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Interdental papilla and various preservation techniques: A review

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Abstract

Esthetics is an integral part of successful periodontal therapy. Interdental papilla plays a significant part in esthetics. Loss of interdental papilla leads to gingival black triangles. To prevent this, many surgical modifications in the flap designs have evolved over the years. This review focuses on anatomy of interdental papilla, different types of interdental papillary loss and its various preservation techniques.

Keywords: Interdental papilla, interdental papillary loss, esthetics, gingival black triangle, papilla preservation

1. Introduction

Modern dentistry caters to both function and esthetics. Interdental papilla loss is esthetically maxillary anterior gingival architecture. The longer the crown and root exposed and raising interdental spacing leads to picket fence appearance results unsatisfactory form^[1]. A precise periodontal treatment must consider esthetic appearance, which aids in maintaining gingival marginal anatomy and height of papilla as possible. Frequently, non surgical approach is mostly recommended for maxillary anterior dentition^[2].

Dark triangle is the loss of papilla with dark spaces. The main factor for dark triangle is soft tissue but also the supporting bone, tooth contact, gingival biotype and shape of the crown play a role. Surgical procedures only may not eliminate this problem completely^[3]. Mucogingival defects like gingival recession, also contribute to this condition^[4]. (Fig 1)

LOSS OF PAPILLA (Black Triangle)



Fig 1: Gingival black triangle

The main aim of periodontal therapy is 'to prevent progression of periodontal disease and associated trauma by regeneration of the lost periodontal tissues'^[5]. The thickness of gingival biotype determines the success rate of surgical augmentation. A surgical approach that split the papilla causes shrinkage and reduces the height of interdental papilla, leading to exposure of the interproximal embrasures; affecting the esthetics^[6] Takei *et al.* in 1985 introduced the surgical method of papilla preservation, which is named as Papilla Preservation Flap Technique (PPF).

Many modifications have come over the years. Recently, a method non-incised papillae surgical approach (NIPSA), been developed. In this technique, apical approach is executed, without incision or disinsertion of gingival tissues at the end of the papilla, as contrasting to recent marginal access techniques, where the incision is placed intrasulcularly at the level of the marginal tissue [7].

2. Interdental Space

The physiologic space between two adjacent teeth is known as interdental space. It comprised of four pyramidal embrasures, viz. cervical, occlusal/incisal, buccal, and lingual/palatal. The tip of each pyramid ends at the contact point between two teeth. Balance between soft tissue and adjacent teeth without any tissue deformity is a major factor for stable dentition. The width of gingival biotype has a greater impact on the success rate of papilla surgical augmentation.

3. Anatomy of Interdental Space

It is made up of Connective tissue which is composed of epithelium. Factors which determine the anatomy are height of alveolar bone, the distance between teeth and the interdental contact point. In anteriors, the tooth mass enclosing the interdental papilla is smaller, interdental papilla is narrow this forming a pyramidal feature. Whereas in posteriors, it is wider, with a ridged shaped concave area called as col. It is the only non-keratinized part of the gingival and it is most susceptible to trauma [10].

The contour of the interdental tissues, are similar because the color and texture of the keratinized tissues, are essential elements of anterior esthetics. When open interproximal spaces are present, not only esthetic concern, but also phonetic difficulties and food impaction can be expected. The term black triangles disease has been proposed to describe this anatomic alteration that represents one of the most troubling esthetic dilemmas in dentistry.

The level of alveolar bone decides the height of the interdental papilla. It extends 4.5 to 5 mm from the alveolar bone crest whereas the distance between facial marginal embrasure and alveolar bone is approximately 3mm. The biologic width being the same in the interdental area and the facial area, the sulcus depth is more in the interdental area [11]. Some morphologic characteristics should be taken into consideration while performing restorative approaches. The contact point between two teeth should be given with caution, as reduction in cervical pyramid of the interdental papilla may favour food impaction [11].

4. Vascular Supply

The blood supply to gingival is mainly by periodontal ligament vessels, alveolar vessels and suprapariosteal vessels. Since the interdental area is small, the blood supply is also minor, making it a major limiting factor in surgical procedures.

5. Etiology of Interdental Papilla Loss

From numerous studies it's well documented that etiology of interdental papilla is complex. Individual analysis and treatment plan is important for management of each and every patient. (Fig: 2)

1. Abnormal form and size of the tooth.
2. Irregular restorations and prosthetic crowns.
3. Traumatic oral hygiene measures like improper tooth brushing technique and flossing in the interdental space.

4. Periodontal disease.
5. Acute necrotizing ulcerative gingivitis which results in punched out crater like depression of the interdental papilla.
6. After periodontal therapy during healing.
7. Missing of teeth or spacing between the teeth [3].

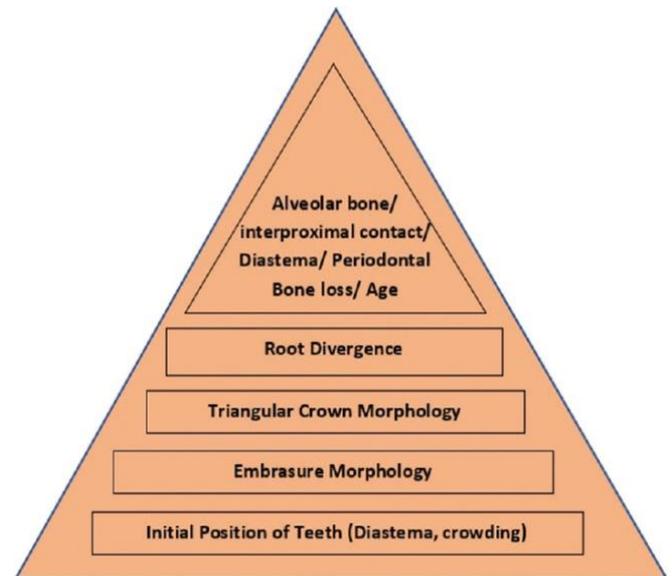


Fig 2: Etiology of Interdental papilla loss

5.1 Interproximal Space between Teeth

Interproximal space between teeth represents the distance between the proximal surfaces of the adjacent interdental soft tissue [14]. The number of papillae that fills the interproximal space is depends upon the interproximal distance of the roots. The papilla in the interproximal space decreases with the increasing interproximal distance of the roots. When interdental distance at the bone crest exceeds 4mm, complete papillae fill should not be expected.

5.2. Distance between Proximal Contact Points to Crest of Alveolar Bone

The most deciding component for the interdental papilla loss is that the distance between interproximal contact point and alveolar bone crest. Tarnow *et al.* study [15] which stated that the presence or absence of Gingival Black Triangle (GBT), by evaluating the vertical distance, delineated that papilla was present 98% when the vertical distance between contact point and crest of bone was ≤ 5 mm, when the distance was more than 7 mm, the papilla was mostly missing (73%) and Guided Biofilm Therapy noted. The study concluded that a 1mm increase in distance between interproximal contact position and crest of alveolar bone (6-7 mm), the chance of GBT occurrence increased by 78% to 97% respectively. Interproximal distance between roots and the distance between the contact point and the alveolar crest have an independent and combined effect on the existence of interproximal papilla was established.

5.3 Diverging Roots and Root Angulation

Diverging roots of adjacent teeth is greatly associated with open gingival embrasures. This either occurs naturally or it is caused by inappropriate bracket placement during orthodontic treatment. Burke *et al.* [16] found that the movement of crowded anterior teeth can split up the roots and stretch the interdental papilla, increasing the presence of Gingival Black Triangle (GBT) between incisors after orthodontic treatment.

5.4 Traumatic Interproximal Oral Hygiene Procedures

Faulty tooth brushing technique, brushing hard and increased frequency of brushing leads to gingival recession. Flossing traumatically can also impart to open embrasures.

5.5 Abnormal Crown Forms and Tooth Morphology

The common tooth forms are circular, square or triangular. Circular or square teeth cause a shallower gingival scallop, while triangular teeth form produce a pronounced scallop. In addition, triangular teeth have divergent roots with thicker interproximal bone, which leads to reduced vertical bone loss compared with square teeth. However, squarer teeth give in better interproximal papilla maintenance because of a smaller interproximal distance from the osseous crest to the contact point [17].

5.6 Gingival Biotype

The periodontal biotype is classified as scalloped-thin and flat-thick biotype [18]. Trauma or inflammation is more common in scalloped-thin tissues, while flat-thick tissue is more certainly to develop deeper periodontal pockets [18].

Thick tissues respond more likely due their increased vascularity and extracellular matrix volume. Therefore, flat-thick biotype has been considered more favorable for attaining optimal esthetics.

5.7 Patient's Age

The probability of open embrasures in aging are bone loss, thinning of oral epithelium, and decrease in keratinization and reduced papilla height.

5.8 Periodontal Disease and Loss of Attachment

It results in progressive destruction of periodontal ligament and alveolar bone. Periodontal disease is associated with loss of interdental papilla due to the loss of alveolar bone. Underlying contour of the osseous crest is the foundation for the gingival support. If the distance from the alveolar crest to interdental contact point exceeds 5 mm, it is of unfavorable that the papilla is insufficient to fill the embrasure [15].

6. Classification of Interdental Papilla Loss (Fig 3)



Fig 3: Classification of interdental papilla loss

6.1 Nordland and Tarnow classified the interdental papilla loss [19] based upon the vertical relationship among the interdental contact point, the facial apical extent of the cementoenamel junction (CEJ) and the interproximal coronal extent of the CEJ. They classified is in to four categories (Fig 4)

- **Normal:** Interdental papilla fills embrasure space to the apical extent of the interdental contact point/area.
- **Class I:** Tip of the interdental papilla lies between the

interdental contact point and the most coronal extent of the interproximal cementoenamel junction.

- **Class II:** Tip of the interdental papilla lies at or apical to the interproximal CEJ but coronal to the apical extent of the facial cementoenamel junction.
- **Class III:** Tip of the interdental papilla lies level with or apical to the facial cementoenamel junction.

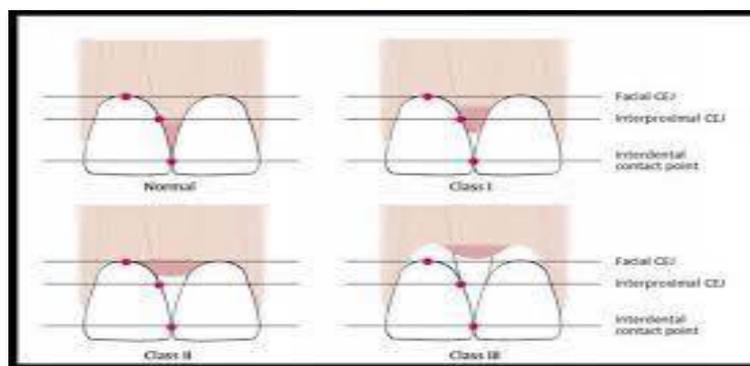


Fig 4: Classification of interdental papilla loss by Nordland and Tarnow

6.2 Nemcovsky [20] proposed a classification system depends on a comparison with adjacent teeth. Papilla is measured by four different index scores and it is represented as PIS.

- **PIS0:** Presence of no papilla and no curvature of the soft tissue contour.
- **PIS1:** Presence of papillae height less than half the height of the papilla in the proximal teeth and a convex

curvature of the soft tissue contour.

- **PIS2:** Presence of atleast half the height of the papilla in the proximal teeth, but not in complete harmony with the interdental papilla of the proximal teeth.
- **PIS3:** Papillae able to fill the interproximal embrasures to the same level as in the proximal teeth and in complete harmony with the adjacent papillae

6.3 The papilla presence index (PPI) was proposed by Cardaroli *et al.* [21] (Fig 5)

- **PPI1:** The papilla is completely present and at the same height of the adjacent tooth.
- **PPI2:** The papilla is not completely present but

interproximal CEJ is not visible.

- **PPI3:** The papilla is not completely present and interproximal CEJ is visible.
- **PPI4:** The Papilla lies apical to both interproximal and buccal CEJ

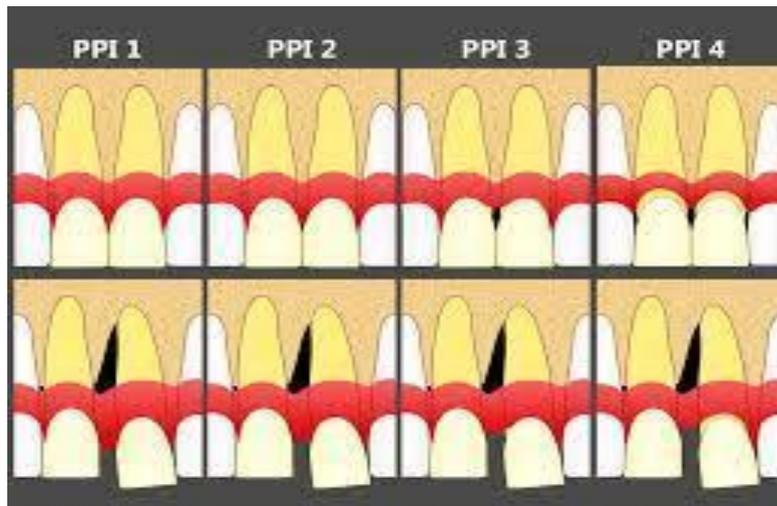


Fig 5: Classification of Cardaroli *et al.*

How to Preserve...

The Basic Treatment Modalities for the preservation of interdental papilla;

- Surgical method
- Non-surgical method

7. Non-Surgical Approach: [11]

1. If the primary cause of periodontal disease is interdental papilla loss, scaling and root gingival is to be done prior to any treatment procedures. In such cases, treatment of periodontal disease is more significant than the reconstruction of lost papillae.
2. If the etiologies of interdental papilla loss traumatic tooth brushing, reinforcement of oral hygiene procedures and oral health education should be given to the patients. Prolonged duration and hard tooth brushing is not advisable as it results in injury to the soft and hard issues
3. If the papilla loss is due to the malpositioning of the teeth, correction and relocation of the contact point should be established.
4. If the interdental papilla loss is due to no contact point between the teeth like in the case of midline diastema, Orthodontic treatment should be carried out to create a contact point.
5. Every 15 days for 3 months curettage of interdental papilla should be performed repeatedly

8. Surgical Approach

Papilla Preservation

Different types of flaps have been discussed for the preservation of interdental papilla

8.1 Conventional Papilla Preservation Flap

Conventional papilla preservation technique was proposed by Takei *et al.* in 1985. The sulcular incision is given around each tooth and through the lingual/palatal flap (Fig:6). Each interdental papilla has a semilunar incision that dip apically from line angle of the tooth so that papillary incision line angle is less than 5 mm from the gingival margin allowing the interdental tissue to be dissected from the lingual /palatal

aspect so that it can be moved intact with facial flap [22]. The first modification of PPF was reported by Checchi *et al.* in 1988, where in the horizontal incision beneath the interproximal area, on opposite side of bone defect was deemed best as it allowed protection of the regenerated area from the oral environment [2].

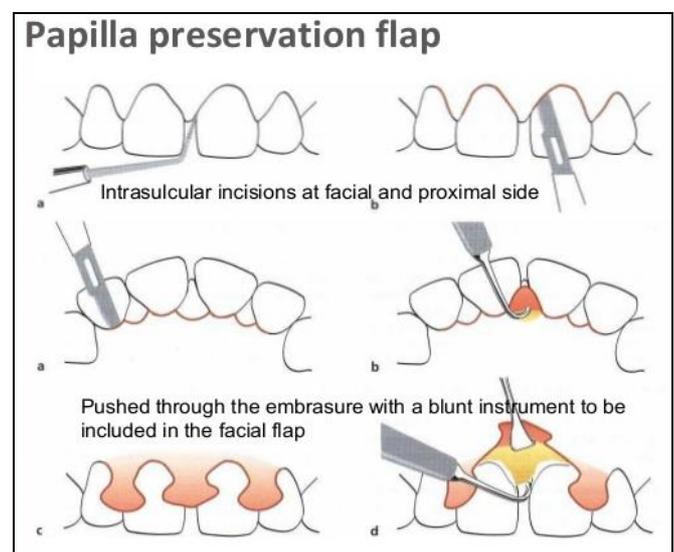


Fig 6: Conventional papilla preservation flap

8.2 Modified Papilla Preservation Flap

Conventional papilla preservation flap was modified by Cortellini *et al.* in 1995. He brought this modified papilla preservation flap into practice. It is indicated in broad interdental spaces and thick interdental papilla [23].

Step 1: In the interdental space at the base of the papilla, a horizontal incision is made at buccally and it is extended towards palataly.

Step 2: After placing a horizontal incision, oblique releasing incision is placed in the alveolar mucosa and it is extended to the interdental papilla in coronal apical direction [2].

8.3 Simplified papilla preservation flap

Modified papilla preservation technique which is further redefined by Cortellini into simplified papilla preservation flap.

It is indicated by narrow interdental space. In the simplified papilla preservation flap, a horizontal incision is replaced by vertical releasing incision [24]. (Fig; 7) An oblique incision is placed along the deformed papilla from the gingival margin at the buccal line angle of involved tooth to middle interproximal part of the adjacent tooth. Intrasulcularly vertical incision is placed and it is extended towards the papilla of adjacent interdental space by partially dissecting it.



Fig 7: Simplified papilla preservation flap

8.4 Entire papilla preservation flap

Deep intrabony defects with periodontal regeneration have been treated by a novel surgical approach, the “entire papilla preservation (EPP)” technique (Aslan, Buduneli, & Cortellini, 2017). The ultimate aim of this concept is to preserve to affected papilla providing a tunnel like undercut incision. The entirely conserved inter-dental papilla provides an intact gingival chamber to stabilize the blood clot and also improves the wound healing process. To provide adequate contact for debridement, EPP requires a short buccal vertical releasing incision on the buccal side of the adjacent tooth extending just beyond the Mucogingival line [25]. (Fig 8)

Tunnel-like “Entire Papilla Preservation” technique may lessen the risk of wound failure mainly in the early healing phase, thereby prevent exposure of regenerative biomaterials, possibly enhancing stabilization of blood clot in shallow intrabony defects and foremost to optimal clinical outcomes.



Fig 8: Entire papilla preservation flap

8.5 Semilunar Coronally Repositioned Flap (SCRF)

Semilunar incision is placed following the curvature of the gingival margin, using a no.15 scalpel blade. This incision ends into the papilla on each inter-proximal area of the tooth to be treated, but not all the way to the tip of the papilla. At least 2mm of 165gingival was conserved on each side of flap in order to protect the blood supply. The semilunar incision was curved apically to an extent to guarantee that the apical part of the flap rests on bone after the coronal development to cover the root.

9. Conclusion

Gingival Black Triangles often consequently in reduced patient acceptance. An increased demand for cosmetic from the patients has resulted in more emphasis on the gingival esthetics. Several factors are responsible for interdental papilla loss and appearance of black triangle, the most common reason is periodontal disease. Papilla preservation flap maintains esthetics and a superior approach for interproximal regenerative procedures. From the article we conclude that esthetics has a greater impact and clinicians should assess the desires of patients to increase the success of treatment. Also it is of significant that dentists must provide health education to patient and community.

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