

TRABAJO DE FIN DE GRADO

Grado en Odontología

**THERAPEUTIC OPTIONS TO RESTORE THE
INTERPROXIMAL PAPILLA**

Madrid, curso 2020/2021

Número identificativo

172

ABSTRACT

BACKGROUND: Due to a constant increase in the desire of a nice and attractive smile, restoration of the interproximal papilla has become one of the most popular demands, thanks to new techniques and instruments. However, according to the different types of techniques proposed, practitioners need to know which alternative will be the most suitable for their patients.

AIM: To study non-surgical and surgical treatment modalities recommended for papilla preservation and reconstruction, then, to identify if the perfect therapeutic technique exists. The sub-aim is to review the definition of the dental papilla, and the aetiological factors involved in its loss. The last part is to find out the multiple factors that should be taken in account in order to be performing an aesthetically and functionally adequate papilla restoration.

METHODS: Electronic research of publications made using the electronic databases Medline and PubMed following specific keywords: “gingival papillae”, “anatomy”, “restore”, “preservation”, “interproximal papillae”, “reconstruction” and “technique”. Over that, a selection of case reports, prospective studies and reviews was made in order to have a large panel of comparison.

DISCUSSION: Practitioners’ choice and ability to select a specific option well adapted to a clinical case is the success depending factor. All the techniques are satisfying while correctly handled and selected according to patients. Facing one case or another, a proper restoration will be made focusing on the ability of the practitioner and the patient’s type of papilla.

CONCLUSION: Without mentioning oral hygiene considerations, all the techniques seem to be very successful but with varying durability over time. Each clinical case is different and need to be analysed in order to use the most satisfactory technique. One of the best surgical techniques seems to be the autologous bone graft with the subepithelial connective tissue. According to all techniques, we keep in mind that in surgical dentistry, the less traumatic, the better papilla regeneration.

RESUMEN

ANTECEDENTES: Debido al aumento del deseo de una sonrisa agradable y atractiva, la restauración de la papila interproximal se ha convertido en una de las aplicaciones más populares, gracias a las nuevas técnicas e instrumentos. Sin embargo, dependiendo de los diferentes tipos de técnicas ofrecidas, los dentistas deben saber qué alternativa sería la más adecuada para sus pacientes.

OBJETIVO: Estudiar las modalidades de tratamiento no quirúrgico recomendadas para la preservación y reconstrucción de la papila y luego identificar si existe la técnica terapéutica perfecta. Los objetivos secundarios son de revisar la definición de papila dentaria tanto como los múltiples factores que se deben tener en cuenta para poder realizar una restauración de papilla estética y funcionalmente adecuada.

MATERIAL Y METODO: La búsqueda de artículos se realizó usando las bases de datos electrónicas Medline y PubMed con las palabras claves siguientes: “papilas gingivales”, “anatomía”, “restaurar”, “preservación”, “papilas”, “interproximales”, “reconstrucción” y “técnica”. Además, se realizó una selección de casos clínicos, estudios prospectivos y revisiones con el objetivo de poder lograr una comparación amplia.

DISCUSION: El éxito del tratamiento de la papilla dental depende de la capacidad del profesional a elegir la opción terapéutica específica más adecuada al caso. Todas las técnicas son satisfactorias mientras se manejan y están correctamente seleccionadas para nuestros pacientes. Frente a un caso u otro, se realizará una adecuada restauración centrándose en la capacidad del practicante y el tipo de papila que tengamos.

CONCLUSIÓN: Sin mencionar las consideraciones de higiene bucal, todas las técnicas parecen tener mucho éxito pero con menos durabilidad en el tiempo. Cada caso clínico es diferente y es necesario analizarlo para utilizar la técnicas quirúrgicas más satisfactoria. Una de las mejores técnicas quirúrgicas parece ser el tejido conectivo subepitelial con injerto de hueso autógeno. Según todas la tas técnicas, mantenemos la idea de que en odontología quirúrgica, cuanto menos traumático seamos, mayor regeneración de la papilla.

INDEX

INTRODUCTION	1
Part 1: The gingival papilla: generality	1
1-Anatomy	1
2-Histology	6
Part 2: The aetiologies of deficient or absent papillae	11
1-Factors influencing the presence or absence of papillae	11
2-The different classifications of the papilla	15
3-The aetiologies of deficient or absent papillae.....	19
Part 3: Preservation and papillary reconstruction	20
1-Papillary preservation.....	20
2- Papillary reconstruction	22
OBJECTIVES	27
MATERIALS AND METHODS.....	28
DISCUSSION.....	29
CONCLUSION.....	41
RESPONSIBILITY.....	44
BIBLIOGRAPHY	45
ANNEXES	47
<u>Annex 1</u> : Definition.....	47
<u>Annex 2</u> : Clinical studies illustrating the advantages and the inconveniences of non surgical techniques to restore the papilla	48
<u>Annex 3</u> : Surgical techniques used to restore the interdental papilla	49
<u>Annex 4</u> : Comparative studies to determine which one is more effective than another	50
<u>Annex 5</u> : Clinical cases illustrating the preservation and the restoration of the papilla in subjects with implant placements	52
<u>Annex 6</u> : Comparative pre-operative and post-operative pictures of the previous described techniques.....	53

INTRODUCTION

Modern dentistry no longer focuses only on restoring missing teeth, but also, increasingly, on reconstructing peri-dental and peri-implant tissue with appropriate surgical techniques.

The absence of interdental and inter-implant papillae can cause significant functional, phonetic and aesthetic disorders.

Restoration of the papilla remains one of the most difficult challenges in reconstructive periodontal surgery.

The objective of this thesis will be to carry out a reflection on the current techniques available to preserve, especially rebuild the papilla and determine which technique will be the best.

Part 1: The gingival papilla: generality

1-Anatomy

1.1 Definition

The interdental papilla corresponds to the gingival volume occupying the space between the proximal surfaces of two contiguous natural teeth (1).

The peri-implant papilla is located between an implant and a natural tooth (2).

Finally, the inter-implant papilla represents a papilla located between two implants (1,2).

1.2 Description

1.2.1 The interdental papilla

The interdental papilla is bordered apically by the alveolar ridge, coronally by the contact area and laterally by the proximal faces of adjacent teeth.

A papilla has two peaks, a vestibular and a lingual or palatal (1).

Between the two summits, there is a gingival or inter-papillary neck. It is a coronary concave hollow that connects the two papillary summits and follows the shape of the interproximal contact zone (1).

The contact point, the larger of the tooth surface and the junction cemento-enamel contribute to give the form of the interdental papilla (1,2).

In anterior regions of the dentition, the interdental papilla has a pyramidal form while in the molar regions, the papilla are more flattened in the buccolingual direction (1,2).

In the premolar/ molar regions of the dentition, the teeth have proximal contact surfaces (1).

A COL is established in the sector of the premolar and molar. In this region, the papillae have one vestibular and one lingual/palatal part separated by the COL region (1).

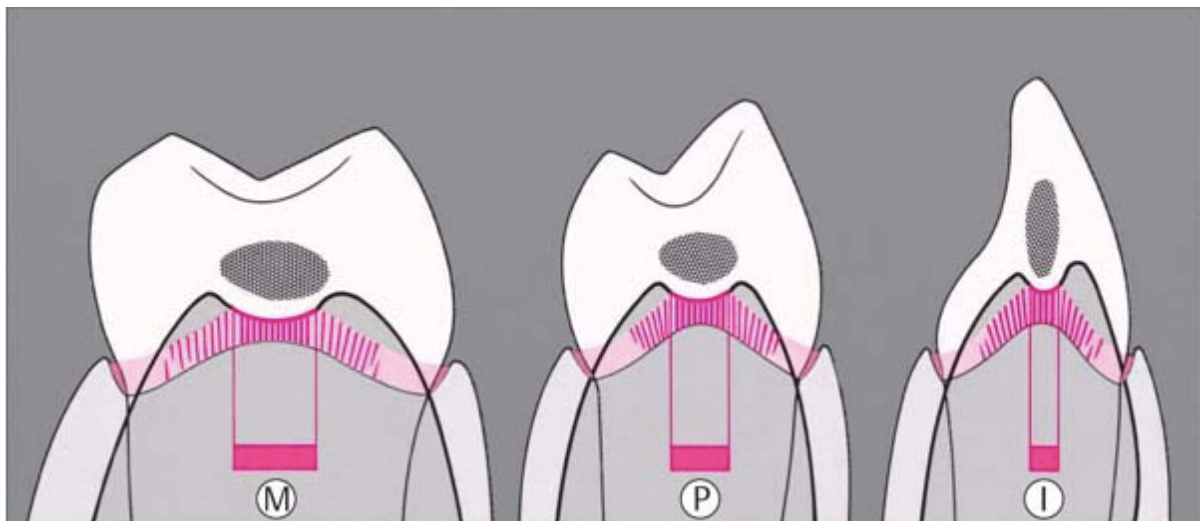


Figure 1: explanation of the Col region (1). (<https://pocketdentistry.com/fundamentals/>)

1.2.2 The inter-implant papilla and the peri-implant papilla

The anatomy of the inter and peri-implant papilla is similar to that of the interdental papilla. However, it should be noted that the level of the bone crest is located more apically due to peri-implant resorption (2).

The dento-alveolo-gingival architecture

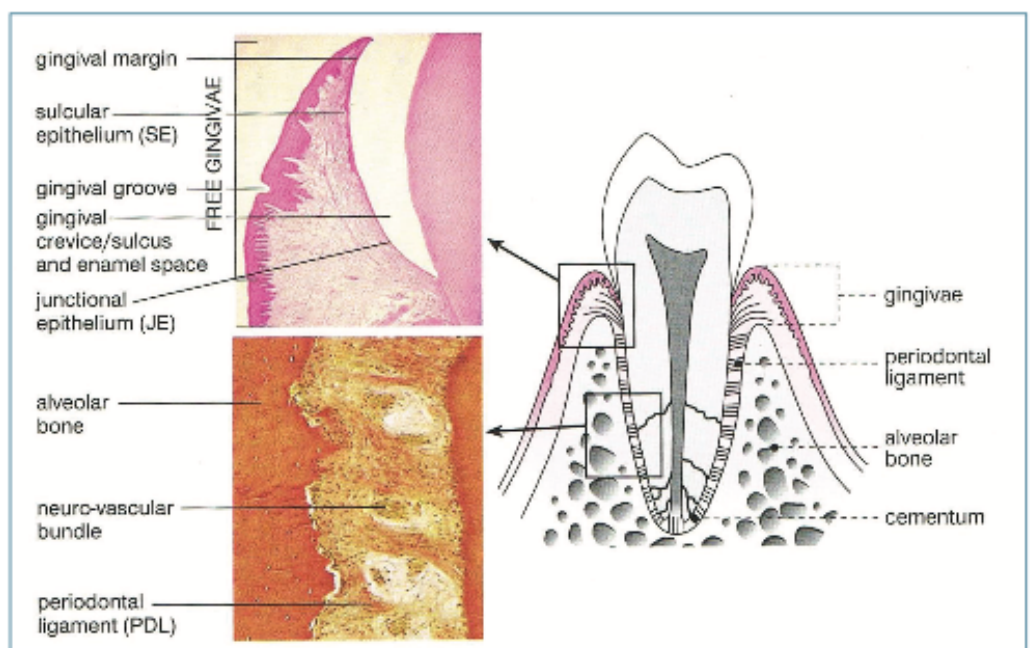


Figure 2: the dento-alveolo-gingival architecture (3).

1.3.1 The gingiva

The gingiva is separated from the alveolar mucosa by the muco-gingival-line.

It is divided into three parts: the free, the attached and the interdental gum (1).

1.3.1.1 the free, interdental and attached gingiva

Free gingiva is narrow, mobile and scalloped, 0,5 to 1 mm high (3).

Pink and firm, it follows the anatomical contour of the teeth and ends at the neck of the tooth forming an epithelial ring: the epithelial attachment (3).

Interdental papilla is the portion of the gum located in the interproximal and coronal spaces to the bone crest (3).

Attached gingiva is the extension of the free gingiva. Firm, resistant and not very elastic, it is attached to the periosteum of the underlying alveolar bone. The healthy gingiva is pink; its

keratinized surface may have an orange peel texture. It begins at the marginal gingiva sulcus and ends at the muco-gingival line (3).

1.3.2 The alveolar mucosa

The alveolar mucosa is red, smooth and shiny. Mobile and elastic, it is covered with non-keratinized epithelium (3).

1.3.3 The periodontal ligament

It is located between the surface of the tooth root and the alveolar bone. Essentially made up of various bundles of collagen fibers and cells (fibroblasts), it anchors the tooth in its alveolus and has an important mechanical role during mastication (2,3).

The bundles are inserted into the alveolar bone and the cementum (Sharpey fiber) (2).

1.3.4 The cement

It is an avascular mineralized tissue that covers the root surface, more precisely the dentin. It provides the interface between the dentin and the periodontal ligament (3,4).

1.3.5 The alveolar bone

It develops during tooth formation and eruption and is resorbed after tooth loss. It is composed of alveolar bone, cancellous bone and cortical bone (3,5).

The alveolar bone forms the tooth socket, the cancellous bone is located between the alveolar bone and the cortical bone (3,5).

The external cortical constitutes the alveolar wall, it is riddled with numerous openings (Volkman's canals) through which vessels and nerve fibers enter and leave the alveolar bone (3,4).

Interproximally, the alveolar crest has a bone contour that varies in the anterior region compared to the molar one. In the interproximal zone, the bone is spongy, which makes it fragile (3).

1.4 The implant-alveolo-mucous architecture

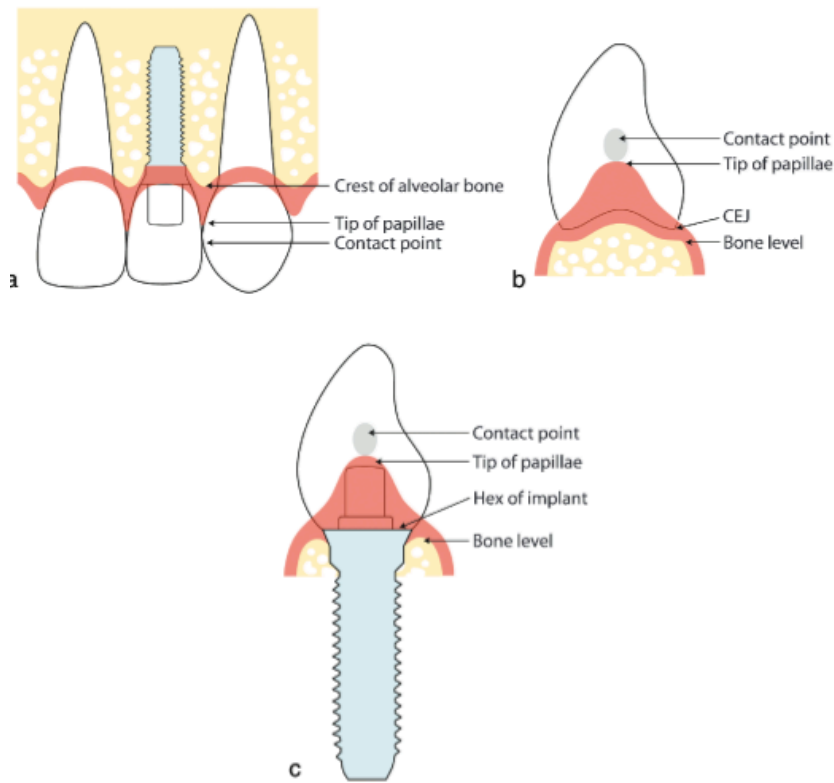


Figure 3: (a) inter-dental/inter-implant papilla (b) inter-proximal view of inter-dental papilla in natural tooth (c) inter-proximal view of inter-dental papilla in implant (2)

1.4.1 Peri-implant soft tissues

The peri-implant anchoring system consist of three distinct elements:

- The implant surface
- The alveolar bone
- The peri-implant mucosa

Clinically, the peri-implant mucosa is similar to the gum but there are some differences such as the absence of periodontal ligament (6).

The soft tissue-implant interface consists of three defined zones (6):

- The sulcular epithelium
- The junctional epithelium

-Connective tissue-implant

1.4.1.1 The sulcular epithelium, junction, connective tissue peri-implant

It is a non-keratinized extension of the buccal epithelium, which is in continuity with the junctional epithelium in its apical part (7).

In a healthy peri-implant sulcus, the probing depth is approximately 2mm (compared to 0,7 mm for the dental sulcus) (7).

The junctional epithelium is in close contact with the implant surface.

The implant-gingival junction does not extend to the alveolar crest. It stops 1-1,5mm from the crestal bone, separated by the connective tissue (7).

The connective tissue is interposed between the top of the bone crest and the apical portion of the epithelium. The collagen fibers, oriented apico-coronally, are placed to the implant surface and attach to the periosteum (2,7).

2-Histology

2.1 The interdental papilla

Epithelium

The papilla is covered with a stratified and keratinized squamous epithelium.

The papillary neck is generally poorly keratinized or paakeratinized and is covered with a stratified squamous epithelium (2,5).

Basal membrane conjunctival epithelium

The basal membrane is located at the interface between the epithelium and the connective tissue and serves as an exchange barrier between these two tissues (2,5).

Gingival connective tissue

Fibrous and dense, it is located under the basal membrane and ensures the innervation, vascularization and defence of the papilla. It is made up of cellular elements, collagen fibers and extra-cellular matrix (2,5).

Vascularization and innervation

Gingival vascularization comes from three sources:

The interdental septas

The periodontal ligament

The oral mucosa

The interdental papilla and the cervix are vascularized for the most part by these anastomoses. This terminal vascularization of the papilla makes it very fragile (high risk of necrosis) (2,5).

2.2 the inter and peri-implant papilla

Some differences exist between interdental papilla and peri-and inter-implant papilla. (2,5,6)

-Due to the lack of cement structure

-The high collagen content and fibroblast poverty of the peri-implant connective tissue

-The peri-implant mucosa lacks the vascularization of ligamentous origin. Its vascularization is therefore less important, which leads to greater difficulties in soft tissue healing.

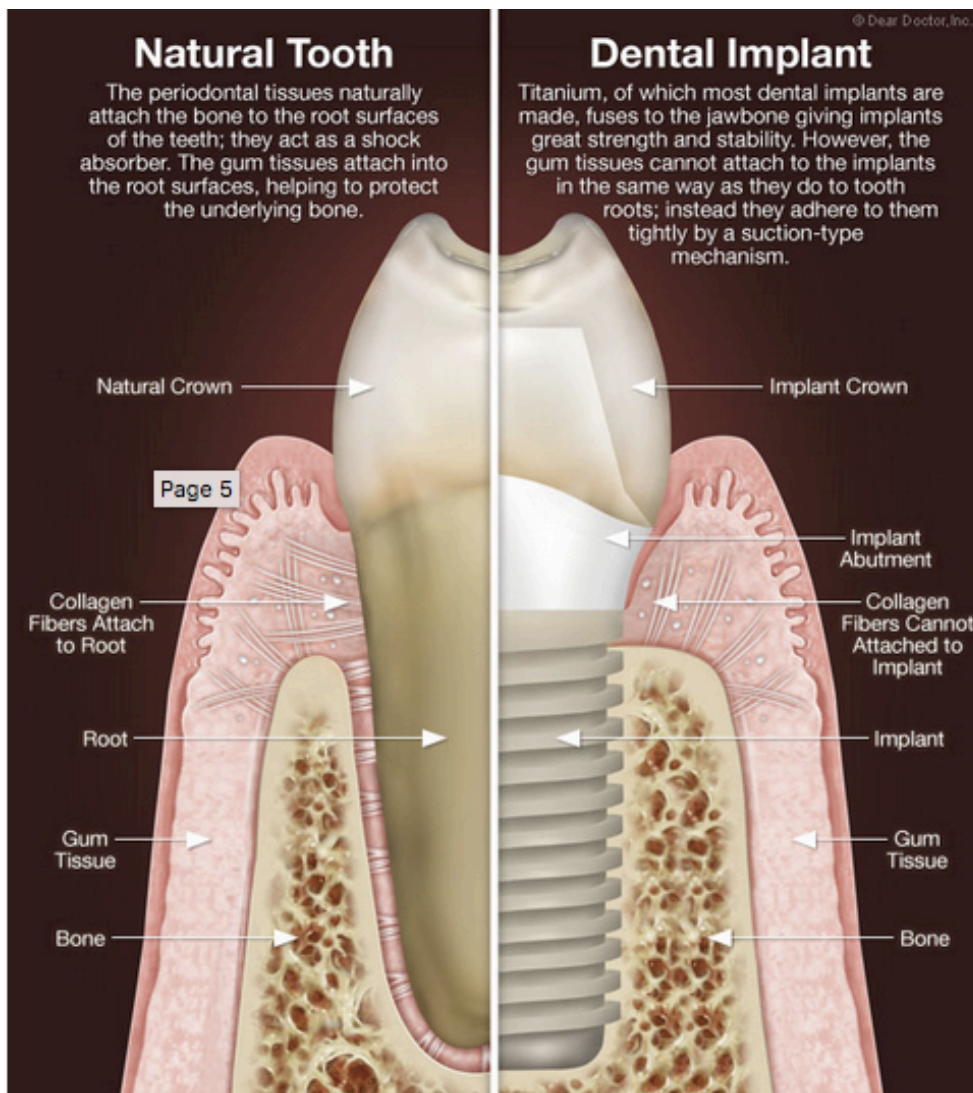


Figure 4:

Comparison of the natural tooth and dental implant anatomy
(<https://supremedentaleducationsupply.wordpress.com/2018/01/07/top-5-differences-between-teeth-and-dental-implants-that-influence-diagnosis-and-treatment/>)

3-Functions and roles

Functional

When the papilla is present, it occupies the entire interproximal space and thus allows the deflection of the food avoiding any food compaction if the contact point is optimal (3,8).

Phonetic

The absence of papilla, especially in the anterior sector, can be the cause of air “leaks” generating certain phonation problems (3,9).

Protective barrier

The papilla acts as a barrier to protect the underlying periodontal structures (3).

Aesthetic

From an aesthetic point of view, the papilla is a particularly important anatomical element (8). Its absence is marked by an unattractive black interdental triangle, particularly in the incisivo-canine area. The dentist must take into account the age and requirements of the patient as well as the type of smile to evaluate the importance of the aesthetic role of the papilla. (8,9)

The periodontium in the facial and labial frame

=>The periodontium in the facial frame

Horizontal references

These are the horizontal lines passing through different areas of the face: the hairline, the brow bone, the pupils, the wings of the nose and the chin. A harmonious face is considered to be dividing into three equal levels. The lines separating these levels must be parallel to each other and perpendicular to the median sagittal plane. (8,9)

It is the general parallelism of the horizontal lines that prevails. (8)

Vertical references

The median sagittal line passing through the bridge of the nose and the philtrum is perpendicular to the horizontal lines. The inter-incisal line coincides with the sagittal line of the face in the majority of the population. (9)

Sagittal references

The sagittal references determine the support of the upper lip, the relationship with the lip and the occlusal plane.

=>The periodontium in the labial frame

The lips

Their curvature and length have a great influence on the quantity of teeth exposed at rest and during the function. (10)

The smile

It is a dynamic position of the lips that varies according to the degree of muscle contraction and lip profile. (10)

The smile line

The smile line can be defined by drawing an imaginary line that follows the lower edge of the upper lip stretched by the smile. (10)

Smile lines is divided into three categories:

- The high smile line, which represents a smile that exposes the full coronal height of the anterior maxillary teeth and a continuous band of gum tissue;
- The middle smile line, which represents a smile that reveals 75-100% of the maxillary anterior teeth and only the interproximal gum;
- The low smile line, which represents a smile that exposes less than 75% of the maxillary anterior teeth.

When the smile line is high, the smile is said to be gingival, which is an aesthetic risk factor. (10,11)

The lower lip

When smiling, the lower lip is parallel to the line of the free edges of the teeth maxillary.

(10)

The gum

The gum is the essential element of the aesthetics of the smile. Gingival contours follow the underlying bone architecture.

The collar line

It is determined by the level of the marginal gingiva of the maxillary teeth. It must follow the shape of the upper lip (11).

The gum line is harmonious when:

- The gingival festoons of the central incisors are symmetrical. They must be either at the same level or 1 mm apically to those of the lateral incisor;
- The gingival festoons of the canines are at the same level or more apical than those of the central incisors;
- The gingival festoons of the lateral incisors are never more apical than those of the canines.

The gingival aesthetic line:

The gingival aesthetic line represents the straight line on which the gingival zeniths of the central incisors and canines should be aligned, forming an angle of less than 90° with the maxillary inter-incisal line. (10,11)

Part 2: The aetiologies of deficient or absent papillae

1-Factors influencing the presence or absence of papillae

1.1 The alveolar bone crest

1.1.1 Dimensions of the alveolar ridge at the level of the interdental space

To achieve sufficient bone support for the interdental papilla, the alveolar bone crest should measure approximately 2 to 4 mm vertically and 3 mm horizontally (12).

1.1.2 Post extraction resorption and its consequences

In the first few months following a dental avulsion, a very important tissue resorption process takes place, leading to the degradation of the dento-alveolo-gingival architecture. This tissue resorption can thus be the cause of the loss of the papilla of the teeth adjacent to the extraction site. (1,12)

According to the periodontal biotype, the post-extraction bone resorption is more or less important. (1,12)

In addition, the level of bone resorption differs according to the type of edentulism. For a partial or complete edentulism, bone resorption is both vertical and horizontal. (1,12)

1.2 The distance between the point of contact and the bone crest

1.2.1 Between the 2 adjacent teeth

If the alveolar crest distance to the contact point is equal to or less than 5 mm, the papilla will be present in almost 100% of cases. At 6 mm, the papilla is present in about half of the cases. If the distance is 7 mm, there will be papilla in 25% of the time. (12)

1.2.2 Between an implant and a natural tooth

Salama *et al.* (1998) also suggest a relationship between the location of the interproximal contact point in relation to the alveolar ridge and papilla development (13).

Thus, they define the IHB (IHB: Interproximal Height of the Bone) according to three categories:

- Class 1: the HBI (measured between the most apical point of the contact area of the implant restoration and the bone crest) is between 4 and 5 mm and suggests a good papillary prognosis.
- Class 2: HBI is between 6 and 7 mm and suggests an uncertain prognosis.
- Class 3: HBI is greater than 7 mm and suggests a poor prognosis.

This work shows that the distance between the interproximal contact point and the top of the bony septum is a determining factor in the maintenance or disappearance of papillary tissue. Therefore, the greater the height of the interproximal bone, the greater the chance of obtaining satisfactory papillary volume. This analysis also highlights the possibility of making a compromise by modifying the position of the contact point. (13)

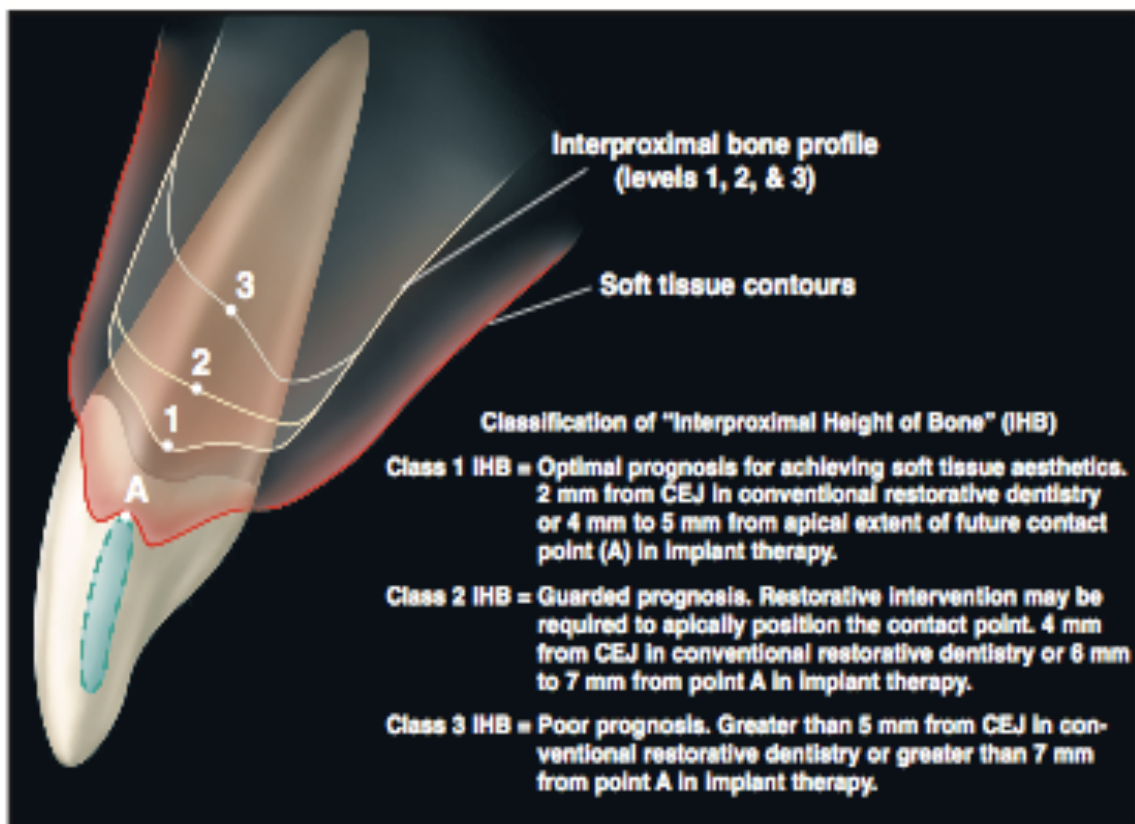


Figure 5: the classification of interproximal bone profile (12)

1.2.3 Between two adjacent implants

Tarnow *et al.* wished to study the variation and average height of inter-implant tissue, measured between two adjacent implants, and independently of the location of the contact point. Thus, the height of 136 inter-implant papillae was measured (from the bone crest to the top of the papilla). (13,14)

The results showed an average inter-implant papillary tissue height of 3.4 mm with a range of 1 to 7 mm. (13,14)

1.3 The appearance of soft tissues and periodontal biotypes

1.3.1 The thick and flat periodontium

Its tissue covering is dense and fibrous with a thick, flat underlying bone. Keratinized attached gingiva is present in large quantities and square anatomical crowns with significant convexities in the cervical third characterize the teeth. The contact points between the crowns are wide and often extend into the cervical third. Consequently, the papillae are shorter than that of the fine and scalloped periodontium. (1)

1.3.2 The thin and scalloped periodontium

It is characterized by a thin layer of soft tissue covering a scalloped bone, with a thin attached gum. This biotype is more sensitive to problems of gingival recessions, dehiscence and fenestration. It is associated with a specific dental morphology characterized by triangular anatomical crowns with small interproximal contact points in the incisal third. (1)

1.4 The inter-implant distance and the tooth-implant distance

Inter-implant distance

Tarnow *et al.* studied the effects of inter-implant distance on inter-implant bone crest height. The results showed that the inter-implant distance should be at least 3mm in order to preserve the interdental bone (14,15).

Distance between an implant and a natural tooth

According to most studies a minimum distance of 1.5 to 2 mm between a tooth and an implant is required (14,15).

2-The different classifications of the papilla

Classification of JEMT

This is the "Papilla Index Score" which distinguishes three reference lines for the measurement of papilla (16):

- The line passing through the most apical point of the crown on the vestibular side
- The line passing through the point of contact
- The line halfway between the two previous ones.

It thus differentiates five groups of papillae, classified from 0 to 4.

The Papilla Index Score (PIS):

- PIS 0: total absence of the papilla (large black triangle);
- PIS 1: three-quarters of the papilla is missing, slightly convex mucous membrane;
- PIS 2: the papilla fills at least half of the interproximal space;
- PIS 3: optimal tissue contour, the papilla fills the entire interproximal space;
- PIS 4: hyperplastic papilla with irregular contours, texture and colour are altered.

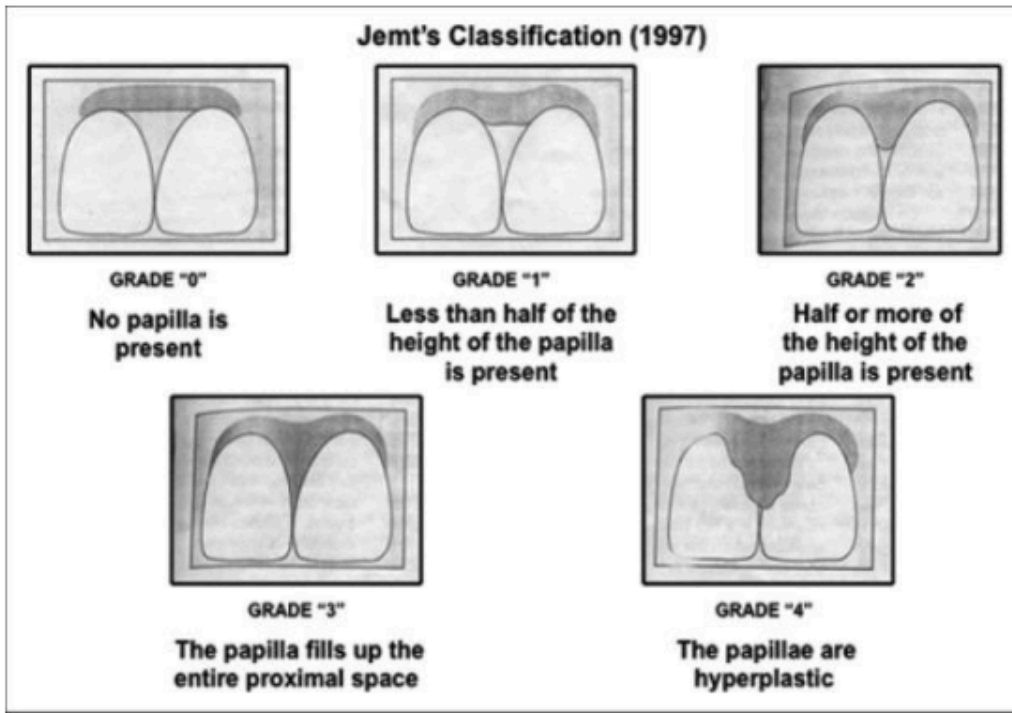


Figure 6: Classification of the papilla index score (16)

Classification of Nordland and Tarnow

Nordland and Tarnow's classification of the height loss of the interdental papilla uses as an anatomical landmark the interdental contact point as well as the most apical (vestibular surface) and the most coronal point of the enamel-cement junction (proximal surfaces) (17):

- Class 1: The apex of the papilla is located between the point of contact and the most coronal point of the joint but on the proximal side;
- Class 2: the top of the papilla is located at the most coronal point of the enamel-cement junction or between it and the most apical point of this junction on the vestibular surface;
- Class 3: the top of the papilla is at the level of the enamel-vestibular cement junction or apically.

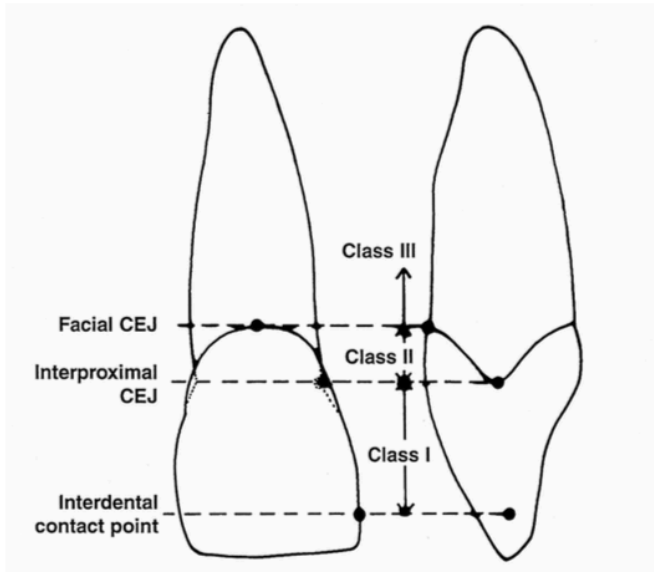


Figure 7: A Classification system for loss of papillary Height (17)

Classification of Palacci and Ericsson

In 2001, Palacci and Ericsson classified the volume of hard and soft tissue lost vertically and horizontally in the maxilla into four groups. (18)

In the vertical direction, Palacci *et al.* differentiate four situations:

- Class 1: Intact or slightly reduced papilla
- Class 2: Moderate decrease in papilla
- Class 3: Significant decrease in papilla
- Class 4: Absence of the papilla

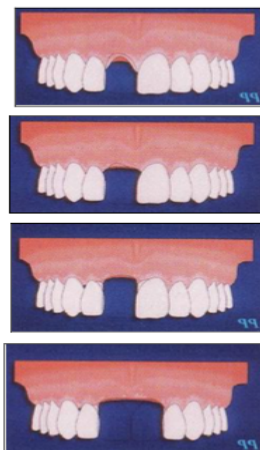


Figure 8: Classification of the volume of hard and soft tissue lost vertically (18)

In the horizontal direction, Palacci *et al.* differentiate four situations:

Class A: intact or slightly reduced vestibular tissue.

Class B: moderate reduction of vestibular tissue

Class C: Severe loss of vestibular tissue.

Class D: Extreme loss of vestibular tissue with often a limited amount of attached mucosa.

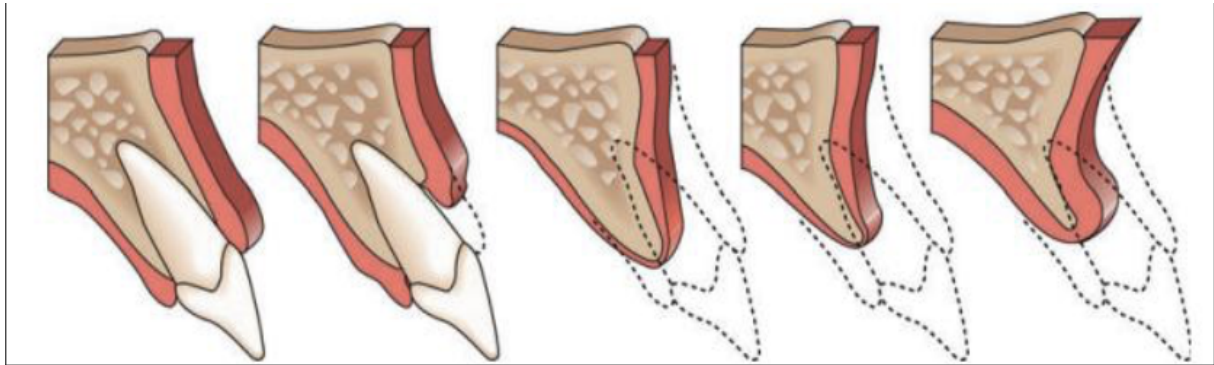


Figure 9: Classified the volume of hard and soft tissue lost horizontally (18)

Cardaropoli index (19)

- IPP-1: the papilla is intact; its apex is coronal at the point of contact. It is at the same level as the adjacent papillae.
- IPP-2: the papilla is not intact; its apex is apical at the point of contact. It is not at the same level as the adjacent papilla.
- IPP-1 and IPP-2 can be complicated by the presence of recession gingiva on the vestibular part. These are IPP-1r and IPP-2r;
- IPP-3: the apex of the papilla is very apical at the amelo - interproximal cemented junction and uncovers it;
- PPI-4: the top of the papilla is apical at the amelo - elemental junction of the interproximal and vestibular regions.

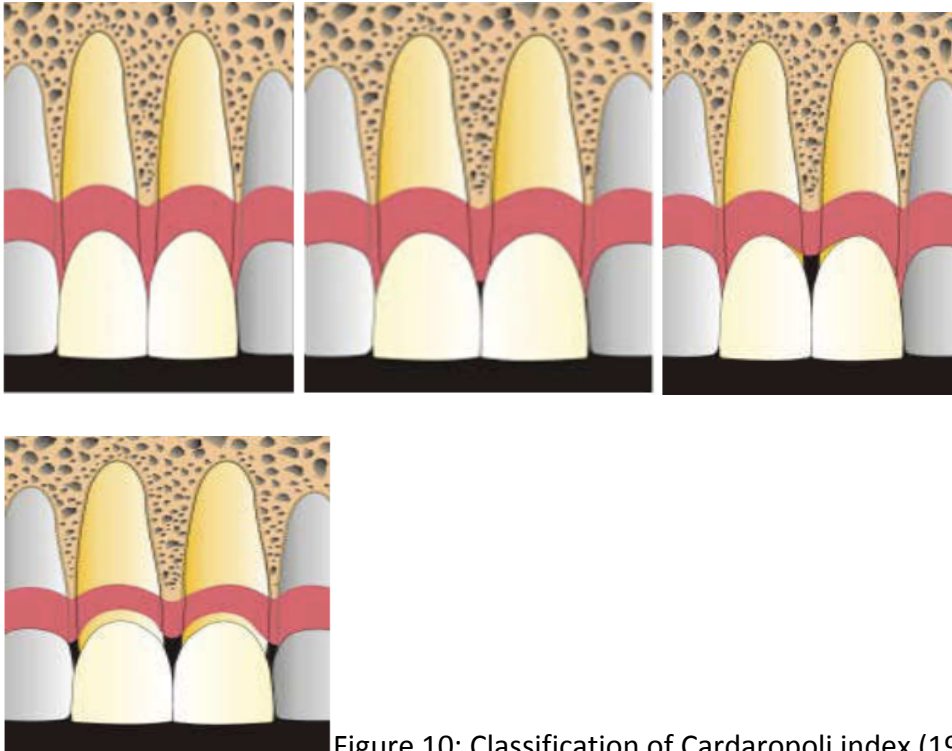


Figure 10: Classification of Cardaropoli index (19)

3-The aetiologies of deficient or absent papillae

3.1 Periodontal disease

The periodontal disease is responsible for a horizontal and/or vertical bone loss, which implies a reduction or even a total loss of the gingival papilla. The anaesthetic aspect will be all the more important as the horizontal alveolysis will be severe (1,3).

3.2 Dental avulsion

According to the periodontal biotype, the post-extraction bone resorption is more or less important: for a flat and thick periodontium, the collapse of the hard and soft tissues is less consequent than for a thin and scalloped periodontium (1).

3.3 Dental malposition

Some dental malpositions can cause black holes and the absence of papillae such as diastemas, wide embrasures, overlaps and tooth crowding (1,4).

3.4 Iatrogenic care

The loss of papillae can be due to iatrogenic dental care or to the non-respect of the biological space (1).

In the case of a proximal dental restoration, the presence of an optimal contact point is of utmost importance. The absence of an optimal contact point can lead to food blockages and aesthetically damaging interproximal bone loss. Overwhelming care (amalgams, crowns) can also lead to gum inflammation and proximal bone loss (1).

3.5 Trauma Local factors (influencing the papillary prognosis and the risk of developing black triangles)

Trauma, such as over brushing, lower lip or tongue piercing, can lead to gum tissue recession and papillary loss (1).

Part 3: Preservation and papillary reconstruction

1-Papillary preservation

The maintenance of the papilla is essential because their absence is marked by a very unattractive black triangle in the anteromaxillary sector (1,4,19).

1.1 The interdental papilla

1.1.1 Oral hygiene

The interproximal space is the region most exposed to oral diseases. It is indeed on the lateral faces of the teeth that caries and periodontal lesions appear in priority. (1,19)

Rigorous hygiene is essential for all oral health, but in the case of acute trauma, if the papillary damage is only related to a poor plaque control technique (such as horizontal brushing), it is sufficient to modify the latter in order to observe a re-epithelialization of the lesion. In this way, the papilla can be completely restored. (19,20)

1.1.2 periodontal care

Scaling

Any periodontal treatment begins with a scaling corresponds to the process by which the tartar is detached from the dental surfaces as well coronary as root surfaces (4,19,20).

Polishing

Polishing should be carried out after each scaling to remove discoloration and achieve smooth surfaces (20).

Surfacing

Root planning is the process by which tartar residues and part of the cement are removed to obtain a smooth, hard and clean root surface. It is performed non-surgically or surgically (20).

To do this, several instruments are available, such as curettes (19,20).

1.1.3 Conservative dentistry

Papillary inflammation may be observed following a food blockage, proximal caries or an overfilling. Proximal reconstructions in restorative dentistry allow papillary preservation by reconstructing an interdental contact point and proximal surfaces that are as close as possible to the physiology and morphology of the tooth. In this way, prophylactic conditions and access to hygiene are optimized (1,20).

1.1.4 Orthodontics

Orthodontics also plays a role in papillary preservation. Alignment and straightening of the dental axes allows the establishment of optimal contact points, compatible with adequate interdental hygiene, thus preventing the risk of tissue recessions (20).

1.1.5 Surgery

Numerous surgical techniques have been developed in order to preserve gingival aesthetics as well as possible. The preservation of the interdental tissues during the realization of periodontal flaps is particularly important. In the same way, the choice of the incision tracings, the sutures and especially the approach of the banks of the flap are determining factors for the future of the gingival tissues (1,3,4,19,20).

1.2 Inter-implant papilla

Bone grafting

Appositional bone grafts are indicated when the residual bone volume in the area to be implanted is insufficient to provide lasting anchorage or when local conditions do not allow for a satisfactory aesthetic result (2,6).

Orthodontic extrusion

Pre-implant forced eruption is often indicated in the maxillary anterior sector. The aesthetic and functional result can be significantly improved (20). Forced eruption allows true bone regeneration in the coronal direction and increases the height of available keratinized tissue. The proximal papillae can be reliably regenerated with this treatment (20).

Extraction immediate implantation

The immediate compensation of the tooth extraction by the insertion of an implant limits the tissue resorption thanks to the immediate support of the residual tissue. Indeed, the combination of an atraumatic extraction, flapless surgery, the immediate placement of an implant adapted to the extraction site and a mucosal healing screw adapted to the emergence profile makes it possible to maintain an aesthetic tissue context (2,6,7).

2- Papillary reconstruction

2.1 The interdental papilla

2.1.1 Non-surgical method

-Orthodontic solution

The displacement of the teeth in orthodontics leads to a modification of the dento-periodontal relationships.

Divergent roots are associated with the gingival black spaces. With the orthodontic treatment, the maxillary central incisors can go along with the axial long axis of the tooth and rectify the black space. As the roots become more parallel, the contact point will stretch and move towards the apex of the papilla (20).

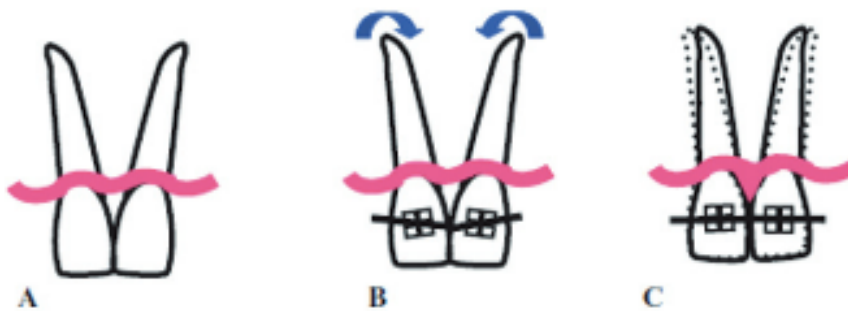


Figure 11: Orthodontic solution to re-establish the papilla (20)

-Restorative solution

The veneer or crown can be use to restore the black triangle. Furthermore, it's possible to use pink porcelain into the restoration to cover up anaesthetic hole between the two adjacent teeth (1,20).

-Biological solution (Hyaluronic acid)

Hyaluronic acid (HA) is a glycosaminoglycan of the extracellular matrix of all tissues. HA is used at a concentration of 0,02% (1). HA can intervene in many process perform an important role in cell migration, since it is linked in processes such as inflammation, reparation and growth of the cells (1). Following these injections, the authors noted an improvement in most of the papillae examined (1). The results of this pilot study are

encouraging and show that papillary deficits can be improved by injecting a hyaluronic acid gel (1).

2.1.2 Surgical method

Several operative techniques for surgical reconstruction of the papilla have been reported.

It should be remembered that the interdental papilla is a small and poorly vascularized structure. This could be the major limiting factor in reconstructive or augmentation surgical techniques.

Root planning in combination with gingival curettage (Shapiro)

In 1985, Shapiro reported the creation of destroyed papillae using root planning combined with gingival curettages repeated periodically for 3 months. The proliferation of gingival tissue would be caused by gingival hyperplasia produced after repeated scaling, root planning and curettage (21). Nine months after the initial treatment, regeneration of the interdental papillae was observed (21). Some papillae were completely regenerated, but others did not respond favourably to periodic curettage (21).

Semilunar incision (Han and Takei)

Han and Takei (1996) used the semi-lunar incision technique, which consisted of incision with coronal displacement of the gingivopapillary unit and placement of a subgingival connective tissue graft (19). This technique is very interesting because the displaced pedicle allows better vascularization to be maintained than in the case of a free gingival graft (19). In the Han and Takei technique, instead of placing the semi-lunar incision on the root surface, it is offset in the interdental region to reshape the papilla (19).



Figure 12: Semi-lunar incision technique for the interdental papilla management (19)

Root covering and papillary reconstruction using a connective graft placed under the vestibular and palatal flaps (Azzi *et al.*)

A reliable and predictable surgical technique to obtain root coverage and completely or partially regenerate the interdental papillae using a connective tissue graft buried under the papillae and vestibular flap, without discharge incisions (19).

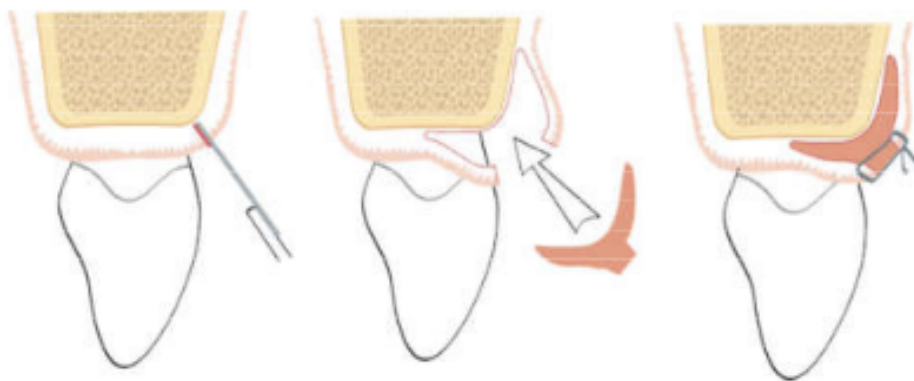


Figure 13: Azzi and all envelope flap technique (19)

Root recovery and papillary reconstruction by autogenous bone and connective tissue grafting (Azzi *et al.*)

In 2001, Azzi *et al.* proposed a surgical protocol consisting of an autogenous bone graft harvested from the tuberosity and augmented with a connective tissue graft to reconstruct

the papilla between the two maxillary central incisors. (19)

The Beagle's technique described a pedicle graft procedure utilizing the soft tissues palatal of the interdental papilla

Beagle proposed a surgical reconstruction of a collapsed interdental papilla. It is based on the principles of two techniques: the Abrams roll technique (applied in ridge augmentation) and the Evian technique (aimed at preserving the papilla) (22,23).

Beagle's technique includes adequate blood supply to the flap, a less invasive procedure, simple to perform, and less time-consuming (22,23).

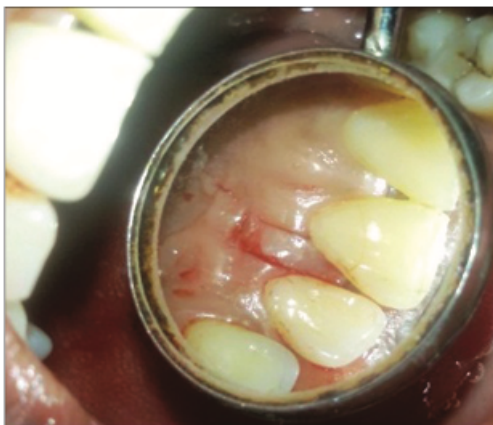


Figure 14: a) incision on palatal b) the partial thickness flap was elevated to the labial part c) suture (23)

OBJECTIVES

Through the fulfilment of this work, we will aim at highlighting the multiple treatments plans available in order to therapeutically restore the dental papilla. Therefore, as a primary objective, we will aim at:

- 1- Studying the diverse non-surgical and surgical treatment modalities recommended for the reconstruction of the dental papilla; thus allowing us to identify a possible gold treatment plan.

Consequently, our secondary objectives will aim at:

- 2- Underlining the multiple aetiological factors involved in the loss of the dental papilla
- 3- Finding out the multiple considerations that should be taken into account in order to perform an aesthetically and functionally adequate papilla restoration.

MATERIALS AND METHODS

An electronic search of publications from 1994 to 2020 was made using electronic databases Medline and Pubmed using the following search terms “interdental papilla, flap, therapeutic treatment, preservation, anatomy, technique, implant”. As a result, case reports, reviews and studies were found, containing comparative tables of different techniques according to the treatment or preservation of the interdental papilla we were facing. The conclusion of the chosen studies was significant and helpful for two reasons; on the one hand, due to the basic theoretical explanation of the general definitions and on the other hand due to their clinical explanation of the different techniques.

DISCUSSION

Due to the loss of interdental papilla, surgical and non-surgical techniques have been used in many situations to provide a therapeutic restoration or regeneration.

Indeed, the techniques can be used with more delicate cases involving the loss of bone and interdental papilla. The reconstruction of the papilla is one of the most difficult periodontal treatments due to the process of regeneration and the aesthetics. The stability and level of the interdental papilla is difficult to maintain in the long term. The papilla is a delicate tissue because it's a small and fragile with minor blood supply and it also depends on the hygiene of the patient in the long term.

In addition, the cause of loss of interdental papilla, due to gingival inflammation, attachment loss and interproximal bone resorption should be investigated. As each case is different, the choice of surgical and non-surgical technique should be clearly thought of in advance.

A case report of the loss of interdental papilla between upper central incisors caused by gingivitis and poor brushing technique shows a patient's great satisfaction and no post operative pain (24). In this case, the infiltrations of 1ml of HA were accomplished 7, 14 and 21 days after the initial infiltration (24). The vertical distance was decreased, the soft tissue height augmented and the black triangle disappeared (24). The negative point of this technique was that there was not enough research and it required more precision and details in the long term (24).

Facing a randomized clinical trial, 10 patients were selected, focusing on 36 papillae (25). A significant decrease of the vertical distance between the bone crest and apical point (difference from the baseline to 6 months was $-0,25 \pm 0,26\%$) was observed and a positive result was obtained to fill the black triangle after 6 months (25). Focusing on the black triangle, the mean percentage of reduction from the baseline to 6 months was $45.0 \pm 28.5\%$.

The patient satisfaction was higher with 7 out of 10 describing a better aesthetic smile (25). Therefore, the full regeneration of the papilla was not confirmed in the long term and could be achieved by increasing the number of injections or in small papillary defects. The main point was to increase the tissue volume (25).

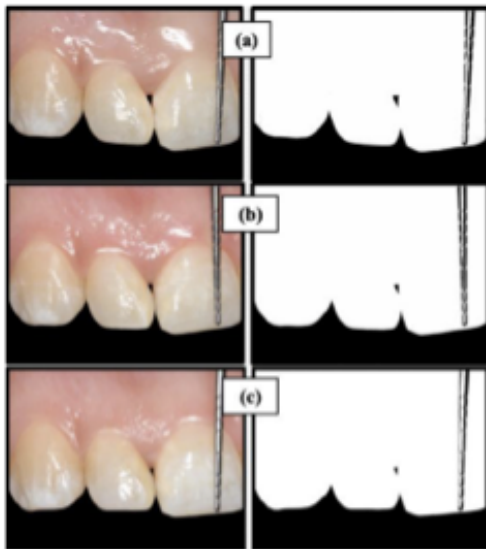


Figure 15: Hyaluronic acid injection a) black triangle

at baseline, b) black triangle at 3 months c) black triangle at 6 months (25)

Concerning the non-surgical technique, the orthodontic technique resulted in reducing the interproximal contact point of enamel to restore the gingival black triangle (26). The study showed that maximum 50% of the interproximal enamel could be removed without dental risk. The goal was to manipulate the level of bone and soft tissue to reconstitute a new papilla (26).

A report of the subepithelial connective tissue reconstruction has been described. The distance from contact point to gingival margin at the baseline showed 2,60mm and 1,87mm at 1st, 3rd and 6 months. The papillary presence index presented at the baseline 2,60mm and 2,40mm at 1st, 3rd and 6 months. The mean width of the keratinized gingiva was 6,60mm

and 7,46 mm at 1st, 3rd and 6 months. All those factors have been regenerated or increased at six months (27). In this article, first the semi-lunar incision played an important role to keep the gingiva in the new position and secondly, the connective tissue provided blood supply that improved the cicatrisation and regeneration of the tissue (27).

Another report using a similar technique proved in two observations that the percentage of reduction of the black triangle from 3 months to 6 months was 48,47% to 60,26% (28).

There was an increase of width of keratinized gingiva from the baseline (4,83mm) to 6 months (6,21mm) about 1,37mm. The technique showed a great gain of keratinized gingiva (28).

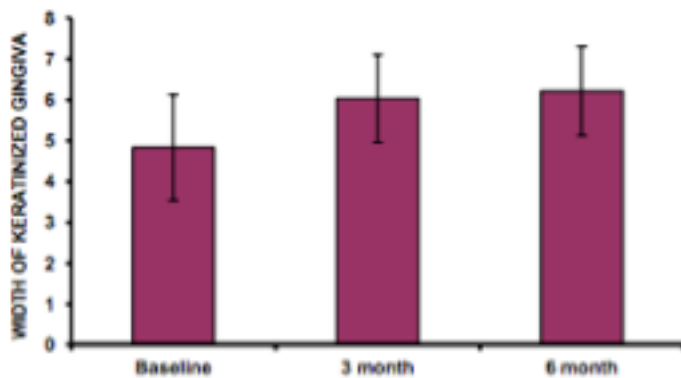


Figure 16: Evaluation of width of keratinized gingiva (28)

One of the undesirable effects was the gingival margin recession (28). The complete regeneration of the black triangle is not achieved (28).

Compared to the previous study, the reduction of the distance between the contact point and the gingival margin proved a better effect in the surgical manipulation than in the HA application (27,28). Also, in both studies, the effect in the long term has not been evaluated.

Concerning a study that used a microscope to improve the visibility and manipulation of the tissue, 13 cases with 20 sites in the upper anterior sector were chosen (29).

Over an observational period of 6 months, the papillary height (increased 1,63mm) and the keratinized tissue (gain of 0,84 mm) have been improved, there was not a significant difference in the value of the pocket depth and there was a horizontal reduction about 0,84mm. The interproximal bone level for these cases with complete fill varied from 5mm to 9mm (29).

Similar to the other cases, there was no evidence of predictability and few demonstrations of a long-term stability. A postoperative diastema was observed in certain patients after 2 weeks. This type of technique allows a delicate manipulation of the tissue and increases a good predictability (29).

The practitioner's experience will be then considered one of the major determining factors of success in microsurgery, the main cause of failure between the other techniques being due to the practitioner's behaviour (29).

Facing a study of Robert Azzi *et al.* about the utility of autogenous osseous to reconstruct the papilla (30). The objective of this technique was to regenerate the papilla through of the regeneration of the bone but to do it, the distance between the bone and the interdental contact point had to be 5mm or less to obtain a stable papilla(30). This technique used the autogenous bone graft to reduce the distance between the bone and the interdental contact point and subperiosteal connective tissue graft to increase the thickness of the vestibule (30).

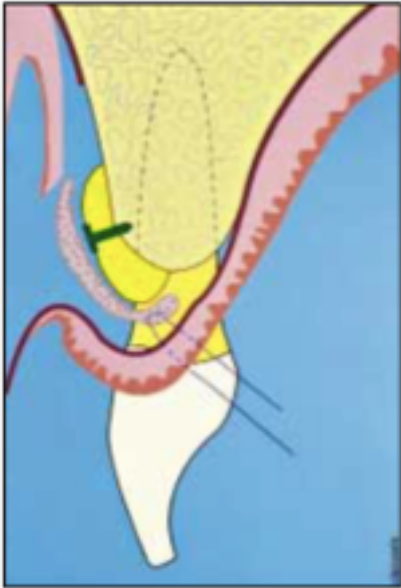


Figure 17: Autogenous osseous technique to reconstruct the papilla using connective tissue graft (30)

For one of the patients, the technique failed. The reason of the success of this technique depended on the cancellous bone for the bone grafting, the management of the double vascularisation and the ability of the practitioner (30).

Concerning this clinical case, there were 2 groups of 20 cases each, one performed the reconstruction of the papilla with Platelet-rich in Fibrin (PRF) (GROUP 1) and the other one with connective tissue graft (CTG) (GROUP 2). Regarding the restoration of the black triangle, Group 2 (95%) obtained better results than the Group 1 (90%). About the reconstruction of the height of the papilla, 3,10mm (87,3%) of gain was obtained in Group 1 against 3,45 mm (95,8%) in Group 2 (31). About the patient satisfaction post operatively it was seen that the Pink aesthetic score (PES) was higher for Group 2 for Group 1 (31,32). The case report clearly demonstrated that connective tissue graft obtained better result compared to PRF for reconstruction of the interdental papillae (31,32). The PRF produced less postoperative pain, better cicatrisation of the tissue and minimal surgical intervention. The connective tissue

graft (CTG) provided an increase of the thickness of the vestibule and better reconstruction of the interdental papilla (31).

About the technique using modified Beagle's technique (Group A) and Beagle's surgical technique (Group B) to observe the evolution of papillary reconstruction (33). At 6 months post-surgery, there was a reduction in the mean vertical dimension (25,59% decrease) and in the mesiodistal diameter (29,08% decrease) of the papillary defect in Group A, whereas there was a slight increase in the mean vertical dimension (29,43% increase) and in the mesiodistal diameter (27,82% increase) of the papillary defect in Group B (33). Moreover, better results were obtained concerning the increase of the papilla height and the distance between the bone crest-root apex in the Group A (33). In a word, the modified Beagle technique is more effective and obtained better results to reconstruct the interdental papilla (33).

Another case compared two surgical techniques: Azzi *et al.* and Han and Takei to reconstruct the interdental papilla using connective tissue graft. There were 2 groups: Group A (Azzi *et al.*) and Group B (Han and Takei) (34). This is a comparative study focused on the plaque score index, gingival index, presence of papilla and the papilla height (34). Concerning the plaque and gingival index there was a difference between the two groups at 12months (34). Moreover, the papilla height was reduced for the both groups at 12months, Group A (4,00mm) and Group B (4,5714mm). Finally, 7 patients were analysed and the interdental reconstruction was presented for 4 patients in Group A and for 3 patients in Group B (34). To conclude about these two techniques, there is not a better one compared to the other, both are very efficient to reconstruct the papilla (34).

Through the analysis of the study performed by Azzi *et al.* one can understand that their

main achievement was the blood supply brought by the connective tissue thanks to its graft (34). On the other hand, in the other technique achieved by Han and Takei, the authors performed a pedicle graft using a semi-lunar incision and doing a coronal displacement through the use of a section of the subepithelial connective tissue graft (34). Therefore, it can be stated that the blood supply provided by the Azzi *et al.* review could provide us with a greater improvement both clinically and better predictability because of the rich blood supply present in both buccal and palatal parts of the tissue (34). On the other hand, in the scientific article written by Han and Takei (34), the blood supply originates only from the base of the pedicle flap (34). Therefore it can be underlined that in this study the presence of the subepithelial connective tissue increases the success and the predictability thanks to its double vascularisation by the overlying flap and the periosteum (34).

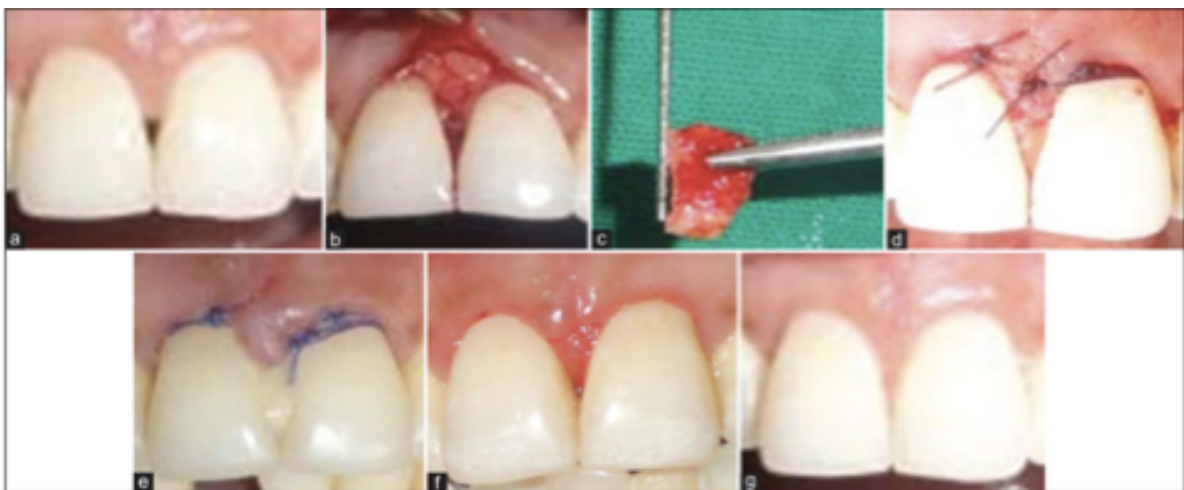


Figure 21: Group A (a) Papilla presence index (PPI) at the baseline (b) buccal reflection (c) connective tissue graft (d) 1 week post-operative (e) PPI at 6 months (f) PPI at 12 months (34)

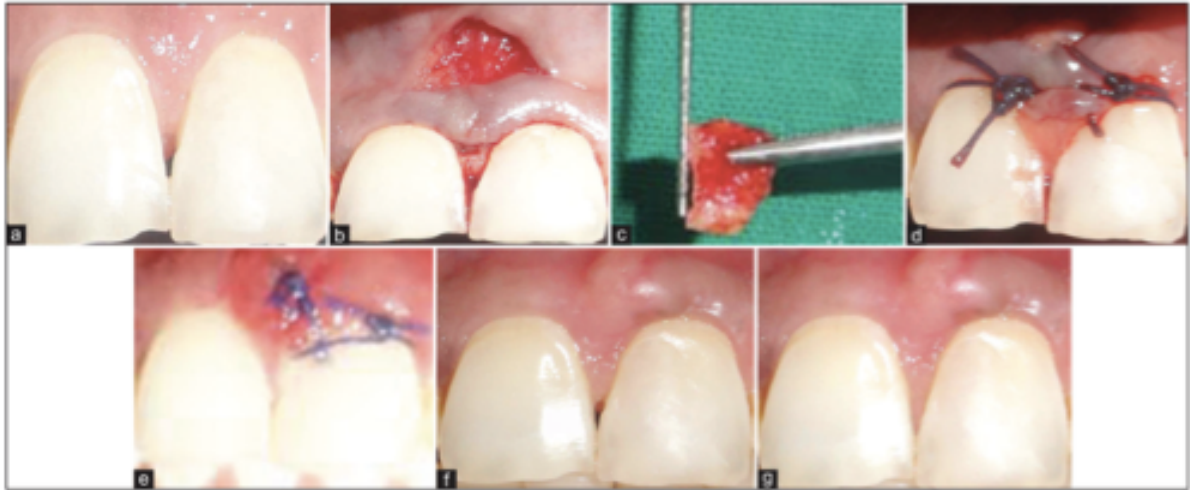


Figure 22: Group B (a) Papilla presence index (PPI) at the baseline (b) semi lunar incision (c) connective tissue graft (d) 1 week post-surgery (e) PPI at 6 months (f) PPI at 12 months (g) PPI at 12 months (34)

Facing the implant surgery, the objective was to evaluate a surgical approach to rebuild the papilla. The surgical technique consists of a U-shaped incision (35). The implant cover screw was consequently removed, and a healing abutment inserted (35). The flap was separated into 2 parts (mesial and distal) (35). Each portion of the buccal flap was placed over de-epithelized papilla and fixed to the palate (35). This technique is applied for interproximal papilla reconstructions adjacent to one implant maxillary restoration (35).

The case report of interproximal papillae reconstruction in maxillary implant shows that this technique produced an increase of the level of the papilla (35). It was concluded that there was an increase of 89% of the interproximal papilla. Compared to another report, it was observed that 58% of the papilla regenerate completely adjacent to single-implant after 1 to 3 years, without any manipulation or periodontal intervention of the soft tissue (35).



Figure 23 : buccal aspect of the ridge

prior to an implant. Noted a flattened proximal papilla (35)



Figure 24: Healing site after 6 months ,

Improved papillary form (35)

Let's compare to a randomized clinical trial using the modified roll flap (MRF) to increase the soft tissue in the aesthetic zone through a peri implant (36). The aesthetic score takes into account the papilla, colour, contour, surface texture and the ridge stability in vestibulopalatal direction (36). The case notified a postoperative pain (36). After 6 months, MRF group obtained implant aesthetic score (IES) of 7,7 whereas the control group (simple crestal incision) obtained a score of 6,3. Moreover, the MRF was effective after 3 and 6 months whereas the control group is effective directly after the intervention and the efficiency decreased after 3 and 6 months (36).

MRF was very efficient to increase the soft tissue thickness and improved the aesthetic level after 6 months (36).

Comparing the both techniques, the “u” shaped procedure preserved the height of the interdental papilla. On the other hand, the MRF improved the thickness of the soft tissue (thick biotype) and in the same time the aesthetic; including the papilla, colour, contour, surface texture and the ridge stability in labiopalatal direction (35,36).

The disadvantage of both techniques was that there were no studies in long term follow up (35,36).

In conclusion, the hyaluronic acid or the orthodontic technique could be used when there was a minimal defect. Non-surgical techniques need to be used especially in cases where patients are looking for minimal invasive approaches and when the practitioner considers that the case can be solved following this technique (24,25,26).

The interdental papilla is a relatively small region of tissue with a vascular supply originating from various sources, but having a unidirectional source from the base. This appears to be the key factor that limits surgical reconstructive and amplification techniques (24,25,26,27).

Concerning this surgical technique, subepithelial connective tissue gives a double vascularisation ensuring good graft integration and correction of root denudations, higher aesthetics, durability and less post treatment complications if they are used in adequate situations. However, success was limited because of the minimal source of blood at the level of the papilla (27,28,29).

Regarding the autogenous bone and connective tissue graft technique, it provided an aesthetic improvement, and a strong bone base to support the papilla, nevertheless it required a large interdental space and a very complex technique. However, there was a little clinical follow up and one failure could be observed in the three cases treated. It seems to be

one of the best techniques, the goal was to increase the bone level in order to reduce the presence of a papillary defect; in order to do so, the practitioners used a connective tissue (30).

Platelet-rich in fibrin maintained flap in position, subsequently reducing the necrosis of the papilla. It is a non-invasive technique which is easy to procure and it is inexpensive. It provides a very good healing; therefore, less postsurgical discomfort can be seen and less edema (31,32).

Concerning Beagle's technique (33), it performs a formation of the pseudo-pocket, therefore increasing the difficulty in making a small flap at the interdental level. The modified Beagle's technique is a less invasive, easier technique therefore offering better results (33).

The reconstruction of the papilla with semi-lunar incision of Han and Takei give a double vascularisation, ensuring good graft integration. It is indicated for weak papillary recessions even though it is a difficult technique as it has to perform a coronary traction and a conjunctive graft. The neoform papilla did not rest on any bone base (34).

About the regeneration of the papilla in the implant, the "u" shaped technique gives a good result, it is a possible technique for a single or multiple implant, needing little clinical retreat. Nevertheless, it requires great precision in the incision whereas the modified Beagle's technique allowed an increase in the amount of gum attached around the implant, the shape of the flap promoted a better vascularization and healing and it was a complex technique with little follow up (33,35,36).

Finally, the restoration of the papilla depends on the quantity of papilla destroyed, the level of bone present, and the useful appliance of the double vascularisation. All these factors influence and give a positive advantage for better restoration of the papilla.

All previous techniques will provide a satisfactory outcome and a high satisfaction of the patient if they are correctly handled and adapted to situations by the practitioner.

CONCLUSION

Current studies define the inter-proximal papilla poorly vascularized, small tissue, filling the interproximal spaces; thus, highlighting the necessity to provide it with specific care. Nevertheless, literature reviews emphasise on the presence of numerous treatment modalities in order to cure this defect, describing the presence of both non-surgical and surgical treatment options.

Therefore, as we previously discussed, clinicians can choose to treat their patients with a non-surgical technique, the latter will help the regeneration of the papilla through the performance of a non-invasive procedure. For instance, they include procedures such as hyaluronic acid injection and the practice of orthodontic treatment. Thus, the regeneration of the papilla will be slightly less important in non-surgical procedures than when using the surgical technique; however, postoperative complications will be fewer. It is therefore paramount to make all possible efforts to preserve the gingival papillae since the non-surgical techniques offer a higher conservation of them, while on the other hand, they will bring a minor regeneration of the papilla. Additionally, the non-surgical approaches preserve the interproximal space whereas the surgical ones regenerate and reconstruct the soft tissue between the teeth and /or the implant.

On the other hand, the use of surgical techniques such as sub-epithelial connective tissue graft with or without simultaneous use of autogenous bone graft, or platelet rich fibrin technique (PRF), offer a strong regeneration of the papilla. However, patients might present discomfort after the procedure, and the delicate and complex biological criteria of the papilla (its poor vascularization and the lack of bone support) interfere with the objectives of periodontal health and anatomical reconstruction sought by clinicians. Henceforth, clinicians

from different disciplines including periodontics, orthodontics, conservative dentistry and periodontal surgery, have offered various treatment plans to restore the papillae. Nevertheless, these studies are based on small samples and multiple variables are present. They do not offer long term scientific results; thus, a gold standard treatment protocol cannot be offered.

Multiple aetiological factors are involved in the loss of the dental papilla, thus the clinician should particularly take them into consideration as they could provide a consequent diverse treatment plan and outcome. Therefore, features such as for instance the gingival biotype, the patient's age and the severity of the periodontal disease have an important role in the success of the therapy. Additionally, the loss of attachment and the traumatic interproximal oral hygiene procedure are major actors that should be underlined.

While the numerous aetiological factors dealing with the presence or the absence of the papilla are well known, the considerations regarding the success in its regeneration still need to be studied thoroughly. For instance, it is essential to explain the multiple considerations that should be taken into account in order to achieve a both aesthetic and functionally adequate papillary restoration. These factors include features such as the presence or absence of an interproximal space between teeth, the various root shapes including if they are divergent or if they present dilacerations, as well as the distance separating the proximal contact point to the alveolar crest, and lastly, patients presenting atypical crown shape and tooth morphology. It is clear that the decision of using one technique over the other should be adapted to each case and clearly thought by the practitioner through the evaluation of the previous factors.

Nowadays, life expectancy has drastically increased worldwide therefore multiple

clinicians will be faced with young patients who might suffer from a loss of the dental papilla sooner or later ; therefore underlying the importance in the restoration of this loss. On the other hand, the multiple techniques present in the literature are based on samples made of young patients, therefore the studies need to be prolonged in a longer period of time in order to achieve pleasant and long-lasting results.

RESPONSIBILITY

The restoration of the dental papilla is a significantly broad topic which is constantly updating its contents and, mainly due to the latter, needs a constant review by the scientific community in order to confirm the great result achieved up to now.

The reason for conducting this review consists of the necessity of determining if the perfect therapeutic technique exist, seeking for the widest spectrum regarding the different available clinical procedures in order to try to establish a more definitive technique to use when it comes to choosing the finest for our patient.

The aim of the restoration of the dental papilla is to improve the smile of the patient by providing a higher degree of oral health and enhancing the aesthetics.

Regarding ecology, the methods used to regenerate the interdental papilla come from the patient (autologous graft) apart from certain materials such as dental floss or cotton.

From a social point of view, the objective sought is aesthetic. Indeed, not intervening in the treatment of the patient could have a negative impact on his social life. From an economic point of view it will be expensive for the patient because this treatment offer an aesthetic purpose.

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ANNEXES

Annex 1: Definition

Flap (pedicle): A loosened section of tissue separated from the surrounding tissues except at its base.

Pedicle Flap: A surgical flap with lateral releasing incision.

Double Papilla Pedicle Flap: The use of the papillae on the mesial and distal of a tooth as laterally positioned flaps sutured together over the tooth root.

Envelope Flap: A flap retracted from a horizontal linear incision, as along the free gingival margin, with no vertical incision.

Platelet-rich fibrin (PRF): a concentrated suspension of the growth factors found in platelets derived from centrifuged blood.

About the incision, we can use suture 3/0; 4/0; 5/0; 6/0. The most use in periodontal surgery is the suture 5/0 because it's thinner and thereby we manipulate more gently the papilla with less aggression of the tissue.

Annex 2: Clinical studies illustrating the advantages and the inconveniences of non surgical techniques to restore the papilla

Article	Methods	Technique used for the study	Result	Advantages	Disadvantages
Corte Sánchez et al. (24)	Clinical case report. Patient of 24 years old, loss papilla between the 11 and 21	Hyaluronic acid injection	Treat the black triangle and restore the volume of the papilla	Advisable technic when the distance between bone and contact point is 5mm or less. Papilla height does not exceed 4mm	Required more research
Abdelraouf et al. (25)	36 deficient interdental papilla sites in 10 patients	Hyaluronic Acid Gel injection in the reconstruction of interdental papilla from 3 to 6months	Decrease in height and surface area of black triangle The better result obtain is due to the high concentration and number of injections	Good aesthetic Increase the papilla height	Lack of evidence and predictability Compleat papilla fill could be achieved in the small defect

Annex 3: Surgical techniques used to restore the interdental papilla

Article	Methods	Technique used for the study	Result	Advantages	Disadvantages
Jhamb et al (27)	Lost of papilla in 10 healthy patients In maxillary anterior region	Using a subepithelial connective tissue graft from the palate with coronally displaced flap	Re-establish the level of interdental papilla	Predictable and an aesthetic regeneration Depend of the anatomical factors, bone loss, plaque inflammation	Not complete restoration of the papilla Small sample Small number of cases
Sharma et al. (28)	Lost of papilla in 11 healthy patients	Using a subepithelial connective tissue graft with coronally displaced flap	Regenerated the lost of interdental papilla	Predictable and an aesthetic regeneration Increased the width of keratinized gingiva	Not complete restoration of the papilla Follow up at 3 and 6 months Required more number of participants
Singh et al. (29)	13 cases with 2 sites in the maxillary anterior region were selected	Surgical microscope was used at 6X magnification Tunnelling + connective tissue graft Splinting of teeth to prevent diastema	5 sites showed complete papillary fill, 3sites were 1 mm deficient. Take into account: keratinized gingiva, pocket depth, facial recession	Improve the visual access to narrow interdental space Ability to handle delicately the papilla	Adverse surgical effect was diastema formation after 4 weeks Required more research Depend of the surgical skill of operator

Robert Azzi et al. (30)	26 years old man	Autogenous bone graft from the maxillary tuberosity and subepithelial connective tissue graft	Decrease the distance between the interdental bone crest and contact point to improve the periodontal biotype	Rectify the level of papilla but not in the totality Improve the biotype of the patient	Predictability is still a problem Difficulty to pronounce certain alphabets Possible recession after surgery
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Annex 4: Comparative studies to determine which one is more effective than another

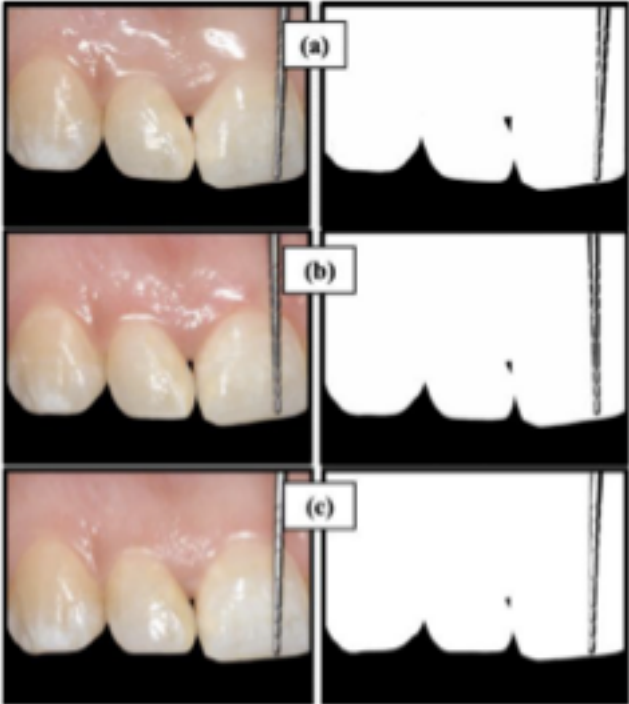


Article	Methods	Technique used for the study	Result	Advantages	Disadvantages
Shaik et al. (31)	2 groups of 20 cases each, one performs the reconstruction of the papilla with PRF (GROUP 1) and the other one with CTG (GROUP 2). The aim is to compare the efficiency of the PRF and CT to restore the interdental papilla	Two types of techniques have been used the PRF and CTG	Better result obtained with the CT, but both technique increase and restore the interdental papilla on 3 months follow up	CT: increase the volume, maintain adequate thickening of the existing gingiva and reconstruction Survival of the CT is based on the vascularisation PRF: less invasive method, less post operative pain, promotes rapid soft tissue healing	Short follow up Law sample size Lack of histologic evaluation Lack of radiographic assessment

<p>Sundaram et al. (33)</p>	<p>20 sites including patients from 20 to 50 years old, 2 groups</p> <p>Comparison of the efficiency of the 2 techniques</p> <p>Follow up: 1week, 1month, 3months, 6months</p>	<p>Group A: modified Beagle's technique</p> <p>Group B: the Beagle's surgical technique</p>	<p>Group A better result than Group B, increase of the height of the papilla, distance between the bone crest and the root apex</p>	<p>Modified Beagle's technique: easy and effective technique compared to the Beagle's surgical technique</p> <p>Both techniques can be used to reduce the vertical dimension and the mesiodistal dimension of the papillary defect, Increase the height of the papilla</p>	<p>At 6 months reduction of the height of the papilla and the distance bone crest-root apex distance</p>
<p>Shruthi et al. (34)</p>	<p>Compare two techniques for the reconstruction of the papilla using connective tissue graft</p>	<p>Robert Azzi and Han and Takei using Connective tissue graft</p>	<p>Better result by Robert Azzi due to rich blood supply generate by the graft from buccal and palatal flap whereas Han and Takei obtain blood supply from the base of the pedicle</p>	<p>Role major of the connective tissue graft to restore the interdental papilla</p> <p>Focused on the evolution of the plaque and gingival score index, papilla presence index and papillary height</p>	<p>Failure of few cases Sometime the black triangle can be restored Viability of donor tissue play an important role in the reconstruction Biotype influence the reconstruction More longer follow up</p>

Annex 5: Clinical cases illustrating the preservation and the restoration of the papilla in subjects with implant placements

Article	Methods	Technique used for the study	Result	Advantages	Disadvantages
Nemcovsky et al. (35)	32 patients, with 36 implants. U shaped periodontal plastic surgery procedure to preserve and restore the interdental papilla in maxillary implants	U shaped periodontal surgery	Increase of the interproximal papillae in 89% of the cases.	Useful for partial or total interproximal reconstruction adjacent to implant, easy to perform, increase the interdental papillary height	Technique not indicated when apical repositioning of the mucogingival junction is needed due to the presence of the inadequate buccal masticatory mucosa Recession was noted
Barakat et al. (36)	12 patients aged from 20 to 50 years old. All patients present missing tooth in the aesthetic zone and thin gingival biotype 2 groups: one control using crestal incision and the other using MRF	MRF was used to increased the aesthetic zone and restore interdental papilla	MRF group compare to the control group show a better aesthetic and thickness at 3 and 6 months	MRF better aesthetic and better thickness of vestibular part, minor postoperative pain and edema Minor pain post-operative Increase biotype of the peri implant tissue. Taking into account: papilla, colour, contour, surface texture and the ridge stability in labiopalatal direction	Deficiency of literature Problem of donor site morbidity about connective tissue graft of the palate, anatomic limitation

Annex 6: Comparative pre-operative and post-operative pictures of the previous described techniques

<p>Hyaluronic acid technique</p>	 <p>Figure 25</p>
<p>Subepithelial connective tissue graft for reconstruction of interdental papilla</p>	 <p>Figure 26: Preoperative view of the papilla</p>  <p>Figure 27: 6 months follow up</p>

Modified Beagle's technique VS Beagle's technique

Pre-operative
Modified
Beagle's
technique



Figure 30

Modified
Beagle's
technique at 6
months follow
up



Figure 31

Pre-operative
Beagle's
technique



Figure 32

Beagle's
technique at 6
months follow
up



Figure 33

ROBERT AZZI VS HAN AND TAKEI

Robbet AZZI
technique
Picture A:
preoperative
papilla
Picture G: 12
months follow
up

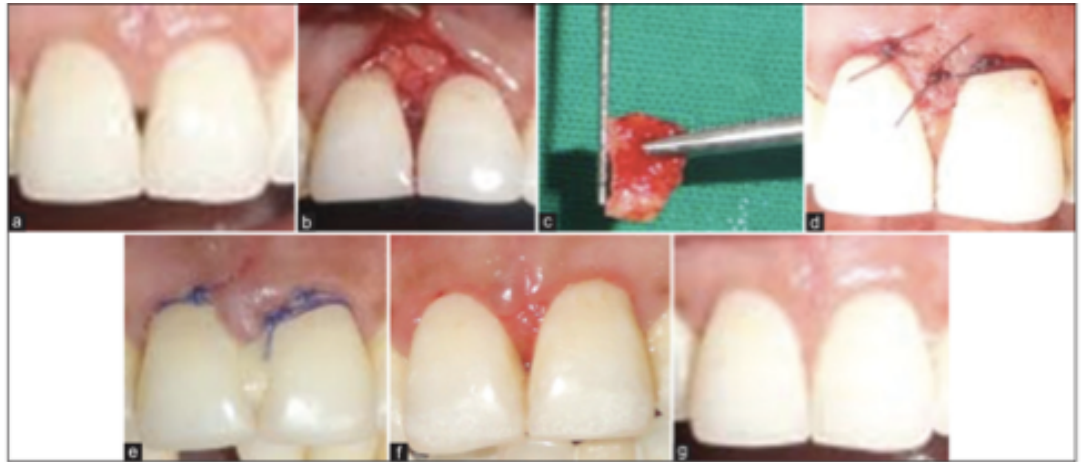


Figure 34

HAN and
TAKAI
technique
Picture A:
Preoperative
papilla
Picture G: 12
months follow
up

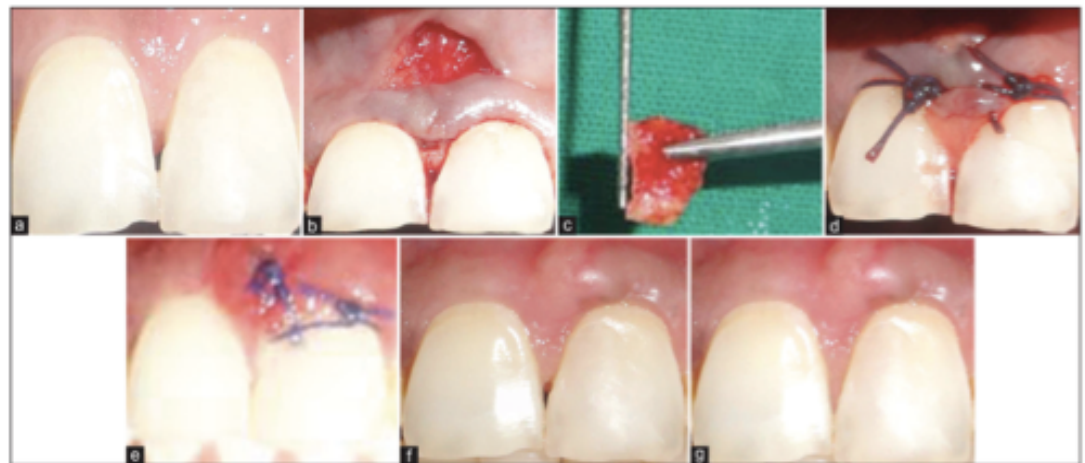


Figure 35

Interproximal Papillae Reconstruction in Maxillary Implants

View of the papilla prior to implant insertion



Figure 36

View of the papilla 6 months follow up after the implant placement



Figure 37

Treatment of Interdental Papilla: A Review

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ABSTRACT

Current dentistry involves both functional and esthetics role. Gingival Recession and loss of Interdental papilla results in Gingival Black Triangle, which is esthetically displeasing. Interdental papilla loss is strongly associated with increasing age, periodontal diseases and post orthodontic treatment. To achieve reconstruction of the lost interdental papilla is difficult and challenging, as it is associated with the patient smile and esthetics. Absence of interdental papilla raises concern over phonetic problems, food and plaque accumulation, which further deteriorates the present condition along with esthetic problems. Various treatment options for papilla loss are present which involves non-surgical approach (oral hygiene procedures), prosthetic restorations and surgical procedure for increasing tissue volume. The present review discusses the different classifications of papilla loss, etiology associated with open gingival embrasures and all currently available nonsurgical and surgical treatment modalities recommended for papilla preservation and reconstruction.

Keywords- Interdental Papilla, papilla preservation, papilla reconstruction, papilla regeneration, black triangle.

INTRODUCTION

Interdental papilla represents a small visible area present in-between teeth and gingiva of the oral cavity. Interdental papilla plays an important role in esthetics due to its strong association with the patient smile. Gingival black triangle (GBT) is a cosmetic deformity which refers to an absence of papilla resulting in black spaces or open embrasures which impairs esthetic features,

phonetics problems and food accumulation.^[1-3] In the absence of contact point, the color disappears leading to black, pyramidal shape formation.^[4] Apart from its functional role, increasing public demand for esthetics, place huge pressure on modern clinical dentistry to restore any lost 'white' and 'pink' esthetics. White esthetics denotes natural teeth and pink refers to gingival tissues surrounding the teeth. Balance between soft tissue and teeth adjacent to it with minimal or no tissue deficiencies is key for stable dentition.

The main objective of periodontal therapy is 'prevention of progression of periodontal disease and associated trauma by regeneration of the lost periodontal tissues'.^[5-7] Though several surgical techniques have been constantly proposed and experimented, they are mostly invasive and unpredictable.^[8] Moreover, the success rate of surgical augmentation of papilla relies on the thickness of gingiva biotype.^[9] Hence, a number of nonsurgical, minimally invasive techniques have been developed to preserve and restore interdental papilla. Though many solutions have been proposed to correct lost interdental tissues, no golden standard technique is followed so far due to the absence of long-term clinical results and predictability. The present review discusses the various classifications of papilla loss, etiology associated with Gingival Black Triangle and currently available nonsurgical and surgical treatment modalities recommended for papilla preservation and reconstruction.

Management of inter-dental/ inter-implant papilla

Zetu L, Wang H-L. Management of inter-dental/inter-implant papilla. *J Clin Periodontol* 2005; 32: 831–839. doi: 10.1111/j.1600-051X.2005.00748.x. © Blackwell Munksgaard, 2005.

Abstract

Objectives: The aims of this paper are to review and compare existing techniques for creation of interdental/interimplant papillae, to address factors that may influence its appearance and to present an approach that authors developed that could help clinicians to manage and recreate the interproximal papillae.

Methods: Papers related to interdental and interimplant papillae published over the last 30 years were selected and analyzed.

Results: Thorough treatment planning is essential for maintenance of the height of the interproximal papillae following tooth removal. The key for achieving an esthetically pleasing outcome is the clinicians' ability of properly managing/creating interdental/interimplant papillae. **Bone support is the foundation for any soft tissue existence; techniques such as socket augmentation, orthodontic extrusion, guided bone regeneration, only graft and distraction osteogenesis are often used for this purpose.** Soft tissue grafts as well as esthetic mimic restorations can also be used to enhance the esthetic outcomes.

Conclusions: An esthetic triangle is developed to address the foundations that are essential for maintaining/creating papilla. These include adequate bone volume, proper soft tissue thickness as well as esthetic appearing restorations.

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Key words: bone grafts; dental implants; esthetic; guided bone regeneration; interdental/inter-implant papillae; monocortical bone graft; papillae; soft-tissue grafts

Accepted for publication 17 November 2004

Inter-dental papilla is the gingival portion, which occupies the space between two adjacent teeth. Morphologically, the papillae had been described first in 1959 by Cohen (1959). Before this time, interdental papilla was considered as a gingival trait having a pyramidal shape and functioning as a deflection of the interproximal food debris. Now it is clear that the physiology of the papilla is more complex. It not only acts as a biological barrier in protecting the periodontal structures, but also plays a critical role in the aesthetics. Hence, it is very important to respect papillary integrity during all dental procedures and to minimize as much as possible its disappearance.

Over the past 30 years, replacing missing teeth with dental implants

became a viable solution to fixed or removable prosthodontics (Brånemark et al. 1977, Adell et al. 1981, Esposito & Worthington 2003). Better understanding of the osseointegration process makes implant rehabilitation no longer a vehicle to restore lost masticatory and phonetic function, but it has become a multi-million industry driven by the bone augmentation, soft-tissue management and aesthetic restoration. Patients have come to expect aesthetically pleasing restorative treatments and have questioned the disappearance of inter-implant papillae (so-called "black triangles disease"). Therefore, many soft- and hard-tissue management techniques were developed to overcome this problem.

Numerous studies have attempted to determine the condition in which papilla would appear and ways to regenerate it. The aims of this review are to evaluate the factors that influence inter-dental/inter-implant papillae, to discuss and

compare techniques that are currently available and to present the approach that the authors developed that could help clinicians to manage/regenerate the inter-proximal papillae.

Anatomy of the Inter-dental/Inter-implant Papilla

In order to understand the factors involved in maintaining the dental papilla, a systematic review of the anatomy is to be included. Gingiva is that part of the mucosa that has an intimate rapport with the dental elements, the interdental space and the alveolar bone. Topographically, the gingiva has been divided into three classic categories: free, attached and inter-dental gingiva. In fact, this subdivision is not needed since we describe gingiva as an anatomical and functional complex with a different shape and topography resulting from the

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The Periodontal Ligament: Development, Anatomy and Function

Rabia Dean

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Abstract

This paper will explore the origin and development of the periodontal ligament (PDL), its anatomical structure and function. The developmental process and anatomy of the ligament is quite complex and some aspects are still unknown, for example the way that ligament lineages develop and are regulated have yet to be clarified. The ground substance will be discussed, as well as the vascular and neural supply, the fibres present, their orientation and the various cell types present in the ligament. There have been recent advances in PDL stem cell research. This area is rapidly growing and can have a huge impact from harnessing these cells to utilise in an array of medical uses. The ligament has several essential functions, which can be highlighted by any deviations from the healthy norm. This can result in retardation of the ligament structure and functional capability. For instance, trauma can result in dental ankylosis, which may disrupt the vital eruptive function of the ligament.

Key words: Periodontal ligament, Oral biology, Development, Structure, Anatomy, Function

Introduction

The periodontal ligament is a unique specialised connective tissue between the cementum covering the tooth root and the alveolar bone. It is derived from the dental follicle region, which originates from the cranial neural crest cells [1]. The ligament has an array of oriented fibres and is vascular. It is also highly cellular, for example it contains PDL fibroblasts, osteoblasts and cementoblasts [2]. The ligament is crucial as it protects, supports and provides sensory input for the masticatory system. It also maintains homeostasis and repairs tissue destruction caused by periodontal disease or mechanical trauma [3].

Origin and development

The PDL is produced mainly from fibroblasts before dental eruption, which originate in the dental follicle and start to differentiate during root development [4]. The dental follicle is a condensation of the ectomesenchymal tissue - its cells differentiate into cementoblasts during their apical development and form the cementum lining the surface of the root [5].

Firstly, collagen fibres become embedded in the cementum and Sharpey's fibres are laid down coronally within the PDL region. The initial orientation is nearly parallel to the root surface. Fibres are formed and deposited from the developing cemento-enamel junction (CEJ) to the tooth's apex. The fibres that are deposited apical to the CEJ form the ligament. Fibres insert themselves within the cementum matrix from the CEJ and continue in a coronal direction, after a third of root formation. This process closely follows the outline of the newly formed crown. At this stage, none of the collagen fibres insert into the alveolar bone.

Loosely arranged fibres continue to deposit and insert along the developing root surface. Opposite to this surface, the fibres also insert along the lining of the bony socket wall and cross the ligament space in a similar way to the root side fibres. The root and bone side fibres will eventually come together in the middle of the ligament space to form the immediate plexus. Initially, the fibres are positioned parallel to the surface of the root, but this orientation dramatically

changes as the teeth erupt [6] and may be a result of the positional relationship of the erupting tooth to the teeth adjacent [7].

During eruption, the dentogingival fibres align themselves from the CEJ in the occlusal direction, which then terminate in the gingiva connective tissue. The transseptal fibres extend over the alveolar crest in an oblique direction towards the surface of the adjacent developing tooth root. The fibres of the cervical-most one-third of the root surface run obliquely in the apico-occlusal direction from cementum to bone. They become more defined, although there is still no direct connection from the root and bone fibres in the mid-third of the root. The root is still to be made in the apical portion, therefore fibre arrangement is poorly developed.

When there is full eruption and occlusal contact, the ligament fibres take on their final arrangement. The dentogingival, transseptal and alveolar crest fibres all originate at the CEJ. The fibres are arranged horizontally within the coronal-third of the surface of the root. In the mid-third of the root, the fibres run obliquely from the occlusal surface to the alveolar bone. The apical-third maintain an oblique configuration, but the fibres run apically from the cementum surface to the alveolar bone [6,7].

Ligament formation in the teeth with and without primary predecessors differs in structure. Grant et al. [5] found that the way that ligament is formed in deciduous teeth differs from succedaneous teeth. Both classes of teeth follow the same stages, therefore they are not unique. However, the timing of development is delayed for secondary teeth. The succedaneous premolar only shows a few fibre extrusions from the cementum during the pre-eruptive stage. No fibres are apparent from bone. Most of the PDL space is filled with loose collagenous elements. The permanent molar has well defined predentogingival and alveodental fibres, which extend between bone and cementum. Upon eruption, the succedaneous tooth only shows organised dentogingival, alveolar crest and horizontal fibres, leaving the rest of the ligament in developing stages. During initial occlusal contact, the succedaneous premolar shows organised and continuous alveodental fibres for the coronal two-thirds of the root. The principal fibre formation is still progressing in the apical one-

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Soft tissue enhancement around dental implants

PATRICK PALACCI & HESSAM NOWZARI

Peri-implant plastic surgery aims at improving the esthetic aspects of smile appearance and masticatory function. Enhancement of the esthetic appearance can lend significant support to patients wishing to experience more effective and successful interactions with others in personal, social and workplace situations. This article reviews pre-implant anatomic features that influence the outcome of dental implant therapy and presents a range of surgical modalities aimed at enhancing the appearance of peri-implant soft tissue.

Peri-implant plastic surgery

Definition

Peri-implant plastic surgery focuses on harmonizing peri-implant structures by means of hard tissue engineering and soft tissue engineering, and includes: bone structure enhancement; soft tissue enhancement; precision in implant placement; and quality of the prosthetic restoration.

The rationale for the peri-implant plastic surgery approach goes well beyond pure esthetics to address issues of quality-of-life and the psychosocial wellbeing of patients. Peri-implant plastic surgery is also important for creating peri-implant keratinized mucosa and interimplant soft tissue height in order to avoid food impaction, interimplant airflow and speech problems.

Limitations

Psychological factors

Implant dentistry contributes to the restoration of oral function and beauty, but may occasionally fail to meet very high patient expectations. Much of what comprises a beautiful and appealing smile is influ-

enced by emotion and personality (28, 48). Patients in a modern, affluent society often demonstrate an obsessive interest in achieving unrealistic beauty forms (12, 14, 43). It is essential to understand that dental implants do not provide a perfect treatment outcome for all patients. Replacement of anterior teeth with conventional fixed partial dentures or with resin-bonded restorations may sometimes accomplish equal or even better esthetic results. Appropriate dentist-patient communication and documentation is necessary in order to prevent unrealistic expectations and misunderstandings (39, 47).

Health vs. esthetics

While dental implants can improve a poor esthetic appearance (28, 48), which may handicap individuals and negatively interfere with function, livelihood and social interactions (43), the most important goal of peri-implant interventions is to alleviate and prevent morbidity, such as mucosal inflammation and peri-implantitis. The interaction between potential pathogenic agents and the host immune response determines the health status around teeth as well as dental implants (35). Virulence factors of periodontopathic bacteria trigger the release of pro-inflammatory cytokines from oral mucosal cells and the release of collagenase and other matrix metalloproteinases from gingival fibroblasts. The design and the composition of dental implants are thought to affect local host-parasite interactions (8, 29, 34–36). However, the features of implant design that affect the height of bone and soft tissue around implants have still not been fully identified (20).

Interimplant anterior scalloped papilla

Peri-implant mucosal height essentially follows the crest of the alveolar bone; however, the determining factors in interimplant papilla development are complex and may not be fully controlled by implant

Natural Tooth Versus Implant: A Key to Treatment Planning

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Since time immemorial, man has constantly contrived to replace natural body parts that are either congenitally absent or lost subsequent to disease or injury, so as to maintain a perfect amalgam of form and function. Dental implants have recently become established as a standard treatment protocol for replacing missing teeth. Ostensibly, a dilemma has arisen whether the implant should obviate the necessity to preserve teeth with debatable restorative prognosis. This article attempts to review the work done hitherto and to formulate a combined perspective in such cases.

Key Words: natural tooth, implant, treatment

INTRODUCTION

The only constant in life is change.
—Heraclitus, Greek philosopher

The goal of modern dentistry is to restore normal contour, function, comfort, esthetics, speech, and health, regardless of the atrophy, disease, or injury of the stomatognathic system. For decades, the underlying objective of preserving natural dentition has provided the foundation for clinical decision making in dentistry. To patients and practitioners alike, tooth extraction has been relegated to be a last-ditch attempt when all other possible options fail. However, current trends in implant dentistry have made inroads in this age-old paradigm. A practitioner's attention is now being drawn toward providing tooth substitutes, often touted as equal or even superior to natural teeth, and many clinicians have moved swiftly to adopt

implant dentistry as the new standard of care, so much so that the rapidity of this shift has actually come to be a cause for concern.¹ While it is true that implant dentistry holds a great deal of promise, when posed with a choice between endodontic treatment and implants, a cautious approach to embracing this technology has to be followed, especially since a dental implant is an invasive procedure, is financially more demanding to the patient, and involves the psyche of living with a foreign material within oneself.

AN IMPLANT IS NOT A TOOTH: A GUIDELINE TO TREATMENT PLANNING

Implants are fundamentally different from natural teeth in that they do not decay, have no dental pulps to function as early indicators of disease, and have no periodontal membrane. The factors involved in the decision-making process regarding whether a tooth should receive endodontic treatment or be extracted and replaced by an implant pertain to the patient, the tooth and periodontium, and treatment-related considerations.²

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DOI: 10.1563/AAID-JOI-D-10-00108

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THE RELATIONSHIP OF FACIAL ANATOMIC LANDMARKS WITH MIDLINES OF THE FACE AND MOUTH

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Statement of problem. The importance of the midline is well known to dentists. Currently, there are no verifiable guidelines that direct the choice of specific anatomic landmarks to determine the midline of the face or midline of the mouth.

Purpose. The purpose of this study was to determine the hierarchy of facial anatomic landmarks closest to the midline of the face as well as midline of the mouth.

Material and methods. Three commonly used anatomic landmarks, nasion, tip of the nose, and tip of the philtrum, were marked clinically on 249 subjects (age range: 21-45 years). Frontal full-face digital images of the subjects in smile were then made under standardized conditions. A total of 107 subjects met the inclusion criteria. Upon applying exclusion criteria, images of 87 subjects were used for midline analysis using a novel concept called the Esthetic Frame. Deviations from the midlines of the face and mouth were measured for the 3 clinical landmarks; the existing dental midline was considered as the fourth landmark. The entire process of midline analysis was done by a single observer and repeated twice. Reliability analysis and 1-sample t tests were conducted at alpha values of .001 and .05, respectively.

Results. The results indicated that each of the 4 landmarks deviated uniquely and significantly ($P < .001$) from the midlines of the face as well as the mouth.

Conclusions. Within the limitations of the study, the hierarchy of anatomic landmarks closest to the midline of the face in smile was as follows: the midline of the oral commissures, natural dental midline, tip of philtrum, nasion, and tip of the nose. The hierarchy of anatomic landmarks closest to the midline of the oral commissures was: natural dental midline, tip of philtrum, tip of the nose, and nasion. These relationships were the same for both genders and all ethnicities classified. (*J Prosthet Dent* 2009;102:94-103)

Presented as a table clinic at the American Academy of Fixed Prosthodontics meeting, February 2009.

Supported by the Tylman Grant award, American Academy of Fixed Prosthodontics.

Third place winner of the Academy of Prosthodontics Foundation award.

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The Influence of the Distance from the Contact Point to the Crest of Bone on the Presence of the Interproximal Dental Papilla

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Chiu-Po Chan³, DDS

Background: Loss of the interproximal dental papilla may cause functional and, especially in the maxillary anterior region, phonetic and severe esthetic problems. The purpose of this study was to investigate whether the distance from the contact point to the bone crest on standardized periapical radiographs of the maxillary anterior teeth could be correlated with the presence of the interproximal papilla in Taiwanese patients.

Methods: In total, 200 interproximal sites of maxillary anterior teeth in 45 randomly selected patients were examined. Selected subjects were adult Taiwanese with fully erupted permanent dentition. The presence of the interproximal papilla was determined visually. If there was no visible space apical to the contact area, the papilla was recorded as being present. The distance from the contact point to the crest of bone was measured on standardized periapical radiographs using a paralleling technique with a RinnXCP® holder.

Results: Data revealed that when the distance from the contact point to the bone crest on standardized periapical radiographs was 5 mm or less, the papillae were almost 100% present. When the distance was 6 mm, 51% of the papillae were present, and when the distance was 7 mm or greater, only 23% of the papillae were present.

Conclusion: The distance from the contact point to the bone crest on standardized periapical radiographs of the maxillary anterior teeth is highly associated with the presence or absence of the interproximal papilla in Taiwanese patients, and is a useful guide for clinical evaluation.
(*Chang Gung Med J* 2003;26:822-8)

Key words: contact point, alveolar crest, interdental papilla.

The concept of biologic width proposed by Garguilo⁽¹⁾ was derived from a histologic description of the so-called dentogingival complex.⁽²⁾ The measurement was established after a study of autopsy specimens, in which the average width of

the dentogingival complex was established. It has been shown that the average dimension of the dentogingival complex in natural teeth is 3mm at the facial aspect and 4.5mm at the interproximal aspect.⁽¹⁻⁴⁾

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Received: Mar. 18, 2003; Accepted: Jun. 24, 2003

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THE INTERPROXIMAL HEIGHT OF BONE: A GUIDEPOST TO PREDICTABLE AESTHETIC STRATEGIES AND SOFT TISSUE CONTOURS IN ANTERIOR TOOTH REPLACEMENT

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Enhanced aesthetic objectives can be achieved with precision and predictability due to recent advances in restorative materials and procedures. Although these developments have expanded the therapeutic options available to practitioners and their patients, anterior hard and soft tissue deformities in the aesthetic zone continue to represent a significant technical challenge to the reconstructive team. The objective of this article is to present diagnostic and prognostic criteria that emphasize the osseous-gingival relationship as a means to achieve predictable aesthetic results in the anterior segment with conventional or implant-supported restorations.

The refinement of adhesive technology and contemporary restorative systems has enabled restorative teams to deliver significantly improved aesthetic restorations. These technological advances have enhanced the clinician's ability to optimize the aesthetic display of discolored,

malaligned, or deficient tooth structure in an otherwise harmonious and intact periodontium. In the presence of anterior hard and soft tissue deformities, however, the selection of even the most advanced restorative materials often proves inadequate in solving aesthetic dilemmas commonly associated with trauma, periodontally compromised teeth, multiple tooth loss, or deformed edentulous spans within the aesthetic zone (Figure 1). The development of aesthetically successful treatment plans for patients in this category is consequently more complex and requires a broader perspective that must be explored in greater detail.

Since various modalities can be utilized to perform anterior tooth replacement in each patient, the determination of a single strategy to effectively direct aesthetic restorative treatment has proven elusive. Clinicians generally agree that successful restoration requires a thorough understanding of the varied components responsible

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Figure 1. Severe soft tissue defect and loss of interproximal papilla following a failed guided tissue regenerative procedure. The underlying bone is deficient and incapable of supporting the papilla.

The peri-implant esthetics: An unforgettable entity

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Abstract:

Esthetic demands in today's world of dentistry are scaling new heights, and are driven by the zeal to look beautiful. The soft tissue esthetics around implants is the fool of attention, which, if failed to meet, leads to unacceptable esthetic failure. The aim of this article is to give a brief overview of the various vital parameters influencing the esthetics governing the peri-implant area.

Key words:

Peri-implant esthetics, soft tissue esthetics, peri-implant soft tissue, anterior implant esthetics

INTRODUCTION

The common esthetic factor in today's world of implant dentistry talks about the soft tissue profile. During the advent of the framework system, the esthetic requirement was not taken into consideration for many years. Palacci was the first clinician to consider the esthetic problem in relation to the peri-implant zone in the anterior region of the mouth.¹ Today's world of implantology not only talks about the appealing prosthetic restorative options but also esthetics that are identical to the contralateral natural healthy teeth and the gingival outline harmonious with the gingival silhouette of the adjacent teeth.

The peri-implant zone primarily comprises of the crestal bone and the healthy soft tissue around it. They are considered necessary for the long-term success of implant-supported restorations. If these two parameters are respected, implant therapy can be a reliable treatment with an impressive outcome.² The primary function of a soft tissue barrier at implants is to effectively protect the underlying bone and prevent ingress of microorganisms and their products. Rationale for the peri-implant soft tissue is: It acts as a transmucosal seal, it resists recession with predictability and enhances an ideal esthetic blending, provides a prosthetic-friendly environment to withstand the mechanical challenge and provides appropriate contours that facilitate a self-cleaning environment.

TOOTH VERSUS IMPLANT: THE BIOLOGIC DIFFERENCES

The peri-implant esthetics is primarily contributed by the dental papilla and the adjoining marginal gingiva. The peri-implant

papilla primarily is the anatomical entity that houses beneath the contact point of the natural tooth and an implant or two adjacent implants. The mucosa that encircles the implant has more of collagen and fewer fibroblasts as opposed to gingival tissues. The collagen fiber bundles run parallel to the titanium surface without attaching to it versus the perpendicular direction around the tooth.³ Poor vascular supply is present in the peri-implant tissues than in the natural teeth. Location of the biologic width is yet another significant difference between them. The implant has the biologic width positioned subcrestally as opposed to the supracrestal formation around the tooth. This subcrestal formation of biologic width results in loss of the interproximal bone. Lack of cementum around the implant has collagen fibers arranged parallel to the tooth surface vs. the perpendicular arrangement around the tooth. Peri-implant tissues are similar to the periodontium, with a junctional epithelium containing basal lamina and hemidesmosomes and connective tissue fibers.

FACTORS GOVERNING THE PERI-IMPLANT ESTHETICS

Factors governing the peri-implant esthetics are the peri-implant marginal bone and the peri-implant papilla.

The peri-implant marginal bone

The peri-implant marginal bone is governed by the following parameters: Biologic width, the concept of platform switching, implant design in the cervical region, thread geometry, insertion depth and the microlesions produced by the second-stage prosthetic intervention.⁴ A stable bone level around the implant neck is a prerequisite for achieving the support and hence long-term optimal and stable gingival contour.



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Submission: 10-08-2010
Accepted: 17-04-2011

Vertical Distance from the Crest of Bone to the Height of the Interproximal Papilla Between Adjacent Implants

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Background: As patient demand increases for more natural restorations in the esthetic zone, clinicians must have the highest level of skill and knowledge to maintain or reform the interdental papilla between teeth, between implants and teeth, and between adjacent implants. To date, there are no reports that have measured the distance from the contact point to the bony crest between implants. One reason for this may be the fact that, with two adjacent implants, the contact point of the crown can be established at any distance from the gingival margin according to the restorative dentist's specifications. Therefore, in this study, the height of the soft tissue to the crest of bone was measured between two adjacent implants independent of the location of the contact point. The purpose of this study was to determine the range and average height of tissue between two adjacent implants.

Methods: A total of 136 interimplant papillary heights were examined in 33 patients by eight different examiners in five private dental offices. After administration of appropriate local anesthesia, a standardized periodontal probe was placed vertically from the height of the papilla to the crest of bone. The measurements were rounded off to the nearest millimeter.

Results: The mean height of papillary tissue between two adjacent implants was 3.4 mm, with a range of 1 mm to 7 mm.

Conclusions: Clinicians should proceed with great caution when placing two implants adjacent to each other in the esthetic zone. In most cases, only 2, 3, or 4 mm of soft tissue height (average 3.4 mm) can be expected to form over the interimplant crest of bone. These results showed that modification of treatment plans may be necessary when esthetics are critical for success. *J Periodontol* 2003;74:1785-1788.

KEY WORDS

Dental esthetics; dental implantation; dental papilla/anatomy and histology; soft tissue/anatomy and histology.

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The presence or absence of the interdental papilla between teeth, between implants and teeth, and between adjacent implants has received much attention in the past decade. With increasing demands for more natural-looking restorations in the esthetic zone, clinicians must maintain a high level of skill and knowledge.

A clinical study related the presence or absence of the papilla between two teeth to the distance from the crest of bone to the contact point between the teeth.¹ When this distance was 5 mm or less, the papilla completely filled this space almost 100% of the time. When the distance was 6 mm, the interdental space filled about 55% of the time; and at 7 mm, the interdental space was completely filled about 25% of the time.

When an implant is placed adjacent to a tooth, a <5 mm distance between the contact point and the crest of bone shows similar results regarding presence or absence of papilla to that between two adjacent teeth. Grunder presented 10 case reports of single-tooth implants and stated that all the papillae reformed after the final crowns were placed on the implants.² The critical factors in all 10 cases were 1) the existence of healthy bone on the adjacent tooth and 2) the location of this bone at a distance of 5 mm or less from the contact point. Grunder's study agreed with earlier research findings of the existence of the papillae between two teeth. It was interesting to note that the vertical position of the implants did not determine the

Original Article

A Comparative Evaluation of Height of Interdental Papilla around Noris Tuff TT and Nobel Active Dental Implants placed in Maxillary Anterior Region

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ABSTRACT:

Background: Interdental papilla height is important as esthetic factor for dental implant success. The present study was conducted to compare the amount of soft tissues around Noris Tuff TT and Nobel Active dental implant systems. **Materials & Methods:** The present study was conducted on 28 patients (males- 13, females- 15) who received 32 dental implants in maxillary anterior region. Group I patients received Nobel Active dental implants and Group II patients received Noris Tuff TT dental implants. In all patients, interdental papilla was evaluated using JEMT index. The amount of bone loss in both groups was evaluated using paired and unpaired t-test. **Results:** The amount of bone loss around dental implants in both groups did not show significant difference ($P > 0.05$). There was non-significant correlation between bone loss and papilla index in both groups ($P > 0.05$). **Conclusion:** The amount of interdental bone loss and papilla profile in the maxillary anterior region around Noris Tuff TT when compared to that around Nobel Active dental implants was non-significant. **Clinical significance:** The preservation of interdental papilla is of paramount importance for the successful dental implant therapy.

Key words: Bone loss, Noris Tuff TT implants, Nobel Active implants, Interdental papilla, JEMT index.

Received: 12 September 2018

Revised: 23 October 2018

Accepted: 25 October 2018

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This article may be cited as: Ahuja N, Arora R, Kumar V, James JR. A Comparative Evaluation of Height of Interdental Papilla around Noris Tuff TT and Nobel Active Dental Implants placed in Maxillary Anterior Region. J Adv Med Dent Scie Res 2018;6(11):5-9.

INTRODUCTION

Maxillary anterior region is common site for tooth loss. The causes may be trauma, cysts or tumours etc. The prime most reason to replace missing anterior teeth is esthetics and functions. Dental implants are considered options for replacing single tooth. This treatment modality has advantages over Fixed Partial Denture (FPD) or Removable Partial Denture (RPD). There is no need to prepare adjacent teeth as in cases of FPD. The clasps of RPD may lead to trauma to tooth as well as to soft tissues. Thus dental implants are useful in restoring function and esthetics.¹

Studies have revealed high success rate of 95% over 10 years for dental implants. The process of osseointegration promotes union of dental implant with bone, ensuring better attachment and success rate. Apart from it, the soft tissues around dental implant play an important role in long term survival. Interdental papilla and labial gingiva add beauty to dental implants.^{2,3} Factors such as periodontitis, over contoured restoration, flossing technique, improper alignment prosthetic part of dental implant and abnormal tooth morphology may affect interdental papilla. The level of bone around dental implant and adjacent teeth determines the future outcome

A Classification System for Loss of Papillary Height

W. Peter Nordland,* and Dennis P. Tarnow†

A CLASSIFICATION SYSTEM FOR LOSS OF papillary height is proposed. It uses readily identifiable anatomical landmarks for reference, and sorts the degree of loss into 3 classes. The 3 broad categories allow for a quick descriptive assessment. In addition to the basic classification, it is suggested that additional and incremental description may be included to further define the defects. *J Periodontol* 1998;69:1124-1126.

Key Words: Dental, papilla/anatomy and histology.

Loss of interdental papillary height is often the sequela of periodontal pathology, as well as the response to periodontal therapy and the return to periodontal health. Papilla loss in the maxillary anterior region often creates a cosmetic concern in afflicted patients. As a consequential need, surgical soft tissue augmentation techniques are developing to restore such lost interdental papillae. Case presentations with follow-ups of treated cases, as well as clinical research papers, are to be expected in the literature.

The development of new techniques for papillary augmentation should benefit from a classification system for identification and description of the degree of loss of papillary height. A generally accepted classification system will facilitate the communication and understanding of the nature of treated cases. A simple, descriptive system is included herein. The system utilizes 3 identifiable anatomical landmarks: the interdental contact point, the facial apical extent of the cemento-enamel junction (CEJ) and the interproximal coronal extent of the CEJ (Fig. 1).

Normal. Interdental papilla fills 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 the interproximal CEJ (space present but interproximal CEJ is not visible) (Figs. 2 and 3).

Class II. The tip of the interdental papilla lies at or apical to the interproximal CEJ but coronal to the apical extent of the facial CEJ (interproximal CEJ visible) (Figs. 4 and 5).

Class III. The tip of the interdental papilla lies level with or apical to the facial CEJ (see Figs. 6 and 7).

DISCUSSION

This proposed classification system allows for easy means to assess progressive degrees of interdental papilla loss using readily observed anatomical landmarks for reference. It provides a description of the extent of reduction of papillary height. The use of such a system should assist future communication among clinicians and researchers.

In addition to the use of this basic classification, we suggest that additional descriptions could be linked and used as supplements. It is possible to be more precise in the description of the height of the "black triangle" by incorporation of millimeter increments of papilla loss. For

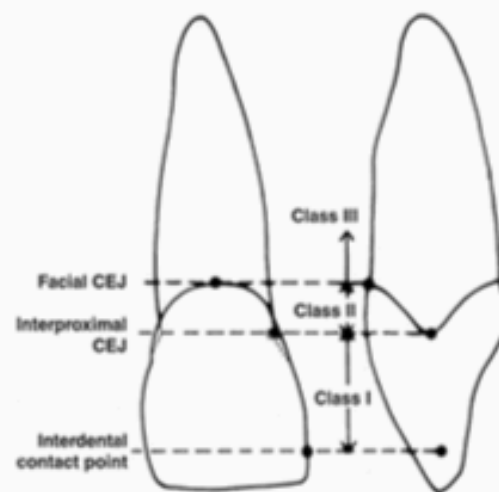


Figure 1. Schematic illustration of the proposed classification system. The location of the tip of the interdental papilla in relation to the three indicated anatomical landmarks forms the basis for the classification. For details, see text.

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Soft Tissue Consideration for Implants Placement in Esthetic Zone

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Abstract: Replacement of missing teeth with implants has made a revolutionary change in restorative dentistry. There is increasing demand for esthetics along with restoration of comfort and function. Adequate zone of attached tissue around a natural tooth or implant prosthesis is desirable to better withstand the functional stresses resulting from mastication, oral hygiene efforts and to maintain predictable levels over time. The importance of soft tissue in implant dentistry is often underestimated. The present literature review focuses various non-surgical and surgical procedures for soft tissue augmentation in implantology and also discusses various approaches to preserve and restore the interdental papilla. Goals for peri-implant soft-tissue grafting are to create a stable peri-implant soft tissue environment by providing an adequate zone of attached non-mobile tissues with intimate adaptation to emerging implant structure and reconstructing soft tissue architecture for maintaining harmonious relationship with implants. There are several factors that affect peri-implant soft-tissues which should be taken into consideration while planning for soft-tissue augmentation procedures around implants. So it is important for an implantologist to not only select the appropriate procedures for optimal soft tissue management but to also sequence them properly.

Keywords: Soft tissue augmentation, implants, peri-implant esthetics, surgical and nonsurgical approaches.

I. Introduction:

Replacement of single or multiple missing teeth with soft and hard tissue deficiencies in esthetic zone is most challenging part for implantologist. Branemark and coworkers in 1969 introduced the concept of replacement of missing teeth by implants and osseointegration. This made a revolutionary change in restorative dentistry. Patients increasing demand for esthetic as well as functionally sound prosthesis have given rise to special concern while placing implants in esthetic zone.

Belser and colleagues¹ in a literature review published in 2004 have mentioned that dental implants in the anterior maxilla have an overall survival and success rate similar to those reported for other segments of the jaw. Eckert and Wollen in 1998² conducted an 11-year retrospective study evaluating 1170 implants placed in partially edentulous patients and found no differences in survival rates of the implants with regard to their anatomical location. Placement of implant in esthetic zone is extremely technique sensitive. Hence, proper examination, diagnosis and treatment are essential. Preservation or regeneration of lost soft and hard tissue is extremely important for success of implant. Several surgical and non-surgical procedures have been proposed to preserve or regenerate soft tissue in peri-implant areas. This literature review includes proper diagnosis and management of soft tissue surrounding implants in esthetic zone.

II. Soft Tissue Management Prior To Implant Placement In Esthetic Zone:

Peri-implant plastic surgery focuses on harmonizing peri-implant structures by means of hard tissue engineering and soft tissue engineering, and includes: bone structure enhancement; soft tissue enhancement; precision in implant placement; and quality of the prosthetic restoration.³ Goals of soft tissue augmentation surrounding implants is to create adequate zone of attached non-mobile tissues with intimate adaptation to emerging implant structure and reconstructing soft tissue architecture

2.1 Implant-soft tissue attachment:

Clinically, peri-implant mucosa follows contour of alveolar bone. Alveolar height and width are very important factors determining soft tissue contours around but tooth morphology, location of the interdental contact point, and arrangement and quality of soft tissue fibers also influences soft tissue appearance around implants. In this article, only soft tissue consideration around implants in the esthetic zone has taken into consideration.



RESEARCH ARTICLE

INTER DENTAL PAPILLA MANAGEMENT: A REVIEW

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ARTICLE INFO

Article History:

Received 19th October, 2017
Received in revised form
26th November, 2017
Accepted 22nd December, 2017
Published online 31st January, 2018

Key words:

Gingival Recession,
Interdental Papilla,
Mucogingival Surgery,
Periodontal Plastic Surgery.

ABSTRACT

Interdental papillary recession has been esthetical as well as an oral hygiene maintenance problem for the patients. Abnormal tooth shape, improper contours of prosthetic restorations, and traumatic oral hygiene procedures may also negatively influence the outline of the interdental soft tissue. There are very fewer surgical techniques to create interdental papilla, which has been very technique sensitive and less predictive in treatment outcome. In this article, a review is attempted to illustrate various causes, classification, and management of interdental papilla.

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Citation: Apoorva, M., Vijay K Raghava, Sarita Joshi Narayan, Dr. UmeshYadalam, Sheetal, S. and Fakeha Hareem. 2018. "Inter dental Papilla Management: A Review", International Journal of Current Research, 10, (01), 64650-64653.

INTRODUCTION

The term periodontal plastic surgery was introduced in the late 1980s and consists of a broad range of procedures aiming at correcting or eliminating anatomic, developmental, or traumatic deformities of the gingiva or alveolar mucosa. One of the major esthetic challenges in periodontal plastic surgery is related to the ability of rebuilding lost papillae in the maxillary anterior segment (Miller, 2000). The presence of such interproximal space results in esthetic and phonetic problems. Interdental papillae can be lost as a result of several distinct clinical situations.

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The first is the presence of a naturally occurring midline diastema. This situation can be remedied with orthodontic treatment, positioning the teeth closer together. Diverging roots are another situation that can result in the presence of an interproximal space when the contact point between the two clinical crowns is situated too incisally. Orthodontics may also correct such a clinical situation by aligning the roots and "squeezing" the interproximal soft tissue, thereby creating a new papilla. A clinical crown that tends to be triangular in shape can also result in a partial interproximal space. This happens because of an accentuated discrepancy in the mesiodistal width at the incisal edge and gingival line. Reshaping the clinical crown is helpful in reducing the interproximal opening (McGuire, 1996).

Literature Review Article

Papillary regeneration: anatomical aspects and treatment approaches

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Received for publication: July 5, 2012. Accepted for publication: August 20, 2012.

Keywords:

dental papilla; gingival;
regeneration.

Abstract

Introduction and objective: This paper aims to report a literature review on the anatomy and morphology of the interproximal papilla and present the options of both surgical and nonsurgical treatment for the recovery of interdental papilla. **Literature review:** The loss of the interdental papilla because of the interproximal bone loss accounts for aesthetic, phonetic and functional problems of patients with periodontal disease. The interproximal tissue reconstruction has been reported in literature through both surgical procedures with the use of subepithelial connective tissue graft, restorative and orthodontic treatment. **Conclusion:** The etiology of gingival black space is multifactorial, therefore, it is important to diagnose properly the etiological factor to establish an appropriate treatment planing. However, the treatment approaches are not predictable and further studies are necessary to recommend the clinical practices available to date.

Case Report

Salvaging the Lost Pink Triangle: A Case Series of Papilla Reconstruction

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Academic Editor: Giuseppe Alessandro Scardina

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Introduction. The interdental papilla may be lost or reduced in height, forming black triangles due to various reasons, which gives an unaesthetic appearance when the patient smiles. Various noninvasive and invasive techniques have been used to augment/reconstruct the interdental papilla, to reclaim the pink triangle. The most satisfactory and natural appearance can be obtained by augmenting or reconstructing the lost papilla as the pink esthetics is as important as the white esthetics. Cases. Two female patients and 1 male patient reported to the dental department with the complaint of a small black gap in the gum area between their upper front teeth since 6 months and 1 year, respectively. On examination, the interdental papillae in all three cases were classified as class 1 (Nordland and Tarnow's). The interdental papilla was augmented surgically by using three different approaches in each case. **Result and Conclusion.** Postoperatively and after 1-month follow-up, there was a complete fill of the interdental area by the interdental papilla normal (Nordland and Tarnow's). As a result, the black triangle was successfully converted into a natural pink triangle in all three cases.

1. Introduction

The interdental papilla is a component of the gingiva which is present between the proximal surfaces of the teeth occupying the cervical embrasure space which extends to fill the lingual, buccal, and occlusal pyramidal space of the interdental space [1]. The interdental papilla is triangular when observed two dimensionally and pyramidal when viewed three dimensionally. The shape, position, and presence is dependent upon the presence of underlying alveolar bone proper, the proximal contact point, and the area of the adjacent teeth [1]. This entity is also referred to as the interdental papillary house by Gonzalez et al. [2] where the dimensions of the roof, floor, and lateral walls of the interdental house play important roles in maintaining the interdental papilla.

It is needless to say that in the absence of tooth, alveolar bone proper, and adjacent tooth contact, the interdental papilla will fail to sustain its original form and result in an empty space between teeth, which is commonly referred to as a black triangle. The black triangle can result in unaes-

thetic appearance while smiling and can result in food impaction and phonetic problems [3]. The etiologies which can result in black triangle include aging, periodontal disease, loss of height of the alveolar bone relative to the interproximal contact, length of embrasure area, root angulations, tooth loss, faulty oral hygiene procedures, interproximal contact position, and triangular-shaped crowns [4, 5].

Once the papilla is lost due to any of the above factors, rebuilding it again and expecting regeneration is cumbersome. Papilla reconstruction or its augmentation is the most esthetically challenging procedure in perioplast procedure [6]. A number of techniques have been developed by various authors such as Beagle [7], Azzi et al. [8], Han and Takei [9], Carnio [6], and Froum et al. [10] in an attempt to convert the black triangle into an aesthetic pink triangle. The methods include nonsurgical and surgical methods (Table 1). In many cases, surgical methods if performed correctly can give everlasting and natural results. This article attempts to observe and compare the outcome of three different procedures carried out to reconstruct the papilla.

Case Report

Interdisciplinary Approach to Reconstruct Papilla in Esthetic Zone: A Case Series

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ABSTRACT In today's world, people are more concerned about their beauty, looks and physical appearance. This has brought greater demands to esthetics in dentistry. One of the unaesthetic appearance of the oral cavity is loss of interdental papilla i.e., black triangle between maxillary anterior teeth which can occur due to many reasons and it's a challengeable task to treat it. The present case series demonstrates an interdisciplinary approach with a combination of modified Beagle's technique and composite restoration to reconstruct interdental papilla between maxillary central incisors with 6 months follow-up. Complete reconstruction of the lost papilla was achieved in both the cases 6 months postoperatively.

KEYWORDS: Beagle's technique, black triangle, composite restoration, esthetics, papilla reconstruction

CLINICAL RELEVANCE TO INTERDISCIPLINARY DENTISTRY

Black triangle has multifactorial aetiology and treatment of open gingival embrasure requires an orthodontic, periodontal and restorative considerations depending on the underlying etiology. Thus, an interdisciplinary team approach with the general dentist, orthodontist, and periodontist is critical.

INTRODUCTION

Smile is a facial expression which plays an important role in social interaction and is most often the need for "esthetics" which pushes the patients toward dental treatment.^[1] There are various conditions of the oral cavity which can produce an unesthetic appearance such as missing anterior teeth, midline diastema, gingival recession, anterior crowding, gummy smile, discolored tooth, fractured anterior tooth, and a black triangle.

Black triangle is the loss or absence of interdental papilla (IDP) between two adjacent teeth resulting in lateral food impaction, an obstacle in phonetics, and functional and esthetic problems. The loss of IDP has multifactorial etiology which includes traumatic oral hygiene procedures, abnormal tooth shape, plaque-associated lesions, improper contours of the restorations, loss of teeth, and spacing between teeth. It can be managed through various and surgical and nonsurgical procedures.^[2]

Various surgical techniques which have been proposed to reconstruct papilla include free gingival grafts, free

connective tissue grafts, and pedicle flaps. Long-term predictability and stability of these surgical techniques have failed to achieve better results because of minor blood supply in the IDP. However, in comparison to free gingival grafts, pedicle flaps have shown better results.^[3] One such pedicle flap technique to reconstruct IDP is Beagle's technique which is the combination of two techniques, i.e., Abram's roll technique for ridge augmentation and Evian's papilla preservation technique.^[4]

The present study describes cases treated by an interdisciplinary approach using modification of Beagle's technique [Figure 1] to reconstruct IDP followed by composite restoration of that respective tooth.

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How to cite this article: Chhavia S, Sandeep JN. Interdisciplinary approach to reconstruct papilla in esthetic zone: A Case series. *J Interdiscip Dentistry* 2017;7:117-21.

Access this article online	
Quick Response Code: 	Website: www.jdonline.com
	DOI: 10.4103/jid.jid_40_17

Ausencia de papila interdental: etiología, clasificación y terapéutica.

Interdental papilla loss: etiology, classification and therapeutic.

Max Campos-Suárez¹, Claudio Peña-Soto²

RESUMEN

La presencia de papila interdental está íntimamente relacionada con los resultados estéticos y funcionales de la terapia periodontal y rehabilitadora. Sin embargo, uno de los factores más importantes para la ausencia de papilas, es su epitelio, ya que es muy similar al epitelio de unión, el cual no es queratinizado; por lo tanto, es muy susceptible a la enfermedad periodontal, siendo el sitio más frecuente en la iniciación de la enfermedad. En esta revisión de la literatura determinaremos, en base a la evidencia; las condiciones anatómicas para la presencia o ausencia de papila interdental, los principales factores etiológicos involucrados en su pérdida, las opciones terapéuticas y técnicas más predecibles; así como, los resultados clínicos obtenidos.

Palabras Clave: Papila interdental; encía; estética; hueso.

ABSTRACT

The interdental papilla's presence is closely related with the aesthetic and functional results of the periodontal and prosthetic therapy. However, one of the most important factors in the absence of papillae, is the epithelium, being that it is very similar to the junctional epithelium, which is nonkeratinized; therefore, it is very susceptible to periodontal disease, being the most frequent site in the disease initiation. In this literature review, we will determine, based on the evidence; anatomical conditions for the presence or absence of interdental papilla, the main etiological factors involved in their loss, the therapeutic options and the more predictable techniques; thus, the clinical results obtained.

Keywords: Gingiva; gums; interdental papilla; inter-dental papillae; esthetics; bone.

En los últimos años, la demanda estética en odontología ha aumentado rápidamente y uno de los mayores problemas de los periodoncistas y de los pacientes es la solución de los problemas ocasionados por la pérdida de la papila interdental. La papila interdental cumple una función mecánica al ocupar el espacio interproximal evitando la acumulación de restos alimenticios; además, su ausencia resulta en los conocidos triángulos negros, que ocasionan problemas fonéticos, al dejar pasar el aire y saliva. La reconstrucción de la papila interdental es uno de los mayores desafíos y uno de los tratamientos menos predecibles. Es por eso, que es muy importante respetar la integridad de la papila interdental durante todos los procedimientos odontológicos para así prevenir su desaparición.

El nivel de evidencia que encontramos en la literatura en su mayoría es reporte de casos. Por lo tanto, la presente revisión de la literatura tiene como objetivo determinar, las

situaciones anatómicas para la presencia o ausencia de papila interdental, los principales factores etiológicos que determinan su pérdida, las opciones terapéuticas y técnicas más predecibles para su conformación, así como, los resultados clínicos obtenidos.

CONSIDERACIONES ANATÓMICAS Y FACTORES ASOCIADOS

La papila interdental es la encía interdental que ocupa el espacio interproximal, este espacio está compuesto por 4 espacios piramidales: cervical, oclusal, vestibular y lingual, donde el ápice de cada pirámide termina en el punto o área de contacto de dos dientes adyacentes. Las pirámides vestibular, lingual y oclusal están vacías mientras que la cervical es ocupada por la papila interdental. La papila interdental está determinada por el punto de contacto o superficie de contacto entre los dientes, el ancho de las caras

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Use of hyaluronic acid as an alternative for reconstruction of interdental papilla

Uso de ácido hialurónico como alternativa para la reconstrucción de la papila interdental

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ABSTRACT

Introduction: Hyaluronic acid (HA) is an essential glucosaminoglycan of the extracellular matrix of all tissues; it is found at an average concentration of 0.02%. A subject weighing 60 kg contains approximately 12 g of HA. The greater concentrations of this acid are found in connective tissue such as the skin, which exhibits up to 56% percent of said acid. HA plays an important role in cell migration, since it is involved in processes of growth, inflammation and repair as well as stimulation of different connective tissue cells. **Objective:** To present a clinical case involving interdental papilla reconstruction with HA infiltration. **Clinical case:** 24 year old female who reported being systemically healthy. The patient exhibited loss of interdental papilla in the area of tooth number 11 and 21 caused by presence of gingivitis and poor brushing techniques. The patient was assessed according to Nordland and Tamow classification in order to ascertain the procedure's degree of predictability; she was additionally examined according to Cardaropoli classification in order to be able to establish pre- and post-treatment comparisons. The patient exhibited 5 mm of contact point to the bone crest, therefore, HA infiltration was undertaken into the papilla, every seven days for four weeks. **Conclusion:** There are very few non-surgical techniques to regenerate interdental papillae, one of them is HA use. Research conducted on this technique is not new, nevertheless, it would be suitable to further it taking into consideration different factors; conducting them in greater-sized populations with subjects of different ethnicities and gender, and using different infiltration intervals.

Key words: Interdental papilla regeneration, hyaluronic acid, non-surgical technique.

Palabras clave: Regeneración de papila interdental, ácido hialurónico, técnica no quirúrgica.

RESUMEN

Introducción: El ácido hialurónico (AH) es un glucosaminoglicano esencial de la matriz extracelular de todos los tejidos, estando en una concentración media del 0.02%. Una persona de 60 kg de peso contiene aproximadamente 12 g de AH; las mayores concentraciones de este ácido se encuentran en los tejidos conectivos como la piel, la cual presenta hasta un 56% de éste. El AH tiene un papel importante en la migración celular, ya que está involucrado en procesos de crecimiento, inflamación y reparación, así como estimulación de diferentes células del tejido conectivo. **Objetivo:** Presentar un caso clínico de reconstrucción de la papila interdental infiltrando AH. **Caso clínico:** Paciente femenino de 24 años de edad que al interrogatorio refiere ser sistémicamente sana. Presenta pérdida de la papila interdental de la zona CD 11 y 21 a causa de una gingivitis y mala técnica de cepillado. Se valora de acuerdo con la clasificación de Nordland y Tamow para saber el grado de predictibilidad del procedimiento y de acuerdo con la clasificación de Cardaropoli, con el fin de poder realizar comparaciones antes y después del tratamiento. La paciente presentaba 5 mm del punto de contacto a la cresta ósea, por lo que se realizó un infiltrado de AH en la papila durante cuatro semanas cada siete días. **Conclusión:** Existen muy pocas técnicas no quirúrgicas para la regeneración de la papila interdental, dentro de ellas encontramos el uso de AH. Las investigaciones sobre esta técnica no son nuevas, sin embargo, se deben continuar y ampliar los estudios considerando diversos factores: realizarlos en poblaciones mayores con personas de distintas razas, sexo y utilizando diferentes intervalos de infiltración.

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Received: October 2016. Accepted: February 2017.

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<http://www.medigraphic.com/facultadodontologiaunam>

See related content at doi:
<http://dx.doi.org/10.1016/j.rodex.2017.09.017>

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Assessment of Hyaluronic Acid Gel Injection in the Reconstruction of Interdental Papilla: A Randomized Clinical Trial

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Abstract

Objectives: Abdelraouf SA, Dahab OA, Elbarbary A, El-Din AM, Mostafa B. Assessment of Hyaluronic Acid Gel Injection in the Reconstruction of Interdental Papilla: A Randomized Clinical Trial. Open Access Maced J Med Sci. 2019 Jun 15; 7(11):1834-1840. <https://doi.org/10.3899/maejms.2019.478>

Keywords: Deficient interdental papilla; Reconstruction; Hyaluronic acid; Injection

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Received: 01-Apr-2019; Revised: 29-May-2019; Accepted: 30-May-2019; Online first: 14-Jun-2019

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Funding: This research did not receive any financial support

Competing Interests: The authors have declared that no competing interests exist

BACKGROUND: Various techniques have been implemented to reconstruct the deficient interdental papilla.

AIM: The present trial was conducted to assess the effect of injection of hyaluronic acid gel for the reconstruction of deficient interdental papilla.

MATERIAL AND METHODS: Thirty-six deficient interdental papilla sites in ten patients were randomly allocated into two equal groups; intervention group who received the injection of hyaluronic acid (HA) gel and control group who received the injection of saline solution as a placebo. Each deficient papilla received three injections. The first injection was given one week following the re-evaluation period (four weeks after performing full mouth supra-gingival scaling and sub-gingival debridement). The second and third injections were given after three and six weeks, respectively. The height and surface area of black triangles were recorded at baseline before the injection procedures. The participants were recalled after three and six months from the first injection for re-measuring the recorded parameters. At 6 months, patients' satisfaction was also assessed.

RESULTS: After three and six months from baseline, the results revealed a statistically significant higher mean decrease in height and surface area of black triangles in favour of the HA group. From three to six months, there was no statistically significant difference between the two groups in both parameters. At 6 months, the HA group showed a statistically significant higher mean satisfaction score than the saline group.

CONCLUSION: The use of hyaluronic acid gel for the reconstruction of interdental papillary deficiency was effective with promising levels of patients' satisfaction.

Introduction

The interdental papilla is the gingival portion that occupies the proximal area underneath the contact between two adjacent teeth. It has distinctive anatomical, histological and molecular characteristics with tremendous significant importance from an esthetic perspective, especially in the anterior region since it is almost universally displayed during smiling [1].

The interdental papillary deficiency or "the black triangle (BT)" is a large concern for dentists and patients [2]. Black triangles are rated as the third most disliked esthetic problem below caries and apparent crown margins [3]. Also, the absence of interdental papilla contributes to chronic retention of food debris

leading to subsequent affection of periodontal health. Last but not least, it also causes phonetic problems by allowing the passage of air and saliva [4]. Reconstruction of papillary insufficiency is one of the most difficult and challenging periodontal treatments. This is because the interdental papilla is a small, fragile area with minor blood supply which seems to be the major limiting factor in all surgical and augmentation techniques aiming at reconstructing the interdental papilla [5], [6].

Several surgical approaches using traditional periodontal plastic and augmentation procedures have been proposed to overcome this problem. However, these techniques were found to be invasive with increased patient morbidity, limited success and long-term stability [7], [8]. Non-surgical attempts to treat papillary deficiencies include orthodontic, restorative approaches or a combination of both. However, these

Reconstruction of Lost Interdental Papilla: A Review of Nonsurgical Approaches

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Abstract Modern dentistry involves both functional and esthetics role. Interdental papilla loss results in Gingival Black Triangle (GBT), which is considered esthetically unacceptable. It is strongly associated with aging, periodontal disease and post orthodontic treatment. Reconstruction of the lost interdental papilla is difficult and challenging objective to be achieved, as it is strongly associated with the patient smile. Apart from its esthetic function, absence of interdental papilla raises concern over phonetic problems, food and plaque accumulation, which further deteriorate the present condition. Treatment for papilla loss involves correcting oral hygiene procedure, prosthetic restorations and tissue volumizing. Therefore, the present review discusses the different types of papilla loss classifications, etiology associated with open gingival embrasures and all currently available nonsurgical treatment modalities recommended for papilla preservation and reconstruction. It can be inferred that though a golden standard is not yet set to treat papilla loss, the usage of minimally invasive technique has a promising clinical potential in aesthetic reconstruction of lost interdental papilla.

Keywords- Open gingival embrasures, Gingival black triangle, Interdental papilla, Papilla reconstruction, Hyaluronic acid

Date of Submission: 05-02-2018

Date of acceptance: 23-02-2018

I. Introduction

Interdental papilla represents small visible area presents in-between a hard (teeth) and soft tissue (gingiva) of the oral cavity. Though anatomically small, it plays a huge role in face esthetics due to its strong association with the patient smile as a result of its anterior positioning. Gingival black triangles (GBTs) are cosmetic deformities which refer to an absence of papilla resulting in black spaces or open embrasures which impair esthetic features, phonetics problems and food accumulation [1-3]. In the absence of contact point or when papilla migrates apically due to inflammation, the col disappears leading to black, pyramidal shape formation [4]. GBT is highly prevalent among adult population and frequently encountered among adult (38% of 119 cases) [5] and adolescents patients (41.9% of 129 cases) [6]. According to a survey conducted by Kokich *et al.* [7], it was reported that orthodontists considered a 2 mm open gingival embrasure as less attractive and a similar study reported that both patients and dentist consider GBT about 3 mm to be less esthetic [1]. Irrespective of its functional role, growing public demands for esthetics, place huge pressure on modern clinical dentistry to restore any lost 'white' and 'pink' esthetics. White esthetics denotes natural teeth arrangement or restoration of lost dental tissues and pink refers to gingival tissues surrounding the teeth [2]. Harmony association of these soft tissues adjacent to teeth with minimal or no tissue deficiencies is key for stable dentition and to eliminate issues like dental caries [8].

Therefore, the main objective of periodontal therapy is to prevent progression of periodontal disease and associated trauma by regeneration of the lost periodontal tissues [8,9]. Though several surgical techniques have been constantly proposed and experimented, they are mostly invasive and unpredictable [10]. Moreover, the success rate of surgical augmentation of papilla relies on the thickness of gingiva biotype [11]. Hence, a number of nonsurgical, minimally invasive techniques has been developed to preserve and restore interdental papilla. Though many solutions have been proposed to correct lost interdental tissues, no golden standard technique is followed so far due to the absence of long-term clinical results and predictability. The present review discusses the various classification of papilla loss, etiology associated with GBT and currently available nonsurgical treatment modalities recommended for papilla preservation and reconstruction [2].

II. Etiology of Interdental Papilla Loss

From several studies it is well documented that etiology of interdental papilla is multifactorial [1,13]. Patients may present with one or more etiologic factor; thus, managing each patient requires an individual assessment and treatment plan. The major causes of interdental papilla loss are explained below;

Clinical Evaluation of Papilla Reconstruction Using Subepithelial Connective Tissue Graft

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ABSTRACT

Objective: The aesthetics of the patient can be improved by surgical reconstruction of interdental papilla by using an advanced papillary flap interposed with subepithelial connective tissue graft.

Materials and Methods: A total of fifteen sites from ten patients having black triangles/papilla recession in the maxillary anterior region were selected and subjected to presurgical evaluation. The sites were treated with interposed subepithelial connective tissue graft placed under a coronally advance flap. The integrity of the papilla was maintained by moving the whole of gingivopapillary unit coronally. The various parameters were analysed at different intervals.

Results: There was a mean decrease in the papilla presence index score and distance from contact point to gingival margin, but it was statistically not significant. Also, there is increase in the width of the keratinized gingiva which was statistically highly significant.

Conclusion: Advanced papillary flap with interposed subepithelial connective tissue graft can offer predictable results for the reconstruction of interdental papilla. If papilla loss occurs solely due to soft-tissue damage, reconstructive techniques can completely restore it; but if due to periodontal disease involving bone loss, reconstruction is generally incomplete and multiple surgical procedures may be required.

Keywords: Aesthetic, Black triangle, Interdental papilla, Subepithelial connective tissue graft

INTRODUCTION

Aesthetic demands have been climbing ever higher in dentistry driven by an enhanced awareness of beauty. A concept of creating something tangibly better, "Dental aesthetics" is fueled by fascination, generating compliments and popularity. A successful aesthetic dental treatment helps regain the patient's self-image, revive social skills and experience professional success. Modern aesthetic dentistry involves not only the restoration of lost teeth and their associated hard tissues, but increasingly the management and reconstruction of the encasing gingiva [1]. In the past, periodontal treatment has been aimed more at the preservation and restoration of periodontal health than at the aesthetic outcome of treatment. However, recent advances have enhanced the periodontist's proficiency to address the aesthetic concerns [2]. Periodontal plastic surgery consists of a broad range of procedures aiming at correcting or eliminating anatomical, developmental and/or traumatic deformities of the gingiva or alveolar mucosa [3]. One among such problems is open interproximal spaces or the black triangles.

"Black triangles" or the interproximal spaces are one of the most troubling dilemmas in dentistry, can cause aesthetic concerns, phonetic difficulties, and food impaction. Several reasons contribute to the loss or absence of interdental papilla and establishment of "Black Triangle", including gingival inflammation, attachment loss, and interproximal bone resorption. The most common reason for black triangle in the adult population is plaque associated loss of periodontal support as well abnormal tooth shape or traumatic oral hygiene [4]. While Kandaswamy et al., reported that black holes (dark triangles) are more likely to develop following labial movement of overlapping or palatally placed incisors and diastema closure [5]. An interproximal contact point and an adequate level of bone support are essential for maintenance of a healthy papilla that completely fills the interproximal space [6]. From a biological point of view, the presence or absence of the papilla primarily depends on the distance between the interdental contact point and the interproximal crest of bone. Tanow et al., stated that the distance of 5 mm is critical for

this purpose [7]. Various periodontal plastic surgical procedures like soft tissue sculpturing, use of connective tissue / free gingival grafts, use of enhanced conservative new mucoperiosteal flap designs, and methods to improve soft tissue topography with/without GTR/VGBR, all are invented to enhance regeneration of lost interdental hard and soft tissue. The most difficult and elusive goals for periodontists is reconstruction, regeneration of lost interdental papilla and to achieve the Aesthetics which is lost because of open interproximal spaces [8]. Several non-surgical and surgical procedures have been presented to treat the soft tissue deformities in the interproximal areas such as prosthetic covering, perio surgeries, orthodontic teeth alignment or combination of above [4]. Inocencio et al., observed that combined periodontal surgery and orthodontic repositioning tooth helps in achieving periodontium with better aesthetic results and proper formation of interdental papilla [9]. The non-surgical approaches modify the interproximal space whereas the surgical approaches aim to recontour, preserve, regenerate and reconstruct the soft tissue between the teeth and implants [10]. Surgical techniques aiming at correcting the "black hole problem" have been used mainly with free epithelialized gingival grafts, repeated interproximal curettage, or displacement of the interproximal palatal tissue in the buccal direction [2,11], but limited success has been achieved with these procedures. The major limiting factor for the complete and predictable survival of the graft tissue is the lack of a minimal source of blood supply [12]. The healing principle on which the subepithelial connective tissue graft for root coverage and ridge augmentation are based have been applied to the reconstruction of the interdental papilla, thus increasing both the success rate and predictability [13].

So, in the present study an attempt has been made to clinically evaluate the surgical reconstruction of interdental papilla by using an advanced papillary flap with interposed subepithelial connective tissue graft.

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Research paper

The role of subepithelial connective tissue graft for reconstruction of interdental papilla: Clinical study



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ARTICLE INFO

Keywords:

Interdental papilla
Subepithelial connective tissue

ABSTRACT

Background: The ideal goal of periodontal therapy is regeneration of the lost periodontium. However regeneration of the lost interdental papilla has been elusive. Therefore the ability of rebuilding lost papillae in the maxillary segment has become one of the major challenges in periodontal plastic surgery. **Objectives of the study:** To evaluate the success and predictability of surgical technique using a sub epithelial connective tissue graft interposed in a coronally displaced flap to reconstruct the lost interdental papillae.

Methods: The purpose of this study is to evaluate the success and predictability of a surgical technique using a subepithelial connective tissue graft from the palate with coronally displaced flap to regenerate the lost interdental papilla in 11 systemically healthy patients.

Results: Post treatment follow up show statistically significant results from baseline to 3months and 6 months.

Conclusion: The present study attempted a single surgical procedure to reconstruct the lost interdental papilla using subepithelial connective tissue graft interposed in coronally displaced flap in 11 patients with Tarnow's class-II papillary recessions. At the end of 6 months it was found that the sites demonstrated significantly superior results as determined by percentage of reduction in the area of the black triangle both clinically (80.26%) and on the model (54.29%).

Clinical Implications: Although complete regeneration of interdental papilla was not achieved, the results of this study demonstrate that a predictable and an esthetically pleasing surgical outcome can be achieved in one attempt for class II papillary recessions.

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Introduction

Esthetics has become a major concern in periodontal therapy. A key to an aesthetically pleasant smile is proper management of the soft tissues around natural teeth or implants. Aesthetic soft-tissue contours are described by a harmoniously scalloped gingival line, the avoidance of an abrupt

change in clinical crown length between adjacent teeth, a convex buccal mucosa of sufficient thickness and a distinct interdental papilla [1].

The interdental space is a physical space between two adjacent teeth. Its form and volume are determined by the morphology of the teeth. Morphologically, the papillae had been described first in 1959 by Cohen [2]. Prior to this time, interdental papilla was considered as a gingival trait having a

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Surgical Reconstruction of Interdental Papilla using Subepithelial Connective Tissue Graft by Microsurgical Technique: A Clinical Study

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Received date: February 12, 2018; Accepted date: March 12, 2018; Published date: March 16, 2018

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Abstract

Background: Loss of interdental papilla is one of the most concerning esthetic problem for the patient and equally challenging for the clinician. Management of papillary loss has shown limited success and is limited to case reports with lack of long-term follow-up.

Method: Surgical microscope was used at 6X magnification in this study to enhance the visual acuity in the narrow interdental space. 13 cases with 20 sites in the maxillary anterior region were selected for surgical reconstruction. Tunneling was performed under the deficient papillae and connective tissue graft used to fill the space created.

Results: Among 20 sites, 5 sites showed complete papillary fill, while 3 sites were 1 mm deficient. The mean vertical gain achieved was 1.63 mm which was statistically significant at P value<0.01. A significant adverse surgical outcome was diastema formation within 4 weeks postoperatively.

Conclusion: Microsurgery enhances the surgeon's ability to handle delicate papillary tissue and hence more predictable. Splinting of teeth prior to papillary reconstruction may be considered to prevent diastema formation.

Keywords: Interdental papilla; Gingival embrasure; Microsurgery

Introduction

Periodontal plastic surgery encompasses a broad range of procedures aimed at correcting or eliminating anatomic, developmental or traumatic deformities of gingiva or alveolar mucosa [1].

One of the major challenges in this field is related to the ability of rebuilding papillae lost either due to periodontal disease or therapy. Loss of interdental papillae in the maxillary region results in esthetic and phonetic aberrations [2].

A major limiting factor in all papillary reconstruction techniques is inadequate blood supply. The recipient interdental space borders non-vascularized tooth surfaces and has small surface area for manipulation and grafting [2].

Several surgical and non-surgical approaches have been suggested to improve esthetics but with limited success [3].

Microsurgery in general is not an independent discipline, but is a technique that can be applied to different surgical disciplines. It is based on fact that human hand, by appropriate training, is capable of performing finer movements than the naked eye is able to control.

Microsurgery enhances the capability of operator by enhancing the visual acuity by means of illumination and magnification. Literature on periodontal microsurgery shows improved surgical outcome when used for root coverage procedure [4,5-13] and regenerative therapy [14,15].

In this clinical study, a microsurgical approach is attempted to manage papillary loss using connective tissue graft harvested from the palate. The emphasis is on minimizing trauma by utilizing microsurgical instruments to work in the narrow interdental region of anterior maxilla.

Materials and Methods

A total of 13 patients with 20 sites in maxillary anterior region were selected to undergo microsurgical papillary reconstruction. The inclusion criteria included systemically healthy individuals in age group of 20-50 years, with interdental papillary loss in maxillary anterior teeth without diastema. The exclusion criteria included chronic smokers, pregnancy, root exposure with proximal restoration and endodontically treated teeth.

This clinical study assessed the efficacy of microsurgical reconstruction of lost interdental papilla using interposed connective tissue graft harvested from palate. The assessment was based on single surgical intervention irrespective of class of papillary loss. Surgical procedure was explained to the patients and informed consent obtained. All patients with papillary loss in maxillary anterior region and willing for surgical reconstruction were taken up for study. Patients diagnosed with periodontitis were taken up for the surgical reconstruction after the completion of active periodontal therapy.

The amount of vertical gain that can be achieved with one surgical intervention was assessed. The measurements were recorded to the nearest millimeter and tabulated for each site (Table 1). Wilcoxon Signed Ranks Test was carried out to compare parameters within group at baseline and 6 months interval.

Root Coverage and Papilla Reconstruction Using Autogenous Osseous and Connective Tissue Grafts



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Previous studies have reported that the distance from the interdental crest of bone to the apical portion of the contact of the two approximating teeth must be 5 mm or less to support a stable interdental papilla. The reconstruction of a stable, long-term papilla for esthetic purposes must therefore consider interdental bone reconstruction. Autogenous osseous graft material was harvested from the tuberosity and augmented with a subperiosteal connective tissue graft for papilla reconstruction between the maxillary central incisors. Flap design, osseous graft fixation with a screw, connective tissue placement, wound closure, and suturing techniques are presented. To enhance the final result, porcelain veneers were bonded to the approximating central incisors. This case report demonstrates a surgical procedure that has not been reported to date for papilla reconstruction to enhance periodontal esthetics. (*Int J Periodontics Restorative Dent* 2001;21:141-147.)

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In the last decade, esthetics has become a major concern in periodontal therapy. Gingival recession resulting in the denuded root surface and the loss of the gingival papillae are the two main concerns in periodontal esthetics. Presently, there are numerous predictable surgical techniques available for correcting the denuded root surface¹⁻¹¹ but none for the reconstruction of the lost papillae. The literature is limited to only a few case reports on papillary reconstruction.¹²⁻¹⁷ Any technique related to gingival tissue reconstruction must emphasize adequate blood supply to the surgical site. Because of the limited area that the interdental papilla occupies, any form of grafting presents a blood supply problem in the reconstruction of the papilla. It is also known from previous studies that the long-term stability of the papilla is dependent on the anatomic environment. The incisal distance from the interdental crest of bone to the apical portion of the contact is important to maintain the papilla. Tarnow et al¹⁸ stated that the distance of 5 mm is critical for this purpose. Therefore,

Efficacy of Platelet-rich Fibrin in Interdental Papilla Reconstruction as Compared to Connective Tissue Using Microsurgical Approach

Abstract

Aim: This study aims to evaluate autologous platelet-rich fibrin (PRF) and autogenous connective tissue graft (CTG) in interdental papilla (IDP) reconstruction with buccal and palatal split-thickness flap (STF) using microsurgical technique. **Materials and Methods:** Forty Class I or Class II open gingival or cervical embrasure in maxillary anterior region in 14 patients were surgical treated for the reconstruction of IDP. For experimental Group I (STF with PRF, $n = 20$), surgical site was flushed with PRF fluid. PRF was then placed under the buccal flap and in the IDP region and squeezed. For experimental Group II (STF with CTG, $n = 20$) after the preparation of recipient site, CTG procured from palate was trimmed to the desired size and shape and placed at the site. Clinical parameters and patient satisfaction response recorded were plaque index, gingival index, probing pocket depth, clinical attachment level, height of IPD, and papilla index score (PIS). **Results:** STF surgery in combination with PRF or CTG, are an effective procedure to increase IDP-height with mean values of 3.10 mm (87.3%) and 3.45 mm (95.8%) for Group I (STF + PRF) and Group II (STF + CTG), respectively. In terms of complete fill (CF) achieved at 3 months, in the present study, the result showed that 90% CF was obtained in Group I (STF + PRF) and 95% in Group II (STF + CTG). The patient response and acceptance for surgical treatment modality in terms of patient postsurgical discomfort score and patient esthetic score was higher for Group II (STF + CTG) than Group I (STF + PRF). **Conclusion:** Based on single-centered 3 months' follow-up, it may be concluded that STF surgery in combination with PRF or CTG is an effective procedure to increase IDP-height; however, a long-term multicentric randomized clinical trial may be necessary to evaluate the clinical outcome for autologous PRF in comparison to CTG with STF.

Keywords: Connective tissue graft, interdental papilla, platelet-rich fibrin

Introduction

The absence of the papilla with opening of the black spaces result in "black triangles," that may be one of the major esthetic challenges in periodontal plastic surgery, and is related to the ability to reconstitute the lost interdental papilla (IDP) in the maxillary anterior segment. Various treatment modalities may be used in an attempt to achieve the reconstruction of IDP, including manipulating soft tissue, increasing of the hard tissue, and the restorative and orthodontic treatment.^[1] The nonsurgical approaches modify the interproximal space and thereby inducing modifications in the soft tissues.^[2] Many surgical treatment options are available for the reconstruction of IDP. The technique can be broadly classified as use pedicle graft with coronal

displacement of the gingiva-papillary unit,^[3] and subepithelial connective tissue grafting.^[4-6] However, limited published studies have reported the use of platelet-rich fibrin (PRF) in papilla reconstruction. PRF is a form of second-generation platelet concentrate; a matrix of autologous fibrin, which is better than platelet-rich plasma by virtue of its properties, easier preparation, and cost-effectiveness. It promotes wound healing, wound sealing, and hemostasis. Their biologic property help to stabilize the flap, enhance neoangiogenesis, and reduces the necrosis and shrinkage of the flap and stabilization of the gingival flap in the highest covering position.^[7]

Nowadays, microsurgery offers new possibilities to improve periodontal care in a variety of ways. Its benefits include improved cosmetics, rapid healing, minimum discomfort, and enhanced patient acceptance.^[8] Hence, the present study was

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Access this article online

Website:
www.contempclindent.org
DOI: 10.4103/cont.ccd.936.18

Quick Response Code:



How to cite this article: Singh D, Jhingran R, Bains VK, Madan R, Srivastava R. Efficacy of platelet-rich fibrin in interdental papilla reconstruction as compared to connective tissue using microsurgical approach. *Contemp Clin Dent* 2019;10:643-51.

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Platelet rich fibrin: a panacea for lost interdental papilla

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ABSTRACT

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Received: 24/08/2015

Accepted: 20/10/2015

Introduction: Loss of interdental papilla marks phonetics, functional and esthetic problem. Surgical techniques are diverse, but none have given predictable results.

Aim: The purpose of this case report is to present reconstruction of papilla by using platelet rich fibrin membrane in maxillary anterior region.

Methodology: 30yr old male patient reported with an unesthetic smile due to loss of interdental papilla in the maxillary left central and lateral incisor region since 6 months. The treatment was planned for reconstruction of lost interdental papilla using PRF. A pouch was created with a semilunar incision, PRF was prepared and inserted into the pouch and the entire gingivopapillary unit was displaced coronally.

Conclusion: Optimal fill was noted at 1, 3 and 6 months postoperatively with excellent esthetic outcome. Use of PRF and proper technique may thus be the panacea for interdental papilla augmentation.

Keywords: PRF, Interdental papilla, Esthetics, Maxillary anterior, Black triangle

INTRODUCTION

From the time known, dentistry has just been a restricted field but now dentistry has expanded its horizons. Today as we head towards modernization and urbanization esthetic demands in dentistry have increased rapidly, driven by an enhanced awareness of beauty and esthetics. The ultimate goal in modern dentistry is to achieve "white" and "pink" esthetics. "White esthetics" are the natural dentition or the restoration of dental hard tissues with suitable materials. "Pink esthetics" refers to the surrounding hard and soft tissues, which can enhance or diminish the esthetic result.

Today, in majority of the adult population with a history of periodontal disease, open gingival embrasures are a common problem resulting in "black triangles". A black triangle or an open gingival embrasure occurs as a result of a deficiency or loss of papilla beneath the contact point. Periodontists have attempted to reconstruct this lost papilla by numerous surgical methods like free gingival grafting, coronally positioning of the papilla from the palatal side, subepithelial connective tissue graft with apically positioning of the papilla.

A recent innovation in dentistry is the preparation and use of platelet-rich fibrin (PRF), a concentrated suspension of the growth factors found in platelets derived from centrifuged blood. Platelet rich fibrin (PRF) is a type of platelet gel; a matrix of autologous fibrin, which has scored over platelet rich plasma by virtue of its properties, easier preparation, and cost effectiveness. It promotes wound healing, wound sealing and hemostasis.¹ The purpose of this case report is to present the use of platelet rich fibrin (PRF) in the reconstruction of papilla in the maxillary anterior region of a 30 years old man.

CASE REPORT

A 30 year old male patient reported to the Department of Periodontics, A.M.E.'s dental college & hospital with a chief complaint of gap and black appearance in upper front teeth. On Clinical examination it was observed that class I papillary loss (Fig. 1). The distance between the contact point to the bone crest was 6 mm. No facial recession was evident on 11, 12, and 21. The distance between the contact point of adjacent teeth and the existing papilla was 4 mm. The surgical procedure was explained and informed consent was obtained.

Preparation of PRF: Before the start of the surgery the preparation of PRF was carried out as per the protocol developed by Choukron *et al.* en milliliter of intravenous blood (antecubital site) was collected in sterile 10 ml tubes without the addition of an anticoagulant and centrifuged at 3000 revolutions ($\approx 400 \times g$) per minute for 10 minutes. PRF settles down between the platelet poor plasma (PPP) at the top and the red blood cells (RBC) at the bottom of the

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	DOI: 10.5958/2393-9834.2015.00017.0

Original Article

A comparative evaluation of papillary reconstruction by modified Beagle's technique with the Beagle's surgical technique: A clinical and radiographic study

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10.4103/jsp.jsp_186_17

Quick Response Code:



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Submission: 23-07-2017
Accepted: 28-09-2017

Abstract:

Background: To assess and compare the effectiveness of two surgical procedures (Beagle's technique and modified Beagle's technique) for the reconstruction of the lost interproximal dental papilla. **Materials and Methods:** Twenty sites were selected based on the selection criteria which included patients within the age group of 20–50 years and the presence of Class I and Class II recession of the papilla in the maxillary anterior region. They were divided randomly into Group A and Group B. Group A sites were treated with modified Beagle's technique, whereas Group B sites were treated by the Beagle's technique. The patients were recalled at 1 week, 1 month, 3 months, and 6 months postsurgery. Parameters including classification of loss of papilla height (Nordland and Tarnow), change in vertical dimension, mesiodistal dimension and area of the papillary defect, and radiographic parameters (papilla height and bone crest-root apex distance) were recorded preoperatively and postoperatively. **Results:** At 6-month postsurgery, there was a statistically significant reduction in vertical dimension, mesiodistal dimension, and area of the papilla defect in Group A compared to Group B. At 6-month postsurgery, there was an increase in the height of the papilla in Group A, whereas there was a decrease in the height of the papilla in Group B. At 6-month postsurgery too, there was a reduction in the mean bone crest-root apex distance in both groups. **Conclusion:** Thus, the modified Beagle's technique is an easy and effective technique when compared to the Beagle's surgical technique for papilla reconstruction.

Key words:

Beagle's technique, modified Beagle's technique, papilla height

INTRODUCTION

Dental esthetics has become a great concern, for both dental practitioners and patients, in addition to maintaining dental and periodontal health. The contour of the interdental tissues and the color and texture of keratinized tissues play a role in esthetics with the presence of interproximal papilla between the maxillary anterior teeth being the key esthetic component.^[1]

Hence, one of the major esthetic challenges in periodontal plastic surgery is the ability to regenerate the lost papilla in the maxillary anterior segment.^[1]

Black triangle or an open gingival embrasure occurs as a result of a deficiency or loss of papilla beneath the contact point. Numerous risk factors (mainly periodontal disease or as a consequence of periodontal surgery) lead to the development of open gingival embrasures or black triangles.^[2]

Several surgical and nonsurgical techniques have been used to treat and restore the missing interdental papilla. If the loss of papilla is related to soft-tissue damage only, reconstructive techniques are able to restore it completely. If the loss of the interdental papilla is due to severe periodontal disease, with interproximal bone resorption, complete reconstruction is generally not achieved. The surgical techniques used for papilla reconstruction include several

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How to cite this article: Chaukar PP, Mali RS, Mali AM, Lele PA, Patil PA. A comparative evaluation of papillary reconstruction by modified Beagle's technique with the Beagle's surgical technique: A clinical and radiographic study. *J Indian Soc Periodontol* 2017;21:218-23.

Comparison of two surgical techniques for the reconstruction of interdental papilla

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ABSTRACT

Aim: The aim of the study was to check the effectiveness of both Robert Azzi and Han and Takel technique in reconstructing the lost interdental papilla between maxillary central incisors. It also compared the two techniques. **Materials and Methods:** Fourteen systemically healthy patients fulfilling the inclusion and exclusion criteria were selected for the study. The clinical parameters were evaluated at baseline, 6 months and 12 months postsurgically. **Results:** The results showed that there was a statistical significant improvement in both papilla presence index score and papillary height in both the groups from baseline but on comparison, no technique was superior to the other. **Conclusion:** Both the techniques were equally good in reconstructing the interdental papilla. And no technique was superior to the other.

CLINICAL RELEVANCE TO INTERDISCIPLINARY DENTISTRY

An open gingival embrasure or black triangle occurs as a result of a deficiency of papilla beneath the contact point. The treatment of open embrasures may require restorative, orthodontic and periodontal considerations depending on the underlying etiology. Treatment of open embrasures requires an interdisciplinary approach of orthodontic, periodontic, and restorative treatment. Open gingival embrasures have complex esthetic and functional problems. An interdisciplinary team approach with the general dentist, orthodontist, and periodontist is critical.

Key words: Han and Takel technique, interdental papilla, papilla presence index, papillary height, Robert Azzi technique

INTRODUCTION

In addition to maintaining dental and periodontal health, dental esthetics has become a great concern for both dental practitioners and patients. In the last decade, esthetics has become a major concern in periodontal therapy with gingival recession resulting in denuded root surface and loss of gingival papilla being the two main concerns in periodontal esthetics.

The contour of the interdental tissues, the color and texture of keratinized tissues play a role in esthetics and the presence of interproximal papilla between

the maxillary anterior teeth being the key esthetic component. Hence, one of the major esthetic challenges in periodontal plastic surgery is the ability of rebuilding the lost papilla in the maxillary anterior segment.

Today's dentist face esthetic standards that require a soft tissue contour with an intact papilla and a symmetrical gingival outline, especially in the interdental area of the maxillary central incisors. The loss of interdental papilla can result in what is known as black triangle which can result in various problems such as food impaction, affect esthetics and phonetics.

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How to cite this article: Shruthi S, Gujjari SK, Mallya KP. Comparison of two surgical techniques for the reconstruction of interdental papilla. *J Interdiscip Dentistry* 2015;5:17-22.

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Interproximal Papillae Reconstruction in Maxillary Implants

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Modified roll flap a handy technique to augment the peri-implant soft tissue in the esthetic zone: A randomized controlled clinical trial

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Abstract

The esthetic outcome of single-tooth implants in the esthetic zone has become increasingly important concern in the current literature. Deficient or thin per-implant labial soft tissue thickness seriously and adversely affects the esthetic outcome of such situations. The modified roll flap (MRF) is a pedicle flap designed to make use of the gingival tissue overlying the covering screw to expand the thickness of the labial soft tissue instead of discarding it as in flapless technique. The current randomized control trial assesses the efficiency of the MRF technique for augmenting the labial peri-implant soft tissue during stage-two implant surgery. The outcome measures include the measurement of the labial soft tissue thickness and the implant esthetic score system (IES).

Methods: 12 out of 14 patients (8 males and 4 females) aged from 20 to 50 years old were included. All patients were suffering a missing tooth in the esthetic zone and surrounded by a thin gingival biotype classified according to TRAN technique and direct method. At stage II surgery, patients were randomly split to: Control group using a standard crestal incision and MRF study group. All surgical procedures were performed by a single operator the principal author*. Thickness was measured by the direct method using periodontal probe with endodontic stopper via a special stent with a fixed hole to ensure reproducible measurements. A modified form of the IES system composed of the summation of four parameters individually measured was used to assess esthetics. All assessments were performed by a single Co-author who was blinded to the group under evaluation.

Results: The MRF group showed a statistically significant difference over the control group regarding thickness at baseline, 3 month ($P = 0.01$) and 6 month postoperatively ($P = 0.03$). The IES score showed a statistically significant difference in favor of MRF at 3 and 6 month ($P < 0.05$), while, the baseline measurement was not significant ($P > 0.05$).

Conclusion: MRF is a cost effective convenient technique that can effectively augment the thickness of the labial peri-implant soft tissue and help to achieve better appearance in the esthetic zone.

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Keywords: Implant; Esthetic zone; Anterior maxilla; Pedicled flaps; Modified roll flap; Soft tissue augmentation; Peri-implant soft tissue; Gingival biotype; Randomized control clinical trial

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Peer review under the responsibility of the Faculty of Dentistry, Tanta University



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1. Introduction

Implant placement in the esthetic zone is a technique sensitive procedure with a little room for error. Achieving a successful dental implant in this zone is a multifactorial procedure that cannot be judged by the

AGREDECIMIENTOS

Después de este periodo de prácticamente ocho meses, quería escribir esta sección de agradecimientos con fines de finalizar mi trabajo de fin de grado.

Este trabajo representa un aprendizaje intenso, tanto al nivel científico que personal. Fue de gran importancia para poner un punto final a mis cinco maravillosos años de estudio y por eso me gustaría agradecer específicamente a la persona que me ha ayudado durante todo este proceso, mi tutor.

Muchas gracias por su disponibilidad y el tiempo dedicado a mi proyecto. Usted me apoyó, fue muy rápido en sus respuestas a mis preguntas y estuvo perfectamente disponible. Gracias por haber compartido esta experiencia conmigo.

Además, dedico este trabajo a mi familia, por favor encontrad en él todo el reconocimiento que os merecéis.