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Dental Science

Management of Black Triangles: A Literature Review

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ABSTRACT Many factors have been identified for the occurrence of lost interdental papilla, leading to appearance of black triangles that are unaesthetic. In today's aesthetic-driven focus in dental practice where both the dentist as well as the patient is becoming increasingly conscious about aesthetic needs, the real challenge is to reconstruct this lost papilla and moreover to obtain stable and long term results. This review focuses on all the available treatment modalities in the past and the present for the management of black triangles around natural teeth, so as to select the best suitable method in different clinical situations.

KEYWORDS : aesthetics, black triangles, papilla reconstruction

Introduction

Periodontal therapy is becoming increasingly focused on aesthetics, besides maintaining dental as well as periodontal health of the patients. From the anatomic perspective, the interdental papilla may be very small but it has a large significance from an aesthetic perspective, more specifically in the anterior region as it is almost always displayed during smile.

The interdental papilla

The interdental papilla is formed by a dense connective tissue covered by oral epithelium and it occupies the physiological space between the teeth.1 Cohen (1959) was the first to describe the morphology of the interdental papilla. Interdentally, the gingiva that occupies the space coronal to the alveolar crest is known as interdental gingiva. It has a pyramidal shape in the interdental area with the tip located immediately below the contact point, is narrower and called as dental papilla. It is broader in posterior region and was earlier described as having a concave col or bridge shape. In the absence of a contact point or when interdental papilla migrates apically as a result of inflammation, the col disappears and interdental papilla takes on a pyramidal shape, which is dysfunctional and unaesthetic.² Loss of interdental papilla may create aesthetic impairments, phonetic problems and food impaction. Hence, it is very important to respect papillary integrity during all dental procedures and to minimize its disappearance as much as possible.

Occurrence of open gingival embrasures is dependent on many factors such as periodontal disease, length of embrasure area, interproximal contact position, root angulations, triangular-shaped crowns, changes in papilla during orthodontic alignment, traumatic oral hygiene practices and improper contours of restorations. Periodontal surgery can also lead to missing papillae as soft tissues undergo contraction during the healing period.

Techniques for Reconstruction of Lost Interdental Papilla

Due to the aesthetic significance of interdental papilla, efforts have been made to prevent loss of papilla after surgical procedures using incision designs that spare or preserve the existing papilla. Several non-surgical, surgical and regenerative techniques have been proposed to manage the interproximal space. Many attempts have been made to reconstruct the papilla by various surgical methods, but a major limiting factor for the success rate is the lack of blood supply in a small, restricted recipient site.³ Hence the predictability and longterm stability of any single procedure has not been well-documented in literature.

The aim of the present review is to discuss in detail the various treatment modalities available for the management of open interdental spaces around natural teeth.

(a) Non-surgical methods

A combination of periodontal, restorative, prosthetic and orthodontic procedures is used to modify the interproximal space, thereby inducing modifications in the soft tissues.

(i) Repeated scaling, root planing and curettage of papilla

Shapiro A⁴ (1985) described a non-surgical approach for management of the interdental papilla. In this approach, the papilla which was destroyed by necrotizing gingivitis was recreated. Repeated scaling, root planing and curettage of the interdental papillary tissue was performed every 15 days for a period of 3 months. This induces a proliferative reaction of the papilla which is hyperplastic and inflammatory in nature. By this method, some new papillary regeneration was observed, while others did not respond to the periodic curettage.

(ii) Restorative and/or prosthetic approach

Missing papilla may occur due to an abnormal tooth shape, and an appropriate restorative technique is indicated to favour the creeping of the interdental tissues. In incisors in which the incisal edge is much wider than the cervical third, the contact point is located coronally. In this situation, the cervical pyramid of the interdental space is increased and the papilla does not fill the space completely. The contact point may be lengthened and located more apically by a restorative/ prosthetic reshaping of the contours of the teeth, the embrasure is reduced, which allows coronal displacement of the interdental gingiva. Convenient interproximal shapes can be created if the restorations are smooth. Composite, porcelain laminate veneers; pink auto-cure and heat-cured acrylics, resins and thermoplastic acrylics, as well as silicone-based soft materials are the treatment modalities for closure of open gingival embrasures. It is possible to extend porcelain and composite resins into gingival sulcus, but they should not impringe on the interdental tissues or cause biological width violation.5

(iii) Orthodontic approach

Kurth et al⁶ (2001) noticed that a mean root angulation of 3.65° in normal gingival embrasures and an increase in root divergence by 1° increased the probability of occurrence of an open gingival embrasure from 14 to 21%.

In periodontal health, the interproximal gingiva is firmly attached to the teeth and alveolar bone. An orthodontic approach is indicated in these situations. Bodily movement of the two adjacent teeth can help in orthodontic closure of interdental space. Reducing the diastema and creating a contact point between the adjacent teeth is the main aim, without periodontal attempts to build up the missing papilla. In fact, the proper closure of the diastema causes some degree of coronal "creeping" of the interproximal gingival tissue.

Ingber⁷ (**1974**) described coronal movement of tooth through application of a gentle and continuous force using orthodontic appliances.

Alterations within the supporting structures were observed, causing changes in bone level and the soft tissue contours and thereby creating new papillae, ideally.

(iv)Traumatic oral hygiene procedure correction

Overzealous brushing can lead to diffuse erythema and denudation of attached gingiva. Interdental papilla may be damaged due to improper use of dental floss. Traumatic interproximal hygiene procedures must be initially discontinued and successively modified. Reepithelialization of the traumatic lesion can restore the papilla completely.

(v) Non-surgical/ minimally invasive approach for reconstruction of papilla

Hyaluronic acid gel preparation: Intrapapillary injection acts as a dermal filler and significant results have been obtained for papillary fill. Mansouri et al⁹ reported that at 6 months 43 % of cases showed more than 50 % improvement.

Autologous cultured fibroblasts¹⁰: tissue engineered fibroblast cells can be injected for the purpose of regeneration on lost interdental papillary height.

These methods can reduce the complications associated with surgical techniques and have shown better patient acceptance.

(b) Surgical methods

The surgical techniques aim to re-contour, preserve and reconstruct the soft tissue between the teeth.

(i) Papilla recontouring

Remodelling of the soft tissue architecture can be done by elimination of excess tissue in case of gingival enlargement. Gingivectomy can be performed in cases of drug induced gingival enlargement. Gingivectomy associated with a free gingival graft may be indicated in case of localized gingival lesions, such as peripheral giant cell granuloma.

(ii) Papilla preservation Papilla preservation flap

Takei HH et al¹¹ (1985) proposed a new flap design for the placement of regenerative material into osseous defects and in anterior areas of human subjects even with presence of horizontal bone loss to improve postoperative soft tissue contour so as to obtain a better aesthetic result. They compared this surgical approach with the conventional flap design in 25 patients both in anterior as well as posterior regions. In the papilla preservation flap the facial surface was prepared with a sulcular incision around each tooth with no incisions being made through the interdental papilla. The lingual or palatal flap design consisted of a sulcular incision along the lingual or palatal aspect of each tooth with a semilunar incision made across each interdental papilla. This semilunar incision dipped apically from the line-angles of the tooth so that the papillary incision line was at least 5 mm from the gingival margin. This allowed the interdental tissue to be dissected from the lingual or palatal aspect so that the interdental papilla was elevated intact with the facial flap. A full-thickness flap was reflected with a periosteal elevator on both facial and lingual (or palatal) surfaces. In anterior areas where there was horizontal bone loss, minimal trimming of granulation tissue from the underside of the interdental tissue was carried out using fine tissue scissors in order to maintain the maximum thickness of tissue so as to minimize postoperative gingival recession. Direct suturing of the semilunar incision was carried out for the flap closure. Their 6-month results showed that the papilla preservation technique offers better aesthetic results without developing interdental soft tissue craters, and suggested that papilla preservation technique can be used in the anterior area of the mouth to obtain a better aesthetic result.

Modified papilla preservation flap

Cortellini P et al¹² (**1995**) proposed a modification of the papilla preservation technique. The study consisted of deep intrabony interproximal defects. As a modification of Takei's technique, the surgical procedure involved a horizontal incision with a slight internal bevel traced in the buccal gingiva of the interdental space at the base of the papilla and following the sulcular incisions, a full thickness palatal flap including the interdental papilla was elevated to fully expose the in-

terproximal defect. The granulation tissue thickness of the papilla was reduced but in the anterior areas thickness was not much reduced. The defect was fully debrided after scaling and root planing, and the barrier membrane was placed. To allow the coronal positioning of the buccal flap in the absence of tension, vertical releasing incisions extending into the alveolar mucosa were placed. A vertical internal mattress suture was subsequently placed between the buccal aspect of the interproximal papilla and the most coronal portion of the buccal flap to achieve primary closure in the interproximal area. They found that modified papilla technique was a suitable alternative to conventional surgical approaches to interproximal regenerative procedures in single rooted teeth and also a method to obtain better aesthetic results.

To overcome some of the technical problems encountered with the modified papilla preservation technique, including difficult application in narrow interdental spaces and in posterior areas the simplified papilla preservation flap, was subsequently developed by Cortellini.

Simplified papilla preservation flap

Cortellini et al¹³ (1999) treated deep intrabony defects by using simplified papilla preservation flap in combination with bioresorbable barrier membranes. The surgical procedure included first incision across the defect associated papilla, starting from the gingival margin at the buccal-line angle of the involved tooth to reach the mid-interproximal portion of the papilla under the contact point of the adjacent tooth. This oblique incision was carried out keeping the blade parallel to the long axis of the teeth to avoid excessive trimming of the remaining interdental tissues. The first oblique interdental incision was continued intrasulcularly in the buccal aspect of the teeth neighboring the defect. After elevation of a full-thickness buccal flap, the remaining tissues of the papilla were carefully dissected from the neighboring teeth and the underlying bone crest. The interproximal papillary tissue at the defect site were gently elevated along with the lingual/palatal flap to fully expose the interproximal defect. Following defect debridement and root planing, vertical releasing incisions and/ or periosteal incisions were performed, when needed. After application of the barrier membrane, first horizontal internal mattress and later interrupted sutures were placed. It was found that more than 60 % of the treated sites maintained primary closure over time.

Cortellini and Tonetti¹⁴ (2001) further improved the results by using microsurgical approach. Surgeries were performed with the aid of an operating microscope at a magnification of ×4-16. Microsurgical instruments and blades were utilized for the procedure. The advantage includes improved illumination, access and magnification of the surgical field.

(iii) Papilla reconstruction

Before attempts are made to surgically reconstruct the papilla, it is important to assess both the vertical distance between the crest of the bone and the apical point of contact between the crowns; and the soft tissue height of the interdental area. If the distance between the crest of the bone and contact point is ≤ 5 mm and the papilla is less than 4 mm, surgical intervention for increasing the volume of the papilla could be justified in order to solve the problem of an interdental black triangle. However, if the contact point is located at a distance >5 mm from the crest of the bone because of loss of periodontal support and/or inappropriate interdental contact relationship between the crowns, means to apically lengthen the contact area should be selected rather than a surgical attempt to improve the topography of the papilla.

Pedicle graft procedure was described by **Beagle (1992)**. Soft tissues palatal to the interdental area are utilized. After dissection of a split-thickness flap on palatal aspect of the interdental area, the flap is elevated labially and is folded and sutured for creating the new papilla. ¹⁵

Semilunar coronally repositioned flap by **Han and Takei** (**1996**) uses a free connective tissue graft. The approach is based on flap design by Tarnow.¹⁶ A semilunar incision is placed facial to the interdental area and a pouch-like preparation is created. Intrasulcular incisions are made around the mesial and distal half of the two adjacent teeth to free the connective tissue from the root surfaces to allow coronal displacement of the gingival– papillary unit. A connective tissue graft, taken from the palate, is placed into the pouch to support the coronally positioned interdental tissue.

Envelope-type flap by **Azzi et al (1999)** in which an intrasulcular and buccal incision is made across the interdental papilla to be reconstructed, at the level of CEJ. An envelope type split thickness flap is elevated buccally and palatally. The buccal portion of flap is dissected well beyond the mucogingival line, leaving the periosteum and a thin layer of connective tissue on the bone. The palatal portion of flap is also split thickness and includes the interdental papilla. A connective tissue graft of adequate size and shape is placed under the flaps in recipient site.¹⁷

(c) Regenerative methods

Tissue engineering approach is also being tried for the purpose of regeneration. The use of PRF along with pedicle flap is a reliable solution as PRF membrane shows mechanical properties such as adhesion. Biologic properties like fibrin glue help to stabilize the flap, enhances neoangiogenesis, reduces the necrosis and shrinkage of the flap and stabilization of the gingival flap in the highest covering position.

Jhaveri et al¹⁹ concluded that acellular dermal matrix allograft with autologous gingival fibroblasts by tissue-engineering technology may be used as a substitute to a subgingival connective tissue graft for the treatment of Miller class I and II recession defects.

Moreover, of all the techniques, genuine and stable papillary reconstruction results only when the regeneration of interdental bone occurs, therefore, PRF combined with bone graft may improve the clinical success.

Conclusion

Aesthetic demands of patients have increased in recent past. Various surgical and non- surgical treatment modalities are available for the purpose of reconstruction of lost interdental papilla. However, long term predictability of any of the methods has not been completely documented in literature. Hence there is a need for future long term and patient-centered studies to evaluate the outcomes of different techniques and to predict their long-term stability.

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