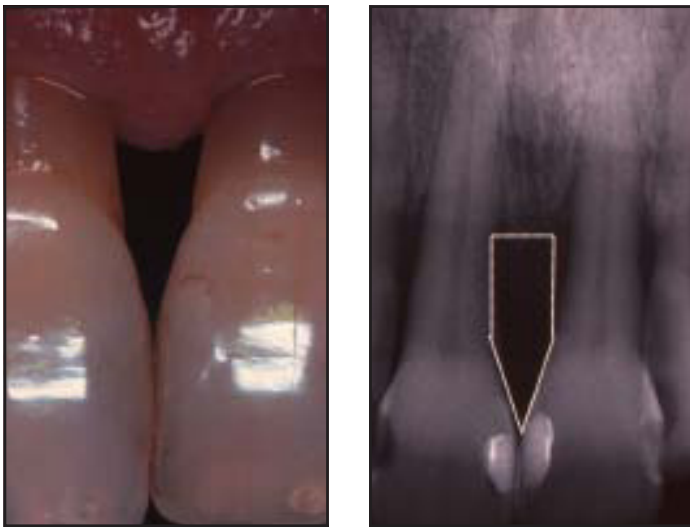


Fig 11a (left) Black space observed between the maxillary central incisors occurred following periodontal surgery. The interdental papilla is pyramid-shaped and its tip has a round form.

Fig 11b (right) Radiographically, the interdental space presents an outline of a duplex, not a house.

stripping, can be performed to reduce the interdental distance horizontally.¹⁴ It reduces the height of the roof to hide the soft and hard tissue defects that may be present.

Height of the house: The concept of the supracrestal gingival tissue

The dimension of the supracrestal gingival tissue (SGT; height of the house) may play a crucial role in establishing the entire height of the papilla. It comprises connective tissue fibers attached to the cementum (lateral wall of the house) and junctional and oral sulcular epithelia adhered on the enamel surface (roof). Based on the work of Gargiulo et al,¹⁵ the overall dimension of the SGT averaged 3.40 mm for mesial surfaces and 3.31 mm for distal surfaces in human autopsy specimens. Kois and Vakay¹⁶ found

that when adjacent teeth are present, interproximal measurement of the SGT should be approximately 4 mm. Coesta¹⁷ evaluated the dimension of the SGT in proximal surfaces around teeth without attachment loss. The mean clinical SGT values ranged from 3.62 to 5.00 mm. Tarnow et al¹² showed that the interdental papilla was always present when the distance between the bone crest and the contact point of two adjacent teeth was 3 or 4 mm. When the distance was 5 mm, the papilla was present 98% of the time. van der Velden¹⁸ investigated the level of the gingival margin 3 years following denudation of the interdental alveolar bone. The results showed that the location of the gingival margin was found at a mean distance of 4.33 mm coronal to where the bone level was defined at surgery. Such findings and recommendations have led to the conclusion that the

papilla will completely fill the interdental space when the height of the house is less than 5 mm.

If the loss of papilla is related only to soft tissue damage, the cause must be eliminated, and adequate plaque control is able to regenerate it completely without any clinical manipulation (Figs 12a and 12b). This spontaneous regeneration can also be observed after remodeling of the roof (proper location of the proximal contact or contour of the proximal tooth surface) (see Fig 7b). Thus, the regeneration of the interdental papilla must be understood histologically as a reformation of the SGT dimensions and clinically as achieving a scalloped contour of the gingival margin. No scientific study has been developed to evaluate how long the soft tissue takes to completely fill the interdental papillary house.



Fig 12a (left) Loss of interdental papillae was observed after suture removal.

Fig 12b (right) Rebuilding of the lost interdental papillae was achieved after 11 months. Effective plaque control allowed reformation of the supracrestal gingival tissue (coronal creeping).



Cleanness of the roof: Plaque control

Effective plaque control also plays an important role in the regeneration and preservation of the interdental papilla. When black spaces are present, patients must be instructed to use dental floss or an interdental brush to remove plaque from the lateral walls and roof of the papillary house (Fig 11a).

Conclusions

There is a close relationship between these seven important aspects that combine to create the housing for the interdental papilla. Identifying the etiology of the black space involves understanding the concept of the interdental papillary house. When there are discrepancies in the components of the papillary house, treatment planning involves alteration of these components. When there are no discrepancies in the components of the papillary house, the problem is related to reformation of the dimensions of the supracrestal gingival tissue. Therefore, if

all components of the interdental papillary house are considered by the dentist and an attempt is made to visualize them during nonsurgical and surgical techniques, the predictability of successful preservation and reconstruction will be improved markedly.

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