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Comparative Study Of Efficacy Of Injectable Platelet Rich Fibrin And Hyaluronic Acid For Interdental Papillary Reconstruction

Dr Archana M. Prajapati
PG Student, Department Of Periodontology, AMC Dental College And Hospital Ahmedabad, Gujarat, India.

Dr Ashish Kaur
Reader And PG Guide, Department Of Periodontology, AMC Dental College And Hospital Ahmedabad, Gujarat, India.

Dr Sirsha Bhattacharjee
PG Student, Corresponding Author, Department Of Periodontology, AMC Dental College And Hospital Ahmedabad, Gujarat, India.

Dr Gunjan Jadav
PG Student, Department Of Periodontology, AMC Dental College And Hospital Ahmedabad, Gujarat, India.

Dr Ankita Patel
Tutor, Department Of Periodontology, AMC Dental College And Hospital Ahmedabad, Gujarat, India.

Dr Harjot Kaur
Senior Lecturer, Department Of Periodontology, Karnavati School Of Dentistry, Gujarat, India.

Abstract
Background: *Gingival black triangles, caused by the absence of interdental papilla, create cosmetic issues, affect speech, and lead to food retention. Reconstruction of the interdental papilla (IDP) is one of the most technique sensitive periodontal therapies. This study compares the clinical efficacy of Injectable Platelet-Rich Fibrin (i-PRF) and Injectable Hyaluronic Acid (HA) for restoring deficient interdental papilla.*
Materials and Methods: *The clinical parameters included the gingival and plaque index, periodontal probing depth, papilla presence index along with radiographic parameter. 44 sites were selected and divided into two groups: Group A and B, and the black triangle height and width was measured for each site. Drug A and B were administered to Group A and B respectively. Follow-up assessments were conducted at 1 month, 3 months, and 6 months.*
Results: *On statistical analysis of the recorded data, results revealed statistically significant differences in both the groups in terms of Papilla presence index, black triangle height and width from baseline to 1 month, 3 months, and 6 months follow up. However, there was a significantly greater reduction in black triangle height and width when interdental papilla reconstruction was performed using iPRF.*
Conclusion: *Injectable platelet-rich fibrin can be a suitable alternative to hyaluronic acid injections for interdental papilla reconstruction.*
Keywords: *Black triangle height; Black triangle width; Interdental papilla reconstruction; Injectable Hyaluronic acid; Injectable platelet rich fibrin.*

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I. Introduction

Today, dental care places a paramount emphasis on esthetics. The esthetic zone is defined as the visible area during functional activities, encompassing the anterior maxillary and mandibular teeth [1]. Loss of

the interdental papilla may lead to a gingival black triangle (GBT), posing esthetic and functional challenges [2]. Kandaswamy et al. (2007) observed that black triangles are more likely to develop when there is labial movement of incisors or when diastemas close [3].

Regenerating interdental papilla is a highly technique-sensitive periodontal esthetic procedure due to limited blood supply [4]. Various surgical strategies for reconstructing the interdental papilla (IDP) include periodic curettage, modified papilla preservation flaps, enamel matrix proteins, acellular dermal matrix allografts, alveolar bone augmentation, membranes, free gingival grafting, pedicle grafts, and interposed connective tissue grafts [5-9]. However, the limited success of these procedures is often due to inadequate blood supply in the interdental region [10]. Therefore, nonsurgical approaches are preferred for their minimal invasiveness, cost-effectiveness, and ability to deliver immediate results with high patient satisfaction [11]. Nonsurgical modalities include orthodontic tooth movement, prosthetic restorative procedures, autologous cultured fibroblast injections, injectable platelet-rich fibrin, and injectable hyaluronic acid (HA) [5].

Autologous platelet concentrates, particularly platelet-rich fibrin (PRF), have been under extensive scientific research and development in the past 15 years, and are now routinely utilized in both surgical and nonsurgical periodontic procedures [12]. The development of an injectable formulation of platelet-rich fibrin (termed iPRF) based on a low-speed concept for blood centrifugation by Ghanaati et al. has been pursued with the aim of delivering to clinicians an easy to use platelet concentrate in a liquid formulation that can be either utilized alone or in combination with various biomaterials [13]. Injectable platelet rich fibrin (iPRF) offers several advantages, including easy formulation, autologous nature, potent antimicrobial activity, and cost-effectiveness [13]. Miron et al. (2017) in their vitro study, demonstrated that Injectable platelet rich fibrin (i-PRF) releases higher concentrations of growth factors such as platelet derived growth factor (PDGF), transforming growth factor-beta 1 (TGF-β1), vascular endothelial growth factor (VEGF), fibroblast growth factor (FGF), and insulin like growth factor (IGF), leading to increased fibroblast migration and collagen expression [14].

Hyaluronic acid (HA), a linear glycosaminoglycan polymer, integrates well into the papillary gingiva, enhancing microcirculation and improving aesthetics by plumping the papilla [15]. Commonly used in facial rejuvenation, HA is also proposed for interdental papillary reconstruction by promoting fibroblast migration and fibrogenesis [16]. Becker et al. studied the application of HA to reduce or eliminate gingival black triangles adjacent to dental implants and teeth in the aesthetic zone [17].

Therefore, it is of interest to report this study to evaluate and compare the efficacy of injectable platelet rich fibrin(iPRF) and injectable Hyaluronic acid (HA) in the reconstruction of the interdental papilla.

II. Materials And Methods:

The study included systemically healthy subjects, aged 18 to 55, with loss of interdental papilla, randomly selected from the outpatient department of Periodontology at AMC Dental College and Hospital in Ahmedabad, India. The study received ethical approval, and each patient signed a written informed consent detailing the procedure.

Selection criteria

A. Inclusion criteria:

(1) Age group between >18-55< years.
(2) Patients with Papilla Presence Index 2 (PPI 2) and Papilla Presence Index 3 (PPI 3) interdental papillary loss score with radiographic evidence of no bone loss (Cardaropoli et al,2004[18]) and having a minimum of 4 black triangles.
(3) Patients with a plaque index and gingival index score between zero and one.
(4) Patients having Periodontal probing depth <3mm.
(5) Vertical distance from the interdental contact point to the crest of the interdental bone <5mm measured by intraoral periapical radiograph as per Tarnow's law.
(6) Willing to provide informed consent and available for follow-up appointments.

B. Exclusion criteria:

(1) Patients with known systemic disease or blood dyscrasias or on any medication known to interfere with the outcomes of periodontal therapy.
(2) Smokers, pregnant women, and nursing mothers.
(3) Patients having open contact.
(4) Patients having PPI 4 score. (Cardaropoli et al,2004[18])
(5) Previously treated for periodontal reasons before 6 months.

Materials used

Injectable Platelet-rich fibrin (I-PRF) preparation:

5 ml of blood was drawn into test tubes without an anticoagulant and centrifuged immediately. Blood was centrifuged for 3 minutes at 700 rpm (Ghanaati et al)[13] i-PRF was obtained from the top most layer of the preparation using insulin syringes. (Fig.1)

FIG.1. Injectable platelet rich fibrin and Hyaluronic acid

Hyaluronic Acid Filler Injection
Commercially available Dermaheal HSR 1% Hyaluronic Acid injection was used in the present study. (Fig.1)

Study design

Informed consent: Written informed consent form explaining the nature of the study and procedure signed by the patient.

Baseline recording of clinical parameters:
a. Plaque Index (Silness and loe,1964)
b. Gingival Index (Loe and Silness, 1963)
c. Periodontal probing depth
d. Papilla Presence index (Cardaropoli et al,2004[18])
e. Black triangle height and Black triangle width

Baseline recording of radiographic parameters:

A preoperative radiographic measurement was conducted to assess the distance from the interdental contact point to the alveolar bone crest.

Pre-surgical Protocol: 44 surgical sites were identified and divided into two groups using a computer-generated randomization table for this split-mouth clinical study. Bilateral or contralateral defects were randomly assigned to each group, and clinical photographs were taken before the procedure.
Group A - Drug A was used for interdental papilla reconstruction.
Group B - Drug B was used for interdental papilla reconstruction.
This trial was double-blinded, where blinding included patients and the researcher.
Allocation concealment was ensured using sequentially numbered, opaque, and sealed envelopes.

Phase I Therapy: The protocol included professional mechanical plaque removal followed by Phase IV therapy, which involved oral hygiene instructions and a 0.2% chlorhexidine gluconate mouth rinse twice daily for 10 days. Patients were recalled after 21 days for further treatment.

Procedure: Topical anesthetic agent 2% Lidocaine was applied.

Drug A and Drug B were pre-loaded in insulin plastic syringes and wrapped with paper prior to injection by co-investigator to ensure patient and researcher blinding.

Drug A was injected in group A using a 31G × 6 mm insulin syringe, positioned 2–3 mm apical to the papilla tip and angled 45° coronally to the tooth's long axis. (Fig.2) Similarly, Drug B was injected in group B with the same syringe and positioning. (Fig.3) The area was gently massaged for 1 minute in circular motion for proper drug distribution. The procedure was performed by a principle investigator.

FIG.2. Group A

FIG.3. Group B

Post surgical evaluation and review: Post-operative assessments of clinical parameters and photographs were taken at 1, 3, and 6 months. The Papilla Presence Index (Cardaropoli et al., 2004) was recorded based on the positional relationship among the papilla, cementoenamel junction (CEJ), and adjacent teeth. Black triangle height was measured from the tip of the papilla to the apical end of the contact point using an endodontic spreader and vernier caliper, while black triangle width was measured at the proximal surface of the associated teeth at the tip of the papilla.

Stastical analysis

The collected data was entered into a Microsoft Excel spreadsheet and analyzed using SPSS version 26.0. The Shapiro-Wilk test assessed the normality of continuous variables. The Friedman test compared indices within the same group over different time periods, while the Mann-Whitney U test evaluated differences in indexing values between groups. A significance level of p=0.05 was set.

III. Result

44 Surgical sites were identified and divided into two groups: Group A (n=22) and Group B (n=22). The clinical parameters assessed were Plaque Index (PI), Gingival Index, Pocket Probing Depth (PPD), Papillae Presence index (PPI), Black triangle height and Black triangle width and radiographic parameters include distance from the interdental contact point to the alveolar bone crest. Drug A and B were administered to Group A and B respectively.

After statistical analysis and unblinding, it was established that drug of group A was injectable platelet rich fibrin(iPRF) and group B was hyaluronic acid(HA). In this study the plaque index, gingival index, and pocket probing depths showed no significant difference between group A and group B. (Table 1&2) Comparison between groups A (iPRF) and B (HA) also revealed non-significant differences in these indices across different time intervals (Table 3). The Papillae Presence Index scores decreased significantly in both groups over time, as indicated by the values at baseline, one month, three months, and six months (Table 1&2). However, there was no significant difference in Papillae Presence Index scores between groups A (iPRF) and B (HA) at different time intervals (Table 3). The Black triangle height decreased significantly in both Group A (iPRF) and Group B (HA) over the study period (Table 1&2). No significant difference was observed between the groups at any time point. Similarly, the Black triangle width decreased significantly in both groups over time (Table 1&2). At baseline and at 3 months, there was no significant difference between the groups. However, at 1 month, Group A (iPRF) showed a significant decrease compared to Group B (HA).

Table 1: Comparison of different indices at different time intervals in Group A

Index	Baseline	1 Month	3 Months	6 Months	F	P value
PI	1.00±0.00	1.00±0.00	1.09±0.29	1.09±0.29	2.10	0.162
GI	1.00±0.00	1.00±0.00	1.09±0.29	1.09±0.29	2.10	0.162
PPD	1.45±0.59	1.45±0.59	1.45±0.59	1.45±0.59	---	---
PPI	2.32±0.47	1.91±0.42	1.82±0.50	1.86±0.56	11.31	<0.001
BTH	1.40±0.49	0.83±0.48	0.60±0.54	0.61±0.56	111.75	<0.001
BTW	1.04±0.34	0.56±0.32	0.40±0.35	0.41±0.35	172.75	<0.001

Table 2: Comparison of different indices at different time intervals in Group B

Index	Baseline	1 Month	3 Months	6 Months	F	P value
PI	1.00±0.00	1.00±0.00	1.09±0.29	1.09±0.29	2.10	0.162
GI	1.00±0.00	1.00±0.00	1.09±0.29	1.09±0.29	2.10	0.162
PPD	1.50±0.59	1.50±0.59	1.50±0.59	1.50±0.59	---	---
PPI	2.45±0.51	2.09±0.42	1.91±0.52	1.95±0.57	13.63	<0.001
BTH	1.48±0.59	1.11±0.54	0.91±0.61	0.91±0.61	154.61	<0.001
BTW	1.11±0.38	0.77±0.36	0.60±0.43	0.60±0.43	171.59	<0.001

Table 3: Comparison of different indices between Group A and Group B at different time intervals

Index	Time Interval	Group A	Group B	Z	P value
PI	Baseline	1.00±0.00	1.00±0.00	0.00	1.000
	1 Month	1.00±0.00	1.00±0.00	0.00	1.000
	3 Months	1.09±0.29	1.09±0.29	0.00	1.000
	6 Months	1.09±0.29	1.09±0.29	0.00	1.000
GI	Baseline	1.00±0.00	1.00±0.00	0.00	1.000
	1 Month	1.00±0.00	1.00±0.00	0.00	1.000
	3 Months	1.09±0.29	1.09±0.29	0.00	1.000
	6 Months	1.09±0.29	1.09±0.29	0.00	1.000
PPD	Baseline	1.45±0.59	1.50±0.59	-0.28	0.777
	1 Month	1.45±0.59	1.50±0.59	-0.28	0.777
	3 Months	1.45±0.59	1.50±0.59	-0.28	0.777
	6 Months	1.45±0.59	1.50±0.59	-0.28	0.777
PPI	Baseline	2.32±0.47	2.45±0.51	-0.92	0.359
	1 Month	1.91±0.42	2.09±0.42	-1.39	0.162
	3 Months	1.82±0.50	1.91±0.52	0.00	1.000
	6 Months	1.86±0.56	1.95±0.57	0.00	1.000
BTH	Baseline	1.40±0.49	1.48±0.59	-0.69	0.486
	1 Month	0.83±0.48	1.11±0.54	-1.74	0.081
	3 Months	0.60±0.54	0.91±0.61	-1.70	0.089
	6 Months	0.61±0.56	0.91±0.61	-1.65	0.098
BTW	Baseline	1.04±0.34	1.11±0.38	-0.75	0.453
	1 Month	0.56±0.32	0.77±0.36	-2.05	0.040
	3 Months	0.40±0.35	0.60±0.43	-1.52	0.127
	6 Months	0.41±0.35	0.60±0.43	-1.49	0.136

IV. Discussion

Microfacial enhancement began with Gersuny (1903), who used low-melting-point paraffin as an injectable filler to correct cosmetic deformities. Gingival black triangles, caused by missing interdental papilla, lead to cosmetic issues such as open embrasures, affecting esthetics, phonetics, and hygiene [2]. Various surgical and nonsurgical techniques have been proposed and experimented in past, for reconstruction of lost interdental papilla.

In the existing study, we have focused on Injectable platelet-rich fibrin (iPRF) and hyaluronic acid (HA) for interdental papilla reconstruction. Platelets can play a vital role in periodontal regeneration as they are reservoirs of growth factors and cytokines, which are key factors for the maturation of soft tissue and the regeneration of bone. Hyaluronic acid enhances microcirculation and integrates well into the papilla, improving esthetic outcomes. Current research focuses on developing therapeutic alternatives that are easy to prepare, biocompatible, cost-effective, and minimally invasive.

Shalini Kapoor et al. (2020) presented a case series of 6 patients using 0.2 ml of 0.2% HA gel to reconstruct interdental papillae in the esthetic zone. Injections were administered at baseline, 3 weeks, and 3 months, with clinical measurements of black triangle size using an acrylic stent. HA gel demonstrated successful results over a 6-month period, consistent with the findings of the current study [19].

Ashima Trivedi et al. (2021) compared autologous Injectable Platelet-Rich Fibrin (i-PRF) and commercially available injectable Hyaluronic Acid for reconstructing small, deficient interdental papilla, specifically PPI2 and PPI3 types of interdental loss (Cadaropoli et al., 2004). Both treatments showed statistically significant improvements in the Papilla Presence Index and reduction in black triangle area at 1 and 3-months follow-up. These findings parallel the results of the present study. Notably, the present study's strength lies in its extended 6-months followup period [20].

V. Conclusion

This study explores the use of Injectable Platelet-Rich Fibrin (iPRF) and Hyaluronic Acid (HA) for reconstructing the interdental papilla (IDP) in patients with Papilla Presence Index (PPI) 2 and 3. Both treatments showed significant improvements in reducing black triangle height and width over 1, 3, and 6 months, with Injectable Platelet-Rich Fibrin (iPRF) demonstrating greater effectiveness. The findings suggest that Injectable Platelet-Rich Fibrin (iPRF) and Hyaluronic Acid (HA) are promising, minimally invasive alternatives to surgical methods for IDP reconstruction, particularly for medically compromised patients.

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Conflicts Of Interest: There are no conflicts of interest.

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