



Clinical Application of Hyaluronic Acid and Platelet-Rich-Fibrin in Reconstructing Interproximal Papillae in Teeth and Implants. A Literature Review.

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Abstract

Aim: This review summarizes and discusses the clinical application of hyaluronic acid and platelet-rich-fibrin in managing missing or lost interproximal papillae between teeth and dental implants in the esthetic zone.

Materials and Methods: Searching dental-related articles online from google scholar, PubMed.

Result and Discussion: The recent studies reveal certain conditions that the clinician should consider before deciding the best approach, such as bone availability, quality, and quantity of gingival tissue in the esthetic zone. This article will discuss Hyaluronic acid injections and platelet-rich fibrin application that has gained popularity in the dental field showed promising results.

Keywords: Interdental papillae deficiency, Dental implants, Esthetic zone, Hyaluronic acid, PRF.

Introduction

The soft tissue profile and gingival esthetic are the determinants of the esthetic success of implant dentistry. People become aware of their beauty and appearance. With this increasing awareness and demand for esthetics, clinicians face the challenge of restoring, reconstructing or rehabilitating missing interproximal papillae in the esthetic zone. The loss of interdental papillae causes black triangles, which are the most critical patients' concerns. The lack of interdental papillae leads to esthetic, phonetic, and food impaction problems. The clinicians consider these problems a significant failure in implant esthetics. Interdental papillae form part of the gingiva that occupies adjacent teeth. Management and reconstruction of interdental papillae involve surgical and nonsurgical approaches. The article discusses the application of HA and PRF in treating interproximal papillae deficiency with current methods.

Before starting any treatment, it is obligatory to analyze the Esthetic Zone. The analysis depends upon the anatomic findings: the amount and the level of available interdental papillae, gingival biotype, Bone availability, tooth morphology, Smile line, lip position, and lip mobility.

The level of interproximal papillae depends upon the following parameters:

The interdental papilla is part of the gingival tissue that occupies adjacent teeth. It aids in food deflection and plays a significant role in esthetics. The papillae have a pyramidal shape in the incisal region, extending coronally beneath the contact point. Many causes lead to the loss of interproximal papillae, such as periodontal diseases, orthodontic treatment, loss or extraction of teeth, and diastema. Tarnow et al. introduce a classification system for loss of papillary height. This system used three landmarks. They include interdental contact points, the apical facial extent of the cemento-enamel junction, and the interproximal coronal extent. The classification comprises: normal when the interdental papilla fills the embrasure space and extends to the interdental contact point. Class 1 is when the interdental papilla tip lies between the interdental contact point and the most coronal extent of interproximal CEJ. Class 11 is when the interdental papilla tip lies at or apical to the interproximal CEJ and lies coronally to the apical area of the facial CEJ. Class 111 is when the tip of the interdental papilla lies at the level with or apical to the facial CEJ [1].

Tarnow et al. conducted a study analyzing interproximal papillae presence vertically by measuring the contact area's distance to the bone crest. The study showed that the papilla was 100% present in space when the distance was <5 mm; 56% existed at 6mm, and only 26% were available when the distance was >7mm. Here it was found that the apico-coronal proximal biologic width position and dimension appear to determine papilla tip location between adjacent implants. There was a significant association between the provisionalization protocol and missing PH, which was also influenced by the horizontal distance between implants. Patient aesthetic satisfaction was high, despite a less than optimal papilla fill.[2]

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Another study analyzed the relationship between the interproximal height of bone to the predictable papilla length by Salama et al. This study showed three classifications depending on the distance from the contact point to the bone crest. Class 1 is 4 to 5 mm and with an optimal prognosis. Class 2 gave 6 to 7 mm with a guarded prognosis. Class 3 showed >7 mm with a poor prognosis [3].

The horizontal distance between the dental implant and the adjacent tooth should be 1.5 mm to counterbalance bone remodeling and preserve interproximal bone peak. Many studies showed that if the inter-implant distance is ≤ 3 mm, the bone loss is 1.04mm [4]. Moreover, if that distance is > 3 mm, the bone loss is 0.45 mm. Therefore, to have a normal inter-implant papilla, there is a need for a minimum length of 3 mm between adjacent dental implants. When examined radiographically, implants if placed less than 3mm apart it was found out that mean vertical bone resorption was 0.62 mm, and the mean horizontal component was 0.60 mm. The bone peak that extended coronally beyond an imaginary line connecting the two implant-abutment interfaces was measured, and the mean bone height preservation above this inter-implant line was 0.24 mm

Gingival Thickness

Soft tissue analysis is a critical step in managing interdental papillae deficiency. Clinicians divided the oral soft tissue into two types: keratinized and non-keratinized. Keratinized tissue is preferable to ensure tissue stability in the esthetic zone; without it, there will be a recession, bleeding on probing, plaque accumulation around the dental implant necks. Therefore, the loss of Keratinized gingiva affects dental implants' health and may lead to implant failure. Clinicians also consider the importance of the Gingival biotype analysis, which is either thick or thin. A dense fibrous and wide keratinized gingival tissue are features of thick gingival biotype. They also lack scalloping between interdental papilla and buccal gingiva. All these features give the shape of a flat periodontium. On the other hand, the thin biotype has the following characteristics: A light, delicate soft tissue, minimal keratinized gingival tissue, and a significant amount of scalloping soft tissue; whenever the clinicians find a thin biotype, soft tissue augmentation is the solution before implant placement or stage II implant covering surgery [6].

Bone Availability

Evaluating the available bone before implant placement in the esthetic zone in three dimensions is crucial and considering bone augmentation to prevent possible dilemmas such as buccal recession, lack of interdental papillae, and poor implant positioning. Clinicians examine the interproximal bone height and thickness of available bone. They are significant to support the interdental papillae. If the distance is more than 5mm from the alveolar bone crest to the contact point, bone augmentation is the solution, such as guided bone regeneration or distraction osteogenesis [6].

Dental Morphology

Tooth morphology plays a role in determining the gingival biotype; Clinicians found that triangular-shaped teeth are related to the thin periodontium. The interproximal contact location is in the coronal one-third of the crown and is associated with long thin papillae. While for the square-shaped teeth, there is an association between this form of teeth and thick periodontium. The interproximal contact area is at the middle one-third of the crown, and the papilla appears short and wide. 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.

Role of HA and PRF in reconstructing interdental papillae:

Hyaluronic acid application: Hyaluronic acid is a glycosaminoglycan located in extracellular tissue in the human body. HA allows cell adhesion and proliferation. Non-cross linked and crossed linked HA has also been used to treat periodontitis and gingival recession. It also enhances wound healing and accelerated periodontal repair and regeneration because hyaluronic acid has shown anti-inflammatory, anti-oedematous, and anti-bacterial effects for the treatment of periodontal disease, which is mainly caused by the microorganisms present in subgingival plaque⁸. It allows interaction of growth factors, regulates osmotic pressure, and enhances tissue lubrication, which helps maintain tissue structural and homeostatic integrity of tissues, hence resulting in a beneficial effect on interdental papilla [9]. Clinicians started to use hyaluronic acid because of its following characteristics: bacteriostatic, fungistatic, anti-edematous, anti-inflammatory, and osteoinductive features; these characteristics make it safe to treat missing papillae and gingival embrasures. It aids in an implant-supported crown as well. [10] Becker et al. showed that injection of hyaluronic acid that small papillary deficiencies between implants and teeth can be enhanced by injection of a hyaluronic gel. Improvements were maintained for a range of 6 to 25 months. enhanced minor papillary deficiencies between implants and teeth [11].

When using HA, the clinicians have found few complications, including pain and swelling discomfort after injection lasted longer, because the hygroscopic feature of hyaluronic acid that absorbs water into the tissues resulted in the swelling of the lips and compresses the blood vessels [8,10].

Clinicians have conflicting viewpoints on hyaluronic acid injection outcomes. Some clinicians believe that interdental papillae and peri-implant papillae showed none or little change after the injection, and the amount used in the injection was not enough. They think that hyaluronic acid increased the interdental papillae volume by water absorption. They also suggest that desirable results in the interdental papillae and gum tissue differed from the results in the skin when they applied hyaluronic acid. The lack of elastic fibers in attached gingiva and peri-implant mucosa limits tissue expansion after injection. The peri-implant mucosa has reduced blood supply because of periodontal ligament lacking

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and few fibroblasts compared to normal gingival tissue, which gives unsatisfactory outcomes after hyaluronic acid injection. Therefore, the clinicians suggest separating gingival tissue from the underlying periosteum and injecting hyaluronic acid [10].

The researchers considered the concentration of HA an essential factor in the management of interdental papilla loss that might occur due to several reasons as a consequence of periodontal surgery, trauma, and others. They have discovered different results when applying varying concentrations of HA into the gingival tissue. The study purpose was to present HA gel in three concentrations, 1%, 2%, and 5% of HA, to evaluate its efficiency in enhancing short interdental papillae. 5% of HA gave highly significant results; the clinical measurements resulted in 19% after one month, 20% after three, and 18% after six months. Photographic analysis showed about 41% after one month, 42% after two months, and 39% after six months. Researchers concluded that the usage of 5% HA is effective for restoring deficient interdental papillae with the slightest rebound after six months [12,13].

Most clinicians reported excellent results when using HA to reconstruct missing interdental papillae; they have found that HA enhanced wound healing and expedited periodontal repair and generation⁸. The case selection regarded the size of the black triangle available, amount of bone loss, and degree of oral tissue deformities—the less the bone or soft tissue loss, the better the results. Hyaluronic acid injection efficacy depends significantly on the contact point (CP) and bone crest (BC) distance. Researchers have found that a 4-6mm (CP-BC) distance will show complete interdental papillae reconstruction. Areas that are more than 6mm will have less interdental papillae coverage. Some studies showed that the combination of autologous bone graft and HA has promising results when applied to infra-bony defects [14].

PRF application

Platelet-rich-fibrin is a second-generation PRP that belongs to a new generation of platelet concentrate with simplified processing and without biochemical blood handling. It has a low thrombin concentrate as a matrix for endothelial cells and fibroblast migration. It allows rapid angiogenesis and fibrin remodeling and is necessary for superficial and cutaneous healing. It contains cytokines, circulating progenitor cells, and growth factors such as PDGF, TGF- β , and VEGF. PRF highlights an accelerated tissue cicatrization due to the development of effective neovascularization, accelerated wound closing with fast cicatricial tissue remodeling, and nearly total absence of infectious events. [15-17]. The PRF is easy to produce, inexpensive with ideal healing properties. PRF acts like a fibrin glue that keeps the flap stable, enhances new blood vessels formation, and reduces necrosis and flap shrinkage¹⁸. Fibrin network structure in PRF is the main factor in tissue healing processes. But it is also seen that slow fibrin polymerization during PRF processing leads to the intrinsic incorporation of platelet cytokines and glycanic chains in the fibrin meshes. This result would imply that PRF, unlike the other platelet

concentrates, would be able to progressively release cytokines during fibrin matrix remodeling; such a mechanism might explain the clinically observed healing properties of PRF [16].

Researchers investigated the effectiveness of cross-linked HA and Leucocyte-PRF on fibroblast viability and proliferation in vitro. Leukocyte- and platelet-rich fibrin (L-PRF) is an autologous derived platelet and leukocyte concentrate. The L-PRF has played a significant role in surgical implantology and procedures that involve hard and soft tissue augmentation. The growth factors associated with L-PRF enhanced wound healing and decreased healing time. HA is a component of the extracellular matrix of the skin, bone, and periodontal ligament. It stimulates cell adhesion and migration as well as has anti-inflammatory effects. There are two types of HA, cross-linked and non-cross-linked. In this study, the researchers compared the combination of L-PRF and CL-HA with two other groups that contained only either L-PRF or CL-HA. The highest cell viability and proliferation were associated with the L-PRF group. Cellular activity and proliferation were related to the HA group and increased from day 1 to day 8. CL-HA combined with the L-PRF group demonstrated lower cells than the other groups [19].

The clinicians used PRF in many techniques, such as filling the peri-implant gap in the anterior region in the pouch flap technique [15].

Clinicians also conducted a study showing that split-thickness flap (STF) surgery combined with PRF or connective tissue graft (CTG) may effectively increase interdental papilla height [18]. Clinicians also used multilayered rich fibrin PRF resorbable membranes as a barrier membrane in some instances, especially those related to bone augmentation and soft tissue regeneration and bone generation. [20].

I-PRF also has similar properties as PRF and in addition to that, it is available in injectable form. As it is a liquid concentrate, its growth factors and other components are not encapsulated in a fibrin matrix and neither are readily available. But the major advantages of i-PRF over other platelet concentrates have been proposed to be due to the slow speed concept of blood centrifugation. Also, it has a higher concentration of growth hormones.

I-PRF forms a small clot that acts as a dynamic hydrogel. It contains more regenerative cells and leukocytes, which play a role in wound healing and tissue regeneration. I-RPF was used for papilla reconstruction by repeated injection over 3 months until favorable results were obtained which seemed to be stable at 6 months follow-up. Thus i-PRF can serve as an easy to prepare and use alternative for gaining the interdental papillary height with excellent results. The result was that papillae had filled the embrasure space with a harmonious relationship with other teeth—a noticeable improvement in gingival tissue [21].

Conclusion

The clinical application of both Hyaluronic acid and PRF has become popular in managing short interdental papillae in implants and teeth. Most cases showed successful results when using either HA or PRF with an eliminating black triangle. Thorough Research is necessary to evaluate the effect of these products on more case studies. Researchers should do more randomized clinical trials and investigate HA and PRF combined with different materials like bone grafts.

References

1. Nordland WP, Tarnow DP. A classification system for loss of papillary height. *Journal of periodontology*. 1998 Oct 1;69(10):1124-6.
2. Tarnow DP, Magner AW, Fletcher P. The effect of the distance from the contact point to the crest of bone on the presence or absence of the interproximal dental papilla. *Journal of periodontology*. 1992 Dec;63(12):995-6.
3. Salama H, Salama M, Garber D, Adar P. Developing optimal peri-implant papillae within the esthetic zone: guided soft tissue augmentation. *Journal of Esthetic and Restorative Dentistry*. 1995 May;7(3):125-9.
4. Thoma DS, Mühlemann S, Jung RE. Critical soft-tissue dimensions with dental implants and treatment concepts. *Periodontology 2000*. 2014 Oct;66(1):106-18.
5. Tarnow D, Cho SC, Wallace SS. The effect of inter-implant distance on the height of inter-implant bone crest. *Journal of periodontology*. 2000 Apr;71(4):546-9.
6. Bashutski JD, Wang HL. Common implant esthetic complications. *Implant dentistry*. 2007 Dec 1;16(4):340-8.
7. Palacci P, Nowzari H. Soft tissue enhancement around dental implants. *Periodontology 2000*. 2008 Jun;47(1):113-32.
8. Zhang Y, Hong G, Zhang Y, Sasaki K, Wu H. Minimally invasive procedures for deficient interdental papillae: A review. *Journal of Esthetic and Restorative Dentistry*. 2020 Jul;32(5):463-71.
9. Tanwar J, Hungund SA. Hyaluronic acid: Hope of light to black triangles. *Journal of International Society of Preventive & Community Dentistry*. 2016 Sep;6(5):497.
10. Bertl K, Gotfredsen K, Jensen SS, Bruckmann C, Stavropoulos A. Can hyaluronan injections augment deficient papillae at implant-supported crowns in the anterior maxilla? A randomized

controlled clinical trial with 6 months follow-up. *Clinical oral implants research*. 2017 Sep;28(9):1054-61.

11. Becker W, Gabitov I, Stepanov M, Kois J, Smidt A, Becker BE. Minimally invasive treatment for papillae deficiencies in the esthetic zone: a pilot study. *Clinical implant dentistry and related Research*. 2010 Mar;12(1):1-8.

12. Singh S, Vandana KL. Use of different concentrations of hyaluronic acid in interdental papillary deficiency treatment: A clinical study. *Journal of Indian Society of Periodontology*. 2019 Jan;23(1):35.

13. Vandana KL, Singh S, Anil L. Histologic evaluation of 5% Hyaluronic acid injection in oral tissue: A pilot study. *Int J Mol Biol Open Access*. 2019;4(6):206-8.

14. Lee WP, Seo YS, Kim HJ, Yu SJ, Kim BO. The association between radiographic embrasure morphology and interdental papilla reconstruction using injectable hyaluronic acid gel. *Journal of periodontal & implant science*. 2016 Aug 1;46(4):277-87.

15. Ayoub AH, Belal SM. Peri-Implant Soft Tissue Augmentation Using Platelet Rich Fibrin (PRF) in Esthetic Zone: A Case Report. *EC Dental Science*. 2016;6:1418-23.

16. Choukroun J, Diss A, Simonpieri A, Girard MO, Schoeffler C, Dohan SL, Dohan AJ, Mouhyi J, Dohan DM. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part IV: clinical effects on tissue healing. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*. 2006 Mar 1;101(3):e56-60.

17. Dohan DM, Choukroun J, Diss A, Dohan SL, Dohan AJ, Mouhyi J, Gogly B. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part II: platelet-related biologic features. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*. 2006 Mar 1;101(3):e45-50.

18. 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. *Contemporary Clinical Dentistry*. 2019 Oct;10(4):643.

19. Peck MT, Hiss D, Stephen L, Olivier A. The in vitro effect of leukocyte-and platelet-rich fibrin (L-PRF) and cross-linked hyaluronic acid on fibroblast viability and proliferation. *South African Dental Journal*. 2018 Jul;73(6):395-9.

20. Soni R, Priya A, Yadav H, Kumar V, Mishra N. Multilayered Platelet-rich Fibrin as a Barrier Membrane in Guided Bone Regeneration with Simultaneous Implant Placement: A 3-year Follow-up. *Dent*. 2020;11(4):328-31.

21. Pratima Oswal, et al. "Free Gingival Graft Along With I-Prf for Recession Coverage and Interdental Papilla Augmentation: A Case Report." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), 19(6), 2020, pp. 22-27