RESEARCH ARTICLE

COMPARATIVE CLINICAL EVALUATION OF INJECTABLE PLATELET-RICH FIBRIN ALONE AND IN COMBINATION WITH HYALURONIC ACID IN THE MANAGEMENT OF INTERDENTAL PAPILLARY DEFICIENCY

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Short title: i-PRF with Hyaluronic Acid for Black Triangles

ABSTRACT

Background: Interdental papilla deficiency, commonly known as the "black triangle", is a frequent esthetic concern in periodontal practice. Besides compromising smile esthetics, these spaces predispose patients to food impaction, phonetic disturbances and plaque retention. Conventional surgical procedures for papilla reconstruction are technically demanding and often produce unpredictable outcomes because of limited vascularity and complex papillary anatomy. Minimally invasive regenerative therapies such as injectable platelet-rich fibrin (i-PRF) and hyaluronic acid (HA) have therefore gained increasing clinical interest.

Aim: To clinically evaluate and compare the effectiveness of i-PRF alone and i-PRF combined with HA in the management of interdental papillary deficiency.

Materials and Methods: Thirty systemically healthy patients with Nordland and Tarnow Class I or II papillary deficiency were randomly allocated to two groups: Group I received i-PRF, and Group II received i-PRF combined with HA. Clinical evaluation was performed at baseline, 3 weeks, 6 weeks, 3 months and 6 months using standardized periodontal indices and photographic analysis. Statistical analysis was carried out using IBM SPSS Statistics version 29.0, with significance set at $p<0.05$.

Results: Both treatment modalities produced a progressive reduction in black triangle dimensions throughout the study period, but the combination therapy consistently produced greater improvement than i-PRF alone. At 6 months, the reduction in black triangle height was 3.00 mm in the i-PRF + HA group, compared with 2.20 mm in the i-PRF group.

Conclusion: Both i-PRF alone and i-PRF combined with HA improved interdental papillary deficiency over 6 months, with greater improvement in the combination group. The i-PRF and HA combination appears to be a promising minimally invasive approach, but larger randomized controlled trials with longer follow-up are needed.

Keywords: Injectable platelet-rich fibrin, Hyaluronic acid, Black triangle, Interdental papilla, Papillary deficiency, Periodontal regeneration, Soft tissue esthetics.

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INTRODUCTION

The interdental papilla plays a critical role in maintaining both esthetic harmony and periodontal health. Loss of the interdental papilla produces unesthetic spaces, commonly known as "black triangles", which are a frequent esthetic concern, particularly in the anterior maxillary region (Figure 1). These spaces not only compromise smile esthetics but may also lead to phonetic difficulties and food impaction.[1]



Figure 1: Interdental papillary deficiency (black triangles) in the anterior region

The presence and integrity of the interdental papilla are influenced by several factors, including alveolar bone height, periodontal attachment level, tooth morphology and contact point position. Papilla loss is frequently observed after periodontal disease, surgical therapy or ageing, which makes its reconstruction a clinical challenge. Conventional surgical procedures for papilla reconstruction are technique-sensitive and often yield unpredictable results because of limited blood supply and anatomical constraints.[1]

Minimally invasive regenerative approaches using autologous platelet concentrates, such as injectable platelet-rich fibrin (i-PRF), have recently gained attention because of their ability to release growth factors that enhance soft-tissue healing and regeneration. Hyaluronic acid (HA), a naturally occurring glycosaminoglycan, has also been reported to improve soft-tissue volume and hydration. Although both i-PRF and HA have shown promising results individually,[2-4] limited evidence exists comparing i-PRF alone with its combination with HA.[1,5]

Objectives

The primary aim of this study was to evaluate and compare the clinical efficacy of i-PRF alone and i-PRF combined with HA in the management of gingival black triangles, using clinical and photographic analysis over 6 months. The specific objectives were to evaluate and compare the efficacy of the two treatments and to assess their potential benefits by comparing outcomes over a 6-month period.

MATERIALS AND METHODS

Study Design and Sample

The study sample consisted of 30 patients who reported to the outpatient department of the Department of Periodontology, Mahatma Gandhi Dental College and Hospital, Jaipur, with complaints of black triangles or loss of interdental papilla in the maxillary anterior region. Patients were randomly divided into two groups of 15: Group I received i-PRF, and Group II received i-PRF combined with HA. All participants underwent phase I periodontal therapy and received oral hygiene instructions before treatment.[5]

Ethical Clearance

Ethical clearance was obtained from the Institutional Ethics Committee of Mahatma Gandhi University of Medical Sciences and Technology, Jaipur, Rajasthan

Eligibility Criteria

Inclusion criteria: Patients above 18 years of age with Type I or II papillary deficiency according to the Nordland and Tarnow classification,[7] and systemically healthy patients with teeth free from caries, proximal restorations and fixed

Exclusion criteria: Type III papillary deficiency according to the Nordland and Tarnow classification;[7] open contacts between the affected teeth; any systemic disease or condition; current or past smoking or other tobacco use; pregnancy or lactation; alcoholism or a history of drug intake predisposing to gingival enlargement; and ongoing or recent (≤6 months) orthodontic treatment, traumatic oral hygiene practices or periodontal surgery at the study site within the past 6 months.



Figure 2: Armamentarium

Clinical Procedure

i-PRF was prepared from the patient's venous blood, which was centrifuged at 700 rpm for 3 minutes, and the liquid i-PRF fraction was collected and loaded into an insulin syringe for injection[12] (Figure 3). In Group I, i-PRF was injected into the black triangle area at baseline, 3 weeks and 6 weeks (Figure 4). In Group II, i-PRF was injected at baseline and 6 weeks and HA at 3 weeks (Figures 5 and 6).

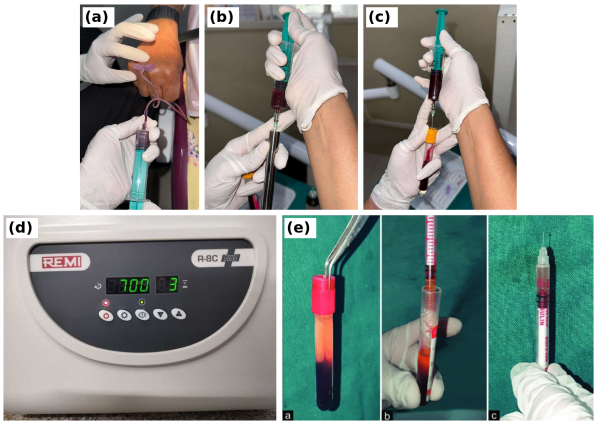


Figure 3: Preparation of i-PRF: (a–c) venous blood collection and transfer; (d) centrifugation at 700 rpm for 3 minutes; (e) i-PRF collected and loaded into a syringe

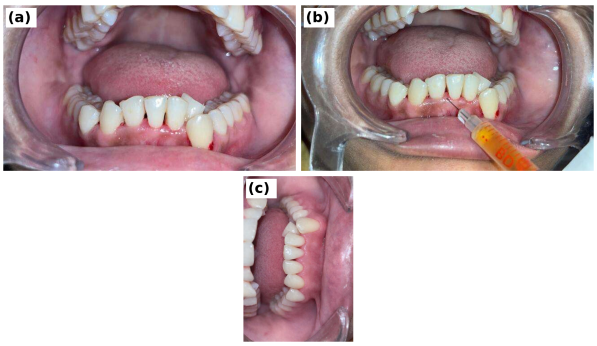


Figure 4: Group I (i-PRF): (a) pre-operative view; (b) i-PRF injected at baseline, 3 weeks and 6 weeks; (c) post-operative view at 6 months

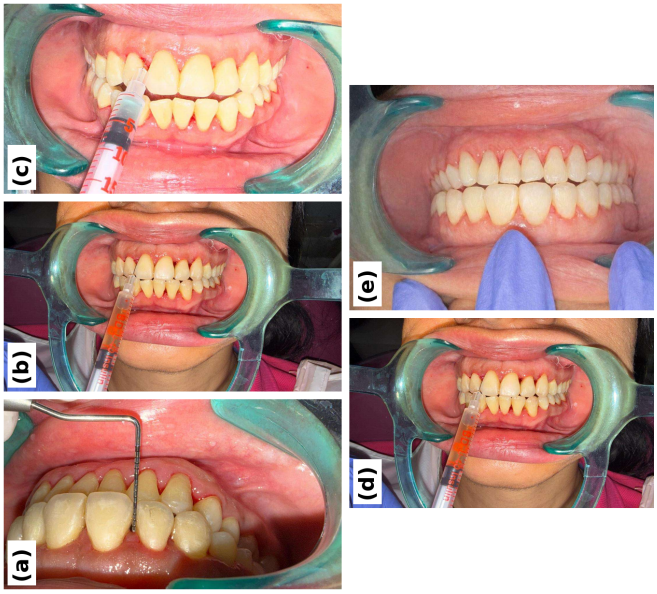


Figure 5: Group II (i-PRF + HA), case 1: (a) pre-operative view; (b) i-PRF injected in the black triangle area at baseline; (c) HA injected at 3 weeks; (d) i-PRF injected at 6 weeks; (e) post-operative view at 6 months

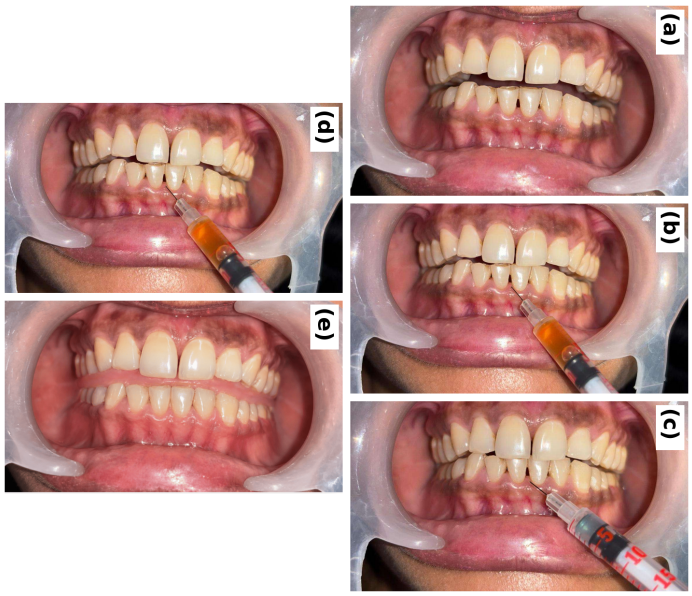


Figure 6: Group II (i-PRF + HA), case 2: (a) pre-operative view; (b) i-PRF injected in the black triangle area at baseline; (c) HA injected at 3 weeks; (d) i-PRF injected at 6 weeks; (e) post-operative view at 6 months

Clinical Parameters

Patients were clinically assessed at baseline, 1 month, 3 months and 6 months[6] using the Gingival Index (Löe and Silness, 1963),[8] the Plaque Index (Silness and Löe, 1964),[9] the Nordland and Tarnow classification of baseline papilla loss (1998)[7] and the Papilla Presence Index (2004).[10] The height of the black triangle was measured

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics version 29.0 (IBM Corp., Armonk, NY, USA). A p-value <0.05 was considered statistically significant.

RESULTS

Both treatment modalities achieved a reduction in black triangle dimensions over the 6-month observation period. Clinical and photographic assessments showed that the combination therapy (Group II) produced consistently greater reductions in defect height and greater improvement in papillary fill than i-PRF alone (Group I). The mean reduction in black triangle height increased progressively in both groups, reaching 3.00 mm in Group II and 2.20 mm in Group I at 6 months (Table 1; Figure 7).

Table 1: Reduction in black triangle height (mm) in the two groups over time

Time interval	Group II: i-PRF + HA	Group I: i-PRF
Baseline	1.98	1.43
3 weeks	2.20	1.68
6 weeks	2.60	1.82
3 months	2.80	2.00
6 months	3.00	2.20

Values are mean reduction in black triangle height (mm). HA: hyaluronic acid; i-PRF: injectable platelet-rich fibrin.

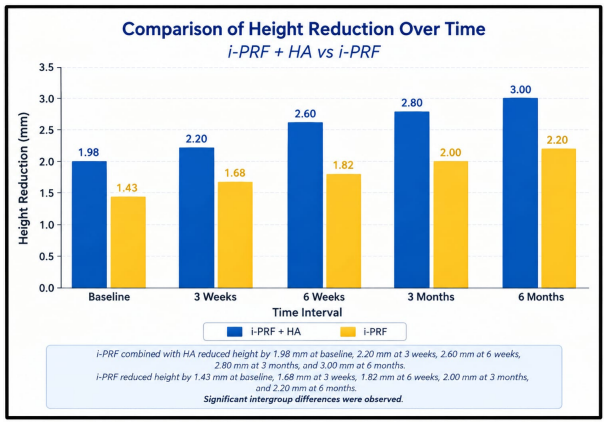


Figure 7: Comparison of the reduction in black triangle height over time in the two groups

DISCUSSION

The present study evaluated the clinical effectiveness of i-PRF alone and in combination with HA in the management of interdental papillary deficiency. Both treatments produced progressive improvement in black triangle dimensions during follow-up, but the combination group showed greater clinical improvement, suggesting that adjunctive HA may enhance the outcomes achieved with i-PRF.

The beneficial effects of i-PRF may be attributed to its autologous composition, which contains platelets, leukocytes and growth factors, including platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β) and vascular endothelial growth factor (VEGF).[11,12] These mediators contribute to angiogenesis, fibroblast proliferation, extracellular matrix formation and soft-tissue healing. However, the relatively fluid consistency of i-PRF may limit its retention and dimensional stability at the injection site.

Hyaluronic acid, a naturally occurring glycosaminoglycan, has hydrophilic and viscoelastic properties that support tissue hydration, extracellular matrix organization and cell migration. Its potential space-maintaining effect may complement the biological activity of i-PRF, facilitating soft-tissue adaptation and papillary fill, and the more favourable outcomes in the combination group may therefore reflect the complementary properties of the two biomaterials. The precise biological interaction between i-PRF and HA, however, requires further investigation.

The progressive changes observed during follow-up also suggest that improvement in papillary contour may involve gradual tissue remodelling and maturation. Nevertheless, interdental papilla reconstruction remains challenging because of anatomical limitations, particularly the relationship between the interproximal contact point and the underlying alveolar bone.

This study has limitations, including its small sample size and limited follow-up. Randomized controlled trials with larger populations, standardized outcome measurement and longer observation are needed to establish the long-term stability and clinical predictability of this approach. Within these limitations, the combination of i-PRF and HA appears to be a promising minimally invasive option for managing interdental papillary deficiency.

CONCLUSION

Within the limitations of the present study, both i-PRF alone and i-PRF combined with HA produced clinical improvement in interdental papillary deficiency over the 6-month observation period, and the combination showed greater improvement in papillary fill and reduction in black triangle dimensions than i-PRF alone. This favourable outcome may be attributed to the complementary biological properties of i-PRF, which promotes tissue healing through growth factor release, and HA, whose hydrophilic and viscoelastic characteristics support tissue hydration and soft-tissue adaptation. The combination therefore represents a promising minimally invasive approach for improving interdental soft-tissue esthetics. Given the anatomical complexity of papillary reconstruction and the limitations of this study, well-designed randomized controlled trials with larger samples, standardized clinical assessment and longer follow-up are warranted to establish its long-term stability, predictability and clinical applicability.

REFERENCES

1. Pal M, Lal N, Verma UP, Pathak AK. Comparative evaluation of hyaluronic acid and injectable platelet-rich fibrin as a non-surgical approach for management of black triangle. Journal of Oral Biology and Craniofacial Research. 2025;15:1660-1667.
2. Puri K, Khatri M, Bansal M, et al. A novel injectable platelet-rich fibrin reinforced papilla reconstruction technique. Journal of Indian Society of Periodontology. 2022;26(4):412-417.
3. Bahadur R, Kashwani R, Sawhney H, Kumar S, Gupta G. Platelet rich fibrin integration in impacted third molar extraction sockets for bony regeneration: a case report. J Dent Probl. 2024;6(1):46-51.
4. Lee W, Lee S, Kim Y, Kim H, Yu S. Reconstruction of interdental papilla using injectable hyaluronic acid gel: a clinical study. Journal of Esthetic and Restorative Dentistry. 2016;28(4):221-230.
5. Fakher I, Hazzaa H, Abdelgawad N. Use of injectable hyaluronic acid gel and injectable platelet-rich fibrin in the treatment of gingival black triangles: a randomized clinical trial. Al-Azhar Dental Journal. 2023;10(2):471-477.
6. El-Sayed A, et al. Minimally invasive pouch technique with leukocyte platelet-rich fibrin compared to non-invasive hyaluronic acid injection in reconstruction of interdental papilla in the esthetic zone: a randomized clinical trial. BMC Oral Health. 2025.
7. Nordland WP, Tarnow DP. A classification system for loss of papillary height. Journal of Periodontology. 1998;69(10):1124-1126.
8. Löe H, Silness J. Periodontal disease in pregnancy. I. Prevalence and severity. Acta Odontologica Scandinavica. 1963;21:533-551.
9. Silness J, Löe H. Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condition. Acta Odontologica Scandinavica. 1964;22:121-135.
10. Cardaropoli D, Re S, Corrente G. The Papilla Presence Index (PPI): a new system to assess interproximal papillary levels. International Journal of Periodontics and Restorative Dentistry. 2004;24(5):488-492.

11. Choukroun J, Adda F, Schoeffler C, Vervelle A. Une opportunité en paro-implantologie: le PRF. Implantodontie. 2001;42:55-62.

12. Miron RJ, Fujioka-Kobayashi M, Hernandez M, Kandalam U, Zhang Y, Ghanaati S, Choukroun J. Injectable platelet rich fibrin (i-PRF): opportunities in regenerative dentistry? Clinical Oral Investigations. 2017;21(8):2619-2627.