



Review

Multidisciplinary Consideration for Managing Gingival Black Triangles in Aesthetic Dentistry: A Review

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Abstract

The gingival black triangle is considered to be one of the most common aesthetic problems among adult patients that results due to loss of interdental papilla below the contact point that could impact function as well as smile aesthetics. Management of this condition is basically by multidisciplinary team efforts, including orthodontist, periodontist and restorative dentist. The aetiology of black triangles is multifactorial, but various researchers have explained the importance of alveolar bone thickness and gingival as well as periodontal health that may contribute to its occurrence. This review is focused to provide a comprehensive summary of the gingival black triangle and multidisciplinary consideration in its management.

Keywords: Alveolar bone; Gingival black triangle; Smile aesthetics; Multidisciplinary approach.

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INTRODUCTION

A key component of aesthetic dentistry is the preservation and maintenance of the interdental papilla within the gingival embrasures in the cosmetic area. Open gingival embrasures and related periodontal diseases are a common occurrence nowadays, particularly in the elderly population [1]. The interdental papilla serves as a biological barrier and is essential for a beautiful smile; when it is lost, a condition known as a "gingival black triangle" might result (GBT). This might exacerbate the plaque build up and have an impact on speech [2].

More than one-third of the adult population must be evaluated and discussed with the patient before beginning any dental treatment due to the prevalence of the black triangle [3]. Black triangles are more common in people over 20 (67%) than they are in those under 20 (only 18%), according to prior studies [4,5].

A black triangle's development is significantly influenced by the multifactorial etiological factors and the fragility of the papillary gingiva. The only sources of nourishment for the interdental papilla are the periodontal ligament and the coronal capillary veins of the crestal bone. The epithelium of the papilla, the terminal of the gingival microvasculature, lies directly apical to the capillary loops of the linked and free gingiva. The conventional research demonstrates that capillaries do not innervate the interdental col area [6]. One of the trickiest and most unpredictably challenging situations that might occur in clinical practise is the surgical repair and regeneration of the damaged papilla. Consequently, the goal of all dental treatments should be to maintain the integrity of the papillary gingiva while minimising its absence, which may cause unintended issues with smile aesthetics. The needed therapy is best delivered by a multidisciplinary team that offers periodontal, orthodontic, and restorative care. This narrative review's goals are to comprehend the potential causes of gingival black triangle formation and to talk about its treatment and clinical practise issues.

Etiology of Gingival Black Triangle

The aetiology of GBTs is multifaceted, according to studies [7,8]. A number of variables, including interproximal space, the distance from interproximal contact to the crest of the alveolar bone, gingival biotype, patient age, periodontal disease, and the ensuing gingival recession, roots divergence, and abnormal restoration, can affect the structure of the papilla [9].

The contact point between teeth is discovered to be situated 1 mm further incisally in instances with gingival black triangles than in those with normal gingival space. The occurrence of full papillae in maxillary front teeth becomes less common when the interradicular distance is more than 2.4 mm, according to a research by Martegani et al. that assessed interproximal width using periapical radiographs. This is possible regardless of the contact sites' distance from the bone [10].

According to a study by Tarnow et al, GBT is related with an increase in the distance from the alveolar bone crest to the interproximal contact [11]. The existence of papilla was around 98% when the distance from the contact point to the alveolar bone was less than 5 mm, 56% at 6 mm, and just 27% at 7 mm. These results indicate that the papilla will only expand from the alveolar crest to the interproximal contact point across a shorter distance. Tarnow's findings on 200 locations in 45 randomly chosen people were similarly replicated in a research by Wu et al [12] that looked at the anterior maxillary teeth.

As compared to square-shaped teeth, a research by Ahmad et al showed that teeth with triangular shapes, divergent roots, and thick interproximal bone might cause sporadic bone loss. Yet, compared to triangular-shaped teeth, square-shaped teeth are said to have a lower incidence of the black triangle. The interproximal distance from the alveolar crest to the free gingival border was thus reduced [13].

Classification of Gingival Black Triangle

The categorization by Nordland and Tarnow used three reference points to describe the reduction of papillary height. Interdental contact points, face apical CEJ extent, and interproximal CEJ are three of these (iCEJ). They divided it into four groups [14] (Table 1).

Table 1: Nordland and Tarnow classification based on loss of papillary height

Normal	Interdental papilla fills the embrasure space to the apical extent of the interdental contact point/area
Class I	The tip of the interdental papilla lies between the interdental contact point and the most coronal extent of CEJ
Class II	The tip of the interdental papilla lies at or the apical to the CEJ but coronal to the apical extent of the facial CEJ
Class III	The tip of the interdental papilla lies at level with or apical to the facial CEJ

In order to determine the interproximal papillary level, Cardaropoli proposed a different categorization based on the spatial connection between the papilla, CEJ, and neighbouring teeth [15] (Table 2).

Table 2: Cardaropoli Classification to assess the interproximal papillary level

PPI 1	When the papilla is completely present and coronally extends to the contact point and at the same level as the adjacent papillae
PPI 2	The papilla is no longer completely present and lies apical to the contact point and not at the same level as the adjacent papillae, but the iCEJ is still not visible
PPI 3	The papilla is moved more apical and the iCEJ becomes visible
PPI 4	Papilla lies apical to both the iCEJ and buccal CEJ

PPI: Papilla Presence Index score

Orthodontic Considerations of GBT

Open gingival embrasures are intimately related to divergent roots. A research found that the average root angulations in normal gingival embrasures converge at 3.65, and that the probability of an open gingival

embrasure rises from 14 to 21% for every 1° increase in root divergence. In orthodontic treatment, the roots of the maxillary incisors should be maintained parallel to reduce the likelihood of open gingival embrasures [3].

Carefully align the bracket slot so that it is perpendicular to the tooth's long axis. Periapical radiographs must be taken prior to bonding the brackets, especially in situations of attrition [12]. The divergence of the root caused by bracket placement based on incisal position may result in open embrasures. If the bracket is positioned perpendicular to the long axis, the roots will converge, which may require the restoration of worn disto incisal edges.

Orthodontic therapy must take into account the direction of tooth movement as well as the thickness of the supporting bone and soft tissue on the labiolingual side since they may have an impact on gingival embrasures. The gingival tissue thickens and moves occlusal on the tooth's facial surface during lingual tooth movement. Yet, the tissue thins and moves apically when a tooth is shifted labially [16] Thus, individuals with a Class II Division 2 malocclusion are more likely than those with a Class II Division 1 with flaring to have an open gingival embrasure. After orthodontic treatment, crowding and the labial migration of teeth with palatally positioned might further increase the risk of gingival diseases.

Restorative Considerations of GBT

Planning restorative therapies for open gingival embrasures requires taking into account a number of factors. By changing the shape of the crown, procedures like applying veneers or restoring the mesial cervical region of the tooth can reduce open embrasures. The composite resin can be injected into the sulcus to affect the interdental papilla's form, much like a temporary crown for an implant. It's crucial to avoid tearing the interdental tissue [17].

For restorative therapy to be effective, the connector and central incisor must have an appropriate crown height ratio. The teeth join at the contact point, whereas they appear to interact at the connector. The central, lateral, and canine teeth's connector to tooth height ratios are 50, 40%, and 30%, respectively.

Teeth with greater crown heights will have longer connections. Between the central incisors, the size of the embrasures is similarly smaller and progressively increases towards the back. It is frequently advised to cover significant tissue anomalies with pink-colored porcelain or a removable prosthetic [11]. A good understanding of anterior aesthetics is required to choose the optimal treatment for patients [18-20].

The likelihood of black triangles gaining prominence is thought to be considerable when two implants are inserted together. There is a 1 to 2 mm soft tissue deficiency because the biological breadth around an implant is apical to the platform for the abutment [21]. The alveolar crestal bone has to be 4 mm apical in order to insert maxillary anterior implants. Additionally, the space between two neighbouring implants needs to be greater than 3 mm in order to prevent bone loss and eventual papilla loss [22]. This allows for the interproximal bone to remain above the implant shoulder. This much ideal mesiodistal distance in the anterior area is challenging to attain.

Periodontal Considerations of GBT

Periodontal health is thought to be a key element in determining the health of the oral cavity. Due to alveolar bone loss, periodontal disease has been linked to the disappearance of the interdental papilla. Although gum disease and plaque buildup are more prevalent when teeth are crowded, other factors, such as the host's susceptibility, may also increase the risk of open embrasures, particularly in those who have recently had periodontal disease treatment. Some reasons for open embrasures include a broken toothbrush and recurrent

periodontitis. If the papillary height is reduced as a result of tooth brushing injury, interproximal cleaning should stop until the tissue heals [23].

As of yet, there is no effective surgical procedure that can completely replace the lost interdental papilla [24-26]. The transplanted tissue may contract and eventually perish after surgery to reconstruct the papillary gingiva. The sensitive tissues and the constrained blood supply up till the interdental papilla's tip are mostly to blame for the procedure's unexpected nature [12]. The use of subepithelial connective tissue grafts with orthodontic treatment, however, has been shown in a small number of studies [27,28] to be somewhat successful. Flap pedicles have been shown to be more effective than free gingival grafts in a number of cases [12]. For surgery to be successful, thick biotype gingiva and less insertion loss at the periodontal attachment are required [23]. Recession is more likely to affect people, and open gums if they have a thin gingival phenotype.

Rodriguez and Caffesse [29] have created a less invasive approach for regeneration in cases when periodontal tissue is badly deteriorated. In this example, intrabony defects that extend into the buccal area of the tooth were fixed during the periodontal reconstructive procedure employing a non-incised papillae surgical approach. It is a method that doesn't alter the tissues close to the margin of the defect. The buccal mucosa's apical region, far from the papilla and marginal keratinized tissues, underwent a single horizontal incision.

Using a full-thickness flap, the coronal expansion of the intra-bony defect was exposed by reflecting the soft tissue apico-coronally. In contrast to conventional flap elevation, excessive bone exposure was avoided to maintain the capillary integrity required for the delicate interproximal tissues. Hence, the soft tissues at the margins do not atrophy [30].

Because to the unpredictable nature of surgical methods and the expensive expense of restorative dentistry, less invasive injectable therapies for GBTs have been proposed. The quantity of cells that may be gathered for cell injections is constrained by the difficulty of collection. Fibroblast injections have been demonstrated to be safe and effective in the short term using cultivated fibroblasts. Hyaluronic acid has been recommended as a low-cost injectable treatment. Although there is now conflicting evidence, pilot results and animal research show potential [31].

CONCLUSION

An increased focus on gingival aesthetic operations is a result of the development of sophisticated surgical techniques supported by the most recent technology as well as the improvement of socioeconomic situations within society. The important element that aids in attaining the best cosmetic outcomes from various operations is thought to be accurate identification of the reason and careful planning of the proper course of action. A comprehensive approach and restorative measures might be used in aesthetically challenged situations to hide the severity of the instances. To attain and preserve intraoral aesthetics and to limit the growth of the gingival black triangle, a team treatment strategy combining an orthodontist, periodontist, and restorative dentist is required.

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