

*Original Research Article*

## Use of Hyaluronic Acid in Black Space

Thalia Ferreira Campos<sup>1\*</sup>, Caio Denardin<sup>2</sup>, Thiago Quirino Mota da Silva<sup>3</sup>, Túlio Garcia Margute<sup>4</sup>,  
Max Soares Maione<sup>5</sup>, Andrei Rabenschlag Rossato<sup>6</sup>, Tiago Garcia Margute<sup>7</sup>, Igor Fonseca dos Santos<sup>8</sup>

### Abstract

Oral health care, prevention and treatment are generally expected by patients in the dental environment, especially in the case of oral aesthetics. The loss of the interdental papilla has led many people to seek treatment, and it is important to consider that the success of this intervention can be compromised. Thus, the main objective of this research was to know the applicability of hyaluronic acid in filling the black space, to identify whether hyaluronic acid was effective in their treatment. Therefore, the studies and data collection were carried out in the second half of 2019 and the first half of 2020, through a literature review in databases such as Pubmed and the Brazilian Digital Library of Theses and Dissertations (BDTD). The development of this study included the use of some key words, such as: hyaluronic acid, black space and interdental papilla. Thus, based on the researched studies, it was possible to verify the applicability of hyaluronic acid being used as a resource in filling/treatment of black spaces, which showed its effectiveness and relevance considering its functionality, also highlighting the importance of longitudinal studies on the subject.

**Keywords:** Hyaluronic Acid; Black Space; Interdental Papilla

<sup>1</sup>CEULP-ULBRA, Palmas, TO, Brazil.

<sup>2</sup>Department of Periodontics, ITPAC, TO, Araguaína, Brazil.

<sup>3</sup>Department of Implantology, CEUMA, MA, São Luis, Brazil.

<sup>4</sup>Department of Prosthodontics, FACOP, SP, Bauru, Brazil.

<sup>5</sup>Medical student, Faculdade de Medicina, UnirG, Paraíso do Tocantins/TO, Brazil.

<sup>6</sup>Department of Implantology, São Leopoldo Mandic, SP, Campinas, Brazil.

<sup>7</sup>Department of Implantology, FACOP, SP, Bauru, Brazil.

<sup>8</sup>Department of Medicine and Dentistry, UNIRG, Paraíso do Tocantins, CEULP-ULBRA, IOA, Palmas, TO Tocantins, TO, Brazil.

\*Corresponding Author's E-mail:  
[tiagomargute@hotmail.com](mailto:tiagomargute@hotmail.com)

### INTRODUCTION

With an important role in smile esthetics, the interdental papilla has the function of preventing food impaction (compromising periodontal health) and protecting the underlying structures, as well as the gingival portion in the proximal area under the contact between two adjacent teeth. As mentioned by Csiszar et al. (2007), the interdental papilla provides distinct anatomical, histological and molecular characteristics, with significant acuity from an aesthetic point of view, especially in the anterior region, since it is common to be displayed during the smile.

The constant innovations adopted in dental procedures serve an aesthetic purpose, which involves the care and treatment of the interdental papillae. Studies

carried out by Tarnow et al. (1992) indicated that the criteria for the successful formation of soft tissues in the superior anterior region depend, in large part, on the existence of a healthy interdental papilla and the formation of a corresponding gingival contour. The authors also found that black triangles are ranked as the third most unpleasant aesthetic problem below caries.

Lee et al. (2016) pointed out that papillary deficiencies can also cause phonetic problems by allowing air and saliva to pass through. Lindhe (1999) explains that the shape of the interdental gingiva, that is, the interdental papilla, is determined by the shape of the points or contact surfaces between the teeth, the width of their proximal surface and the anatomy of the cemento-enamel

junction. Thus, the interdental papilla in the region of the anterior teeth has a pyramidal shape, while in the posterior regions, the papillae are flatter in the buccolingual direction. In the regions of premolars and molars, the teeth do not have a contact point, but a contact surface, thus influencing the topography of the interproximal papilla present in these areas. For this reason, the interdental papilla has its shape determined according to the shape of the interproximal contact surfaces and, thus, a concavity is formed present between the buccal papillary crest and the lingual papillary crest, known as the "col" area Lindhe (1999).

This area also has, according to Lindhe (1999), a great prosthetic-periodontal interest for presenting a thin epithelium, little stratified and not keratinized. Polson et al. (1984) says that the periodontium, and therefore also the interdental papilla, is part of a biological unit formed by a complex system of cells and tissues, organized in three dimensions, whose basic components are the gingival tissues, the root cementum, the periodontal ligament and the alveolar bone. Thus, when seeking the regeneration of this complex, one must think about the regeneration of all these components, and not just a particular component.

Reconstruction of papillary insufficiency is one of the most difficult and challenging periodontal treatments. This is because the interdental papilla is a small and fragile area, with less blood supply, which seems to be the main limiting factor in all surgical and augmentation techniques (Singh et al., 2013; Al-Zarea et al., 2015).

Hyaluronic acid gel preparations, long used as dermal fillers (Bertl et al., 2015; Pistorius et al., 2005) have recently been used to treat interdental/interimplantation papilla loss (Allegra et al., 2012; Casale et al., 2015).

Hyaluronic acid (HA) is an important natural carbohydrate component of the extracellular matrix and can be found in the skin, joints, eyes, and most other organs and tissues, including the periodontium. Furthermore, it is present in body fluids such as serum, saliva and gingival crevicular fluid and as a component of soft and hard tissues (Hyaluronan, 1997). In the periodontium, AH is synthesized by AH synthase enzymes present in various cells including fibroblasts and keratinocytes in the gingiva and periodontal ligament, cementoblasts and osteoblasts (Ijuin et al., 2001; Laurent, 1998).

HA is a polysaccharide (glycosaminoglycan) present in body tissues such as skin and cartilage, and under physiological conditions it binds to water and swells when in gel form, resulting in smoother/ fuller tissue contours. HA is a high molecular weight polymer ( $\geq 105$  Da) consisting of disaccharide repeats of N-acetylglucosamine and glucuronic acid, with several thousand sugar molecules. The viscosity of hyaluronic acid solutions increases with increasing concentrations and its unique rheological properties make it an ideal lubricant

in the biomedical realm. Chemical modification (crosslinking) of HA results in a material that degrades more slowly (due to decreased water solubility) (Pistorius et al., 2005; Sahayata et al., 2014).

A study by Becker et al. (2010) reported that minimally invasive but viable reconstruction was possible in a small area of deficient interdental papilla using an injectable hyaluronic acid gel. To date, injectable hyaluronic acid gel has been stable and used successfully to reduce wrinkles and improve other similar facial deformities. This work aimed to know the applicability of AH in filling the Black Space.

## METHODOLOGY

The methodology selected for this work was through a literature review, which addressed the applicability of using hyaluronic acid as a resource in filling the black space. With the help of records, the study was carried out by bringing together articles in Portuguese, English and Spanish. In the search method on the subject, the online databases LILACS (Latin American and Caribbean Literature in Health Sciences), Pubmed, Academic Google and the Brazilian Digital Library of Theses and Dissertations (BDTD) were used.

For the selection of articles, the following inclusion criteria were established: articles available in the databases that talked about the theme of hyaluronic acid independently and in the treatment of black space. And as exclusion criteria: articles that did not talk about hyaluronic acid independently and in black space treatment.

The search time for articles involved the period between 2019-2020.

Controlled descriptors in health sciences (DeCS) were used: black space, hyaluronic acid.

## RESULTS AND DISCUSSION

The interdental papilla is a non-keratinized gingival tissue, covered by stratified squamous epithelium. Its shape is pyramidal in the anterior region, and occupies the space located below the contact point, between two adjacent teeth, coronally to the alveolar bone crest. In the posterior region, the papilla presents a non-keratinized concave area, which joins the buccal to the lingual papilla, called "col". Due to its minimal vascular supply, the reconstruction of the structure is compromised (Kovalik et al., 2011).

The treatment of "black triangles" (or black spaces) can be subdivided into two groups: invasive and non-invasive. Among the non-invasive techniques are orthodontic movement, proximal enamel reduction (stripping), restorative treatment and non-surgical perio-

dental instrumentation (Shapiro, 1985; Zachrisson, 2004; Sharma and Park, 2010).

Local injection of fillers and other materials comprise non-surgical or minimally invasive forms of treatment (Becker et al., 2010).

The most invasive procedures are accompanied by greater morbidity, although they enable long-term stability (Awartani and Tatakis, 2016). There is a range of injectable materials available for filling in modern dentistry, so in aesthetic areas such as in regions where there has been a loss of interdental papillae, the most used is hyaluronic acid, as it is a substance that is already produced by the self. organism, giving the body volume, support, hydration and elasticity (Lima et al., 2012).

However, its use in Dentistry, according to Buffon and Glesse (2018), the assumption that guided the application of hyaluronic acid (HA) in the oral interior was the supposed idea that it would be possible to explore the stability of HA with cross-links to reduce the "black spaces".

One more point to consider is the periodontal biotype of patients. There are two types of biotypes with regard to the thickness of the gingival tissue that can be identified in the daily routine and are recognized in the literature as: thick gingiva and thin gingiva (Maynard and Wilson, 1980; De Rouck et al., 2009).

Naturally, these two types of gingival biotypes respond differently to infections, restorations or parafunctional phenomena, in addition, having very thin gingiva can lead to aesthetic and functional complications, in addition to greater susceptibility to tissue recession and consequent loss of attachment, whether periodontal or peri.-implant.

Therefore, the periodontal biotype must be correctly identified before treatment, as differences in gingival and bone morphology can demonstrate a significant impact on treatment outcomes. In the case of papillary filling, there is a greater risk of tissue injury during the application of hyaluronic acid in patients with a thin periodontal biotype and therefore the application should be slower and more careful, as the excess of (HA) could induce tissue necrosis and, in this case, automated application could be of great value. It should be noted that monitoring and guidance regarding on-site hygiene is extremely important (Cuny-Houchmand et al., 2013).

Becker et al. (2010) evaluated the effects of applying hyaluronic acid injected 2-3 times in 14 sites (11 patients) after 6-25 months of follow-up and reported 100% improvement in 3 sites, 88-97% improvement in 8 sites and one site adjacent to an implant showed only 57% improvement. Only 4 of the treated sites were between natural teeth, the others were between natural teeth and implants. The authors reported extremely encouraging and encouraging results where the use of injectable HA gel can improve papillary deficiencies, but reported

the need for controlled clinical trials.

Another very similar study, carried out by Mansouri et al. (2013) in a group of 11 patients with deficiency in the interdental papilla, in which 0.2% hyaluronic acid was injected, and the procedure was repeated after 3 weeks and 3 months later. By analyzing the before and after images through a software, the results showed that the HA is effective, since after 3 months of the last application 10% of patients had 50% of the reconstructed papilla, and in an evaluation after 6 months it was found 43% of the patients had 50% of interdental papilla reconstruction.

Buffon and Glesse (2018), analyzing the stability of HA when inserted into tissue, developed a technique called three steps with the objective of creating a stable foundation that can allow the body to regenerate naturally. This technique was used in three clinical cases in which they achieved an improvement in the condition of necrotic interdental papilla, improvement in aggressive periodontitis, and reconstruction of the papilla around the implant.

Periodontal disease is one of the factors that can lead to the loss of the interdental papilla, generating the known "black triangles" or black spaces, which affect approximately one third of the adult population. In addition to detracting from aesthetic harmony, this loss causes changes in some functions of the stomatognathic system, such as phonetics, in addition to contributing to the accumulation and retention of food in the region, thus favoring the development of periodontal disease (Kovalik et al., 2011).

A limitation of studies investigating the efficacy of hyaluronic acid gel injection (Becker et al., 2010; Awartani and Tatakis, 2016; Mansouri et al., 2013) is the small number of patients/sites allocated for treatment. Previous studies by Becker et al. (2010) included 14 to 21 interproximal papillae in the treatment of 9 to 11 patients. The limitation in the number of patients can be attributed to several factors, such as: previous treatment of the papilla, use of antibiotics, anti-inflammatory drugs, drugs that act on gingival tissue, such as calcium channel blockers and cyclosporine, for example, systemic diseases. subsidiaries, among others.

Another factor to be considered is related to the dimension of the gingival recession, in the study by Petersen and Hohl (2011), the average gain acquired with this treatment was 2.7 mm and it was observed that the greater the initial recession of the papilla interdental, the lower the success rate of the intervention with hyaluronic acid. Thus, it can be noted that hyaluronic acid is an interesting treatment for individuals with small interpapillary losses where the marginal tissue recession does not go beyond the cemento-enamel junction, that is, Nordland and Tarnow class I patients (Petersen and Hohl, 2011).

## CONCLUSION

Thus, based on the researched studies, it was possible to verify the applicability of hyaluronic acid being used as a resource in filling/treatment of black spaces, which showed its effectiveness and relevance considering its functionality. However, longitudinal studies on the researched subject become important.

**Conflict of interest:** The author declares no conflicts of interest.

**Acknowledgements:** List here those individuals who provided help during the research

**Funding:** None.

## REFERENCES

- Allegra L, Della Patrona S, Petrigni G (2012). Hyaluronic acid: Perspectives in lung diseases. *Handbook of Experimental Pharmacology*.;207:385–401.
- Al-Zarea BK, Sghaireen MG, Alomari WM, Bheran H, Taher I (2015). Black Triangles Causes and Management: A Review of Literature. *British Journal of Applied Science & Technology*.; 6(1):1-7.
- Awartani FA, Tatakis DN (2016). Interdental papilla loss: treatment by hyaluronic acid gel injection: a case series. *Clin Oral Investig*.;20(7):1775-1780.
- Becker W, Gabitov I, Stepanovv M, Kois J, Smidt A, Becker BE (2010). Minimally invasive treatment for papillae deficiencies in the esthetic zone: a pilot study. *Clin Implant Dent Relat Res*.;12(1)1-8.
- Bertl K, Bruckmann C, Isberg PE, Klinge B, Gotfredsen K, Stavropoulos A (2015). Hyaluronan in non-surgical and surgical periodontal therapy: a systematic review. *J Clin Periodontol*. Mar;42(3):236-46.
- Buffon LR, Glesse S (2018). Uso do ácido hialurônico no preenchimento da papila interdental: estudo de caso. In: *Salão de Ensino e Extensão da Universidade de Santa Cruz do Sul, Anais do IX Salão de Ensino e Extensão*.
- Casale M, Moffa A, Sabatino L, Pace A, Oliveto G, Vitali M, Baptista P, Salvinelli F (2015). Hyaluronic acid: Perspectives in upper aero-digestive tract. A systematic review.;10(6):PLoS One 10: e0130637. Fraser JR, Laurent TC, Laurent UB. Hyaluronan (1997): its nature, distribution, functions and turnover. *J. Int. Med*. 242(1):27–33.
- Csiszar J, Lantos E, Tari I, Madoşa E, Wodala B, Vashegyi A, Horvath F, Pecsvaradi A, Szabo M, Bartha B, Galle A, Lazar A, Coradini G, Staicu M, Postelnicu S, Mihacea S, Nedelea G, Erdei L (2007). Antioxidant enzyme activities in *Allium* species and their cultivars under water stress. *Plant Soil Environ*.;53(12):517-523.
- Cuny-Houchmand M, Renaudin S, Leroul M, Planche L, Le Guehenec L, Soueidan A (2013). Gingival biotype: The probe test utility. *Open Journal of Stomatology*.;3(2):123.
- De Rouck T, Eghbali R, Collys K, De Bruyn H, Cosyn J (2009). The gingival biotype revisited: transparency of the periodontal probe through the gingival margin as a method to discriminate thin from thick gingival. *J Clin Perio-dontol*.;36(5):428.
- Ijuin C, Ohno S, Tanimoto K, Honda K, Tanne K (2001). Regulation of hyaluronan synthase gene expression in human periodontal ligament cells by tumour necrosis factor-alpha, interleu-kin-1beta and interferon-gamma. *Arch Oral Biol*.;46(8):767–772.
- Kovalik AC, Bonafé ETR, Pilatti GL, Santos FA (2011). Papila interdental: pre-visibility das técnicas reconstrutivas. *Braz J Periodontol*.;21(3):22-32.
- Laurent TC (1998). The chemistry, biology, and medical applications of hyaluronan and its derivatives, Wenner-Gren international series, 72 ed. London: Portland Press.
- Lee WP, Kim HJ, Yu SJ, Kim BO (2016). Six month clinical evaluation of interdental papilla re-construction with injectable hyaluronic acid gel using an image analysis system. *J Esthet Restor Dent*. May 9. doi: 10.1111/jerd.12216.
- Lima DI, Pinto M, Mendes L (2012). Eficácia do ácido hialurônico no preenchimento da papila interdental. *Congresso OMD*. [periódico on-line].
- Lindhe J (1999). *Tratado de Periodontia Clínica e Implantologia Oral*. Terceira edição. Rio de Janeiro: Ed. Guanabara Koogan.
- Mansouri SS, Ghasemi M, Salmani Z, Shams N (2013). Clinical Application of Hyaluronic Acid for Reconstruction of Interdental Papilla at the Esthetic zone. *J. Islamic Dental Assoc. Iran (JIDA)*.;25(2):152-157.
- Maynard JG, Wilson RD (1980). Diagnosis and management of mucogingival problems in children. *Dent Clin North Am*.;24(4):683.
- Petersen AS, Hohl, S (2011). Computergesteuerte Weichgeweb-saugmentation mit Hyalu-ronsäure – die ASP-Methode. *Cosmetic Dentistry*.;4:22.
- Pistorius A, Martin M, Willershausen B, Rockmann P (2005). The clinical application of hyaluronic acid in gingivitis therapy. *Quintessence Int*.;36(7–8):531–538.
- Polson A, Caton J, Polson AP, Nyman S, Novak J, Reed B (1984). Periodontal response after tooth movement into intrabony defects. *J Peri-odontol*.;55(4):197-202.
- Sahayata VN, Bhavsar NV, Brahmabhatt NA (2014). An evaluation of 0.2% hyaluron-ic acid gel (Gengigel (R)) in the treatment of gingivitis: A clinical & microbiological study. *Oral Health and Dental Management*.;13(3):779–785.
- Shapiro A (1985). Regeneration of interdental papillae using periodic curettage. *Int J Periodontics Restorative Dent*.;5(5):26-33.
- Sharma AA, Park JH (2010). Esthetic considerations in interdental papilla: remediation and regeneration. *J Esthet Restor Dent*.;22(1):18-28.
- Singh VP, Uppoor AS, Nayak DG, Shah D (2013). Black triangle dilemma and its management in esthetic dentistry. *Dent Res J*.;10(3):296-301.
- Tarnow DP, Magner AW, Fletcher P (1992). The effect of the distance from the contact point to the crest of bone on the presence or absence of the interproximal dental papilla. *J Perio-dontol*.;63(12):995-6.
- Zachrisson BU (2004). Interdental papilla reconstruction in adult orthodontics. *World J Orthod*.;5(1):67-73.