Effectiveness of Non-Surgical Procedures for the Treatment of Black Triangle Cases in the Aesthetic Zone on the Height of the Interdental Papilla: Narrative Review

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ABSTRACT

Background: *The black triangle is a cervical embrasure to the proximal contact that is not filled with gingival tissue. Until, the treatment of black triangle cases has evolved to offer non-surgical procedures such as hyaluronic acid injection, Injectable Platelet Rich Fibrin (i-PRF), and photobiomodulation therapy. Various studies have also reported the use of hyaluronic acid, i-PRF and photobiomodulation therapy to increase the height of the interdental papillae.*
Method: *Literature searches were carried out systematically from various international databases such as PubMed, ScienceDirect, Google Scholar, and Semantic Scholar. The literature selection stages are carried out through the process of identifying articles, screening, and fulfilling inclusion criteria. A total of 52 articles were published in 2012 – 2022 and have met the criteria for data extraction examination of various clinical parameters from the black triangle case.*
Result: *The results of the review showed that the use of hyaluronic acid injection, i-PRF and photobiomodulation therapy showed significant treatment results in cases of black triangle class I and II.*
Conclusion: *It was reported that the non-surgical procedure for the treatment of black triangle cases produce better result and predictable results, an easy technique, more effective time than surgical procedures and reduced discomfort and met the aesthetic demands of patients based on clinical parameters after 6 month injection.*

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INTRODUCTION

The aesthetic composition of the smile is very important for interpersonal relationships and greatly influences the patient's quality of life. To get an aesthetic and harmonious smile, the shape, position and color of the teeth, as well as the gingival tissue must be taken into account.[1,2] The gingiva is one of the key factors in maintaining aesthetics and the presence of normal sized and harmoniously shaped interdental papillae is very important and the key to aesthetics in the anterior region.[3,4]

The interdental papilla is the part of the gingiva, which occupies the space between two adjacent teeth.3 The concept of “interdental papilla house” has been proposed to describe the relationship between the soft and hard tissues surrounding the interdental papilla. This concept likens the interproximal space containing the interdental papilla to a house, which includes: the contact area, the cementoenamel junction (CEJ), the tooth surface, and the area where the roots and soft tissue meet above the alveolar bone crest.[5,6]

Black triangles is defined as an embrasure cervical to a proximal contact that is not filled by gingival tissue.[7] As a result, this space can cause phonetic problems as well as create space for food and plaque accumulation.[8] Black triangles occurs due to several factors including age, absence or presence of periodontal disease, tooth crown shape, tooth root angulation, and proximal contact.[2]

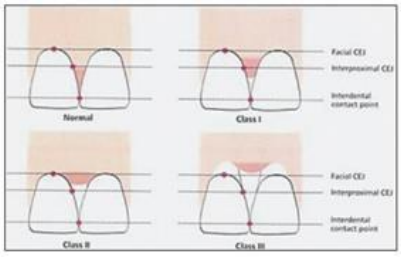

Figure 1. Black triangle classification according to Norland and Tarnow.[9]

Norland and Tarnow introduced the following classification for interdental papilla loss:[8]

Normal: The interdental papilla occupies the entire embrasure space apical to the point of interdental contact. Class I: There is a contact point between two teeth, the tip of the interdental papilla is located between the interdental contact point and the most coronal point of the CEJ on the proximal surface.

Class II: There is a contact point between two teeth, the tip of the interdental papilla is located between the most points coronal CEJ on the interproximal surface and the most apical point of the CEJ on the labial surface.

Class III: There is a point of contact betweentwo teeth, the tip of the interdental papilla is located parallel to or apical to the CEJ point on the labial surface.

Non-surgical methods mostly include closure of the black triangle with orthodontic treatment, and in recent years there has been research into papilla reconstruction with hyaluronic acid.[10] Hyaluronic acid is a glycosaminoglycan located in extracellular tissue in the human body and is a key element of soft tissue and tissues. periodontal hardness.[6,11] The main role of hyaluronic acid is to bind water to maintain tissue structure and characteristics.[2,12]

Injectable-platelet rich fibrin (i-PRF) is a liquid form of platelet rich fibrin. One of the components that makes up i-PRF is fibronectin which is an extracellular glycoprotein with a high molecular weight. The use of i-PRF is generally for regenerative treatments with good results.[13]

Photobiomodulation therapy has become a routine treatment modality in many dental clinics and has been proven to be efficacious in wound healing and tissue regeneration.[14,16] Hemolasertherapy is the result of hemotherapy treatment carried out with blood, where drops of the patient's blood are used in certain areas together with a photobiomodulation laser. The main advantage of this technique is that there is no need to isolate and remove stem cells, because it is used directly in places that do not have interdental papillae.[16,17] The aim of this literature is to examine the effectiveness of non-surgical procedures for the treatment of black triangle cases in the aesthetic zone against high papillae interdental.

RESEARCH METHODS

Data source searches were carried out from various international databases including PubMed, Science Direct, Google Scholar and Semantic Scholar. The search technique used the following keywords: non-surgical procedures, gingival black triangle, and interdental papilla. Boolean operator facilities, namely the words AND and OR and the sign "..." are used as an article search strategy in each database.

The inclusion criteria used were as follows: articles discussing non-surgical procedures for treating black triangle cases, articles discussing black triangle treatment with hyaluronic acid treatment, i-PRF, and photobiomodulation therapy, articles belonging to the literature review category, research, case reports and case series, articles discussing class I and II black triangle treatment Norland and Tarnow classification, articles discussing black triangles in maxillary and mandibular anterior teeth, articles published in the last 10 years (2012-2022) and English and Indonesian journal articles.

The exclusion criteria are as follows: articles that discuss non-surgical procedures for the treatment of black triangles, articles that are not equipped with research methods or reviews, articles that discuss non-surgical procedures outside the field of periodontics, articles that discuss black triangles with patients who have anterior dental caries, diastema, anterior crowding, fixed prostheses or orthodontic appliances.

The selection process starts from screening duplicate articles from each database, and continues with assessing the title and abstract. If duplicate articles and discrepancies in the title and abstract are found, the article is removed from the literature list. The next stage, relevant articles were read carefully in the available full-text and analyzed for their suitability to the predetermined inclusion criteria and continued with data synthesis.

Data were synthesized and collected based on the author's name, year of publication, study design, follow-up, number of black triangles treated, number of subjects, age range, gender, classification of interdental papilla loss, treatment technique and clinical results. Clinical parameters assessed include contact point-gingival margin (CP-GM), black triangle height (BTH), black triangle width (BTW), black triangle area (BTA), and interdental papilla reconstruction rate (IPRR).

RESULTS

An initial search using keywords and other related terms resulted in 162 titles collected from all databases, with details of 78 titles from PubMed, 9 titles from ScienceDirect, 49 titles from GoogleScholar, and 26 titles from SemanticScholar.

The first evaluation, namely identifying

duplicate articles, resulted in 26 titles being removed from the literature list. Furthermore, during the assessment of titles and abstracts, 46 article titles were excluded. Of the 46 potential articles, 38 articles were excluded after careful full-text reading, because they did not meet the inclusion criteria. Thus, a total of 52 articles published between 2012 and 2022 were included in the narrative review.

1.1 Use of hyaluronic acid for black triangle treatment

All articles presenting data on CP – GM parameters showed a significant increase in papilla height after a follow-up of 6 – 12 months. Two clinical studies by Ni et al., and Sing & Vandana., who underwent black triangle treatment showed significant results after 12 months and 6 months. Singh & Vandana conducted research by evaluating three concentrates 1%, 2% and 5%. The results showed that the use of 5% hyaluronic acid was effective for treating interdental papilla deficiencies after 6 months. Ni et al., conducted a study of 8 patients with loss of class I and II interdental papillae in the anterior area and were evaluated over a long term of 12 months. The results showed an increase in papillae from baseline, 3, 6, and 12 months (P=0.005).[18,19]

Alhabashneh et al., and Pitale et al., conducted clinical studies by treating class I and II black triangle cases. The results showed a significant decrease in BTH in classes I and II after 6 months post-injection. Lee., et al and Pitale et al., reported the results of a significant reduction in BTW parameters. The results showed statistically significant differences from baseline to 3 and 6 month intervals.[20,21,22]

The case series research reported by Awartani et al., and Patil et al., resulted in a statistically significant reduction in BTA after 3 and 6 months of injection. In Awartani et al.'s study, conducting a patient satisfaction survey, 2 people out of 9 people stated that the procedure was related to post-injection pain, whereas in Patil et al.'s study, they did not conduct a patient satisfaction survey. [23,24]

Several clinical studies conducted by Lee et al., Firkova, and Mansouri et al., resulted in a statistically significant increase in IPRR after 6 months. In Lee et al.'s study, they performed hyaluronic acid injections at 43 locations in the posterior area of the maxilla and the results showed that 29 locations had complete reconstruction and 14 locations increased from 39% to 96%.[21,25,26]

1.2 Use of i-PRF for black triangle treatment

Candramohan & Swetha A., conducted research with a pilot study design showing that the CP – GM parameters with the first follow-up increased papillae by 10-20%. At the second follow-up the increase was 15-63%, and at the third follow-up the increase was 33-69%. The results of the study showed that it was proven to be helpful in treating black triangle in class I and II cases.[27]

A case report by Puri et al., who performed black triangle treatment with the use of i-PRF showed a significant reduction in BTH after intervention assessed with image J software along with clinical measurements. BTH measurements show a decrease The papilla tip – contact point distance is quite large after 1, 3 and 6 months. [28]

Trivedi et al., conducted research with a study design in the form of a random clinical trial. This study compared the use of i-PRF treatment techniques with hyaluronic acid injections. Both treatment groups were reported to be able to reduce BTA significantly until the third month. In the i-PRF group BTH decreased significantly compared to the hyaluronic acid group.[29]

1.3 Use of photobiomodulation therapy for

the treatment of the black triangle

Two case reports that measured BTH parameters showed a significant increase. Zanin et al., who performed black triangle treatment with photobiomodulation therapy with a 660 nm diode laser, showed a significant reduction in BTH in the first week measuring 1 mm and in the second week the papilla was completely filled with new tissue, thus providing a more aesthetic aspect to the gingiva.[16]

Padmanabhan et al., treated two cases of black triangle with photobiomodulation therapy with an 810 nm diode laser showing significant BTH.[30]

DISCUSSION

The main aim of this study was to examine the effectiveness of non-surgical procedures for treating black triangle cases in the aesthetic zone on the height of the interdental papilla. The hypothesis is that non-surgical procedures namely, hyaluronic acid, i-PRF and photobiomodulation therapy produce effective and predictable results on interdental papilla height based on clinical parameters.

Treatment of black triangle cases requires a detailed periodontal examination and a good assessment of the etiology and factors influencing the presence of interdental papillae. Treatment options are non-surgical and surgical. The first includes orthodontic treatment, installation of prosthetic crowns, adjustment of tooth shape with restorations, and non-surgical periodontal. Surgical treatment is based on the insertion of flaps and gingival grafts of soft or hard tissue. However, the treatments mentioned above may not provide satisfactory and or predictable results.[2]

A newer and non-invasive approach for the treatment of black triangle cases in the aesthetic area is the application of hyaluronic acid, i-PRF and photobiomodulation therapy which have shown promising results in recent years.2,16,29 Hyaluronic acid is an important component of extracellular matrix of several body tissues, such as the connective tissue of the dermis and gingiva.[2] Has it is proven that hyaluronic acid regulates biological processes such as skin repair, cancer diagnosis, wound healing, tissue regeneration, inflammatory action, and immunomodulation. Due to its tissue regeneration potential, hyaluronic acid has been widely used in cosmetic and nutricosmetic products, intradermal filler injections and interdental papilla filling.[2,23]

*Injectable platelet rich fibrin*was developed to fulfill the purpose of acting as a regenerative agent that can be administered in a liquid formulation by rapidly drawing blood in a specific centrifuge tube at a very low speed of 700 rpm with a time of 3 minutes. The aim is to centrifugation without anticoagulant. The advantage of i-PRF is that it is rich in white blood cells, allowing for rapid and sustained release of growth factors and can induce the expression of TGF-β and collagen-1 mRNA.[31]

Photobiomodulation therapy is used with the aim of improving blood microcirculation to increase metabolism and stimulation of fibroblastic activity to obtain healthy and stable gingival growth in the long term.[16] Hemolasertherapy is a type of therapy developed by McGuire et al., to regenerate deficient interdental papillae by stimulating gingival blood flow. and promotes the formation of blood clots in the black triangle area.[6]

Ni et al., conducted a random clinical trial study to measure CP – GM and BTA parameters by comparing hyaluronic acid injection and NaCl injection. Results showed that hyaluronic acid injection resulted in papilla increases of 0.198 and 0.28 mm at 6 and 12 month follow-up. However, the NaCl injection group also grew by 0.278 mm at 12 months. Hyaluronic acid injection significantly

improved papillary deficiency 6 months earlier than NaCl injection. Hyaluronic acid significantly accelerates the proliferation and migration of gingival fibroblasts.[32]

A case report by Oswal and Kour who treated gingival recession and black triangle with free gingival graft (FGG) and i-PRF techniques showed significant results. Clinical examination revealed Miller class III gingival recession and a decrease in the height of the interdental papilla. At 3 months, the gingival recession was reduced to 1.5 mm but the interdental space was still present. The i-PRF injection procedure was carried out 3 months after FGG placement and repeated 6 times with an interval of 15 days each. The height of the interdental papilla increased at 3 months from papilla index score (PIS) 1 to PIS 3 and the results were quite stable after 3 months. These results indicate that the main advantages of i-PRF compared with other platelet concentrates due to the "slow speed concept" of centrifuging blood which contains more regenerative cells and leukocytes.[33]

Zanin et al., who performed black triangle treatment with photobiomodulation therapy with a 660 nm diode laser, showed a significant reduction in BTH in the first week, reduced by 1 mm and in the second week the papilla felt full of new tissue, thus providing a better aesthetic aspect to the gingiva. These results indicate the role of mesenchymal stem cells (MSC) in gingival papilla regeneration. In addition, based on the known effects of photobiomodulation in tissue engineering, MSCs survive and differentiate within the blood clot after photobiomodulation.[16]

The results of this study show, through a narrative review, that hyaluronic acid injection techniques, i-PRF and photobiomodulation therapy reduce BTH and show an increase in CP – GM distance in 6 and 12 month follow-up. However, it should be noted that this review also has some limitations. The main one relates to the small number of studies available in the literature. Therefore, studies with higher numbers and longer follow-up are needed. However, this narrative review of the effectiveness of non-surgical procedures for the treatment of black triangle cases in the aesthetic zone against high interdental papillae is relevant for periodontists because it introduces existing data to a simple, safe, and non-invasive practice that has shown promising results

CONCLUSION

Non-surgical procedures such as hyaluronic acid, i-PRF and photobiomodulation therapy for the treatment of black triangle cases in the aesthetic zone towards high interdental papillae produce better and predictable results, easy, affordable techniques, more time effective than surgical procedures and reduce discomfort patients as well as meeting the patient's aesthetic demands for a minimum period of 6 months.

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