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Comparative Evaluation of the Efficacy of Platelet Rich Fibrin Membrane Meshed with Bioactive Synthetic Bone Graft versus Bioactive Synthetic Bone Graft alone in Treatment of Human Periodontal Intrabony Defect: A Clinico-Radiographic Study

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KEYWORDS

Platelet-Rich Fibrin, Intra-Bony Defect, Bone Graft, Periodontal Disease

ABSTRACT:

Background: Advancing beyond conventional therapy in treatment of intrabony defects, regenerative strategies now aim for true tissue restoration. Platelet-rich fibrin (PRF), a widely used platelet concentrate has gained attention for its ability to enhance both soft and hard tissue healing through the sustained release of growth factors. Bioactive glass, a synthetic bone graft actively participates in tissue regeneration by forming a stable chemical bond with bone. This clinical study explores a novel regenerative approach by combining the biologically active properties of PRF membrane with osteoconductive potential of bioactive glass and compares its efficacy against bioactive glass used alone in the management of intrabony defect.

Materials and Methods: A total of 10 sites of intrabonydefects were selected and randomly divided into two groups. In Experimental Group (5 sites) placement of PRF membrane meshed with bioactive bone glass was done. In Control Group (5 sites) placement of bioactive glass alone was done. Clinical parameters such as plaque index (PI), gingival index (GI), pocket depth reduction(PDR), clinical attachment level gain(CAL)were recordedat baseline, 3 months and after 6 months postoperatively. Radiographicparameter, bone defect area reduction (BDR) was recordedat baseline and 6 months postoperatively.

Results: Statistically significant changes in GI, PDreduction, CAL gain, bone defect area reduction (BDR), from baseline to 6 months were seen in both groups ($P < 0.05$). On intergroup comparison, more favourable changes wereseen with respect to all the clinical parameters and BDR in experimental group compared to control group.

Conclusion: Within limitations ofstudy, combination of PRF membrane and bioactive glass showed a significant improvement in PD reduction, CALgain, and bone fill than bioactive glass alone.

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Introduction

Emerging as a silent yet aggressive condition periodontitis being highly prevalent chronic microbial disease is characterized by progressive inflammatory response that begins in the gingiva and advances to the destruction of periodontal tissues. If left untreated, it results in clinical attachment loss and the formation of complex defects including furcation and intrabony defects that may eventually lead to early tooth loss[1].These defects are associated with a higher risk of progression and thereby considered to require surgical intervention[2]. The key concept is to improve periodontal health and thereby to satisfy a patient's aesthetic and function. Conventional surgical methods, such as open flap debridement (OFD) alone, improves periodontal clinical parameters with healing by repair through formation of a long junctional epitheliumand hence lacks the capacity for regeneration[3,4]. In contrast, regenerative therapy restores tissues structures and function through regenerating the attachment apparatus, including new bone, cementum, and periodontal ligament on a previously diseased root surface[5]. Hence to promote periodontalregeneration and reverse disease-induced damage, regenerative therapies including various bone grafts and their synthetic substitutes have been used. Alloplasts, are an effective alternative to autografts, allograft and xenografts as they offer the advantages of unlimited quantity, no additional surgical site, and no potential for disease transmission.Among various subgroups, bioactive glass (BAG) is a kind of bioactive synthetic silicate-based ceramic which stimulates osteoconduction by bonding to bone andalso has osteostimulatory effect besides its osteoconductiveproperties[6]. Growth factors exert a crucial role in periodontal regeneration. PRF is known to release polypeptide growth factors, such as transforming growth factors-ß, platelet derived growth factors, vascular endothelial growth factors and matrix glycoproteins into the wound site in a sustained manner for at least one week and up to 28 days[7,8,9]. Therefore, considering the distinctive graft's osteoconductive, osteoinductive and osteostimulative properties, along with the regenerative potential of autologous PRF, a combination approach was employed to evaluate their synergistic effect on healing and management of periodontal regeneration in intrabony defects.This study aims to compare the clinical and radiographic outcomes of using PRFmembrane with bioactive glass versus bioactive glass alone in treating intrabony defects.

Materials and Method

Systematically healthy subjects, aged between 20 to 50 years both females and males suffering from chronic periodontitis, having radiographic evidence of one or more intrabony defects (two or three walled) and probing pocket depth of 5 mm or more at the experimental site were enrolled for the study. Patients with habit of smoking and alcohol, with known history of allergy to graft material and who have undergone periodontal surgical treatment for chronic periodontitis within 1 year for the same defects were excluded from the study. Pregnant and lactating females as well as patients on anticoagulant therapy and antibiotic therapy were also excluded from the study. The patients were explained about the procedure and a written informed consent was obtained.A total of 10 sites with intrabony defects in periodontal patients were selected based on the inclusion and exclusion criteria. Patients underwent phase I therapy which included oral hygiene instructions, scaling and root planing under local anaesthesia and occlusal correction if trauma existed. Adjunctive chemical plaque control, in the form of chlorhexidine mouth rinse 0.12% twice daily, was advised. The selected sites were evaluated after four weeks, those with persistent pockets $\geq$ 5mm and radiographic evidence of angular osseous defects were scheduled for periodontal flap surgery.

Clinical Parameters

A single calibrated examiner evaluated the clinicalparameters at baseline on the day of surgery, 3- and 6-months intervals, which included, Gingival index (GI) (Loe and Silness)[10], Plaque index (PI) (Silness and Loe)[10], Probing Pocket Depth (PPD) and Clinical Attachment Level (CAL). Measurements were taken with a calibrated UNC-15 periodontal probe.

RADIOGRAPHIC MEASUREMENTS

The measurements of the defect site on the CBCT were recorded in millimetres in sagittal view. Radiological parameters from the cemento-enamel junction (CEJ) to base of defect and bone defect area were measured at baseline and after 6 months post- operatively.

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PREPARATION OF PRF

Approximately 10 mm of blood was drawn from patient's antecubital vein and was collected into two blood collection tubes without anticoagulant for PRF preparation. The tubes were immediately centrifuged at 400 g for 10 min at 3000 revolutions per minute[11]. The resultant PRF clot was compressed between two sterile glass slides to squeeze and transform into prf membrane.

SURGICAL PROCEDURE

The sites were randomly assigned to either control group (bioactive glass alone) and experimental group (prf membranemeshedwithbioactive glass) by coin and toss method. A full thickness mucoperiosteal flap was raised and thorough open flap debridement was done under local anaesthesia followed by the placement of bioactive glass alone in the control group and prf membrane meshed with bioactive glass in the experimental group. The graft (Bioactive glass) was carefully compacted from the base of the defect coronally in both the groups. However, for the experimental sites, prf membrane was incorporated with required amount of bioactive glass and placed in the defect. A periodontal dressing (Coe pack) was placed to the surgical sites. Postoperatively, patients were prescribed antibiotics and analgesics for 5 days. Periodontal dressing and sutures were removed after one weeks postoperatively.

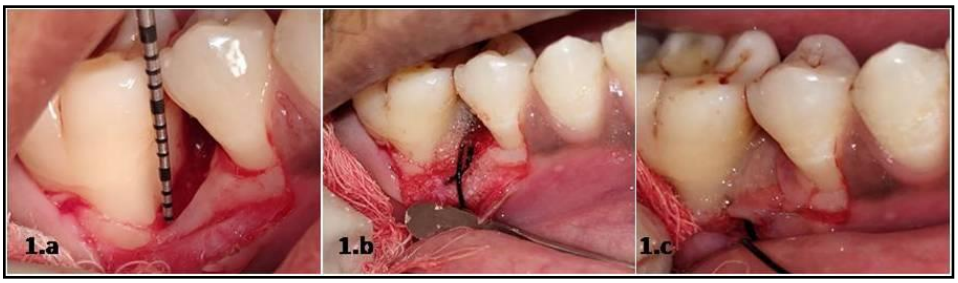

FIG 1.a Measurement of bone defect using UNC-15 probe after reflection in between 45, 46; 1.b Defect Filled with Perioglas® in Between 45, 46; 1.c Defect Filled with PRF membrane meshed withPerioglas® between 45, 46

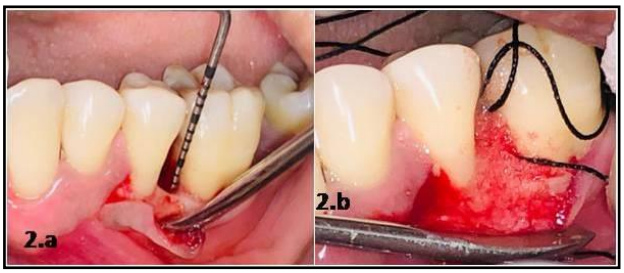

FIG 2.a Measurement of bone defect using UNC-15 probe after reflection in between 35,36; 2.b Defect Filled with Perioglas® in Between 35, 36

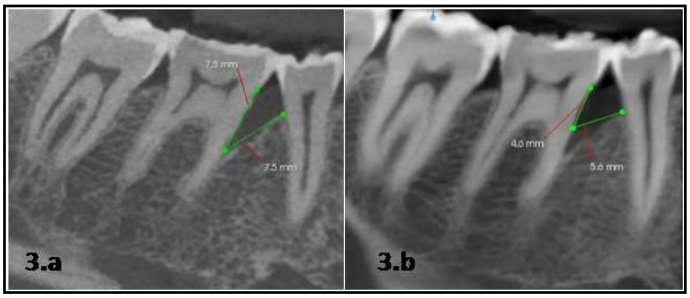

FIG 3.a, b CBCT measurement of defect sites (At baseline and 6months)

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Statistical Analysis

All the results were tabulated and statistically analysed using software Statistical Package for Social Sciences (SPSS version 25, Chicago, Illinios).Comparison between groups were performed with independent samples Student's *t*-test paired *t*-test and at a level of 5% significance.

Results

The mean age of the patients in experimental group was 38.20± 5.11 yearsold, whereas in controlgroup, it was 42.40 ± 5.30 years old with nosignificant difference between the two groups ($P > 0.05$). Inthe meantime, there were three male and two females in experimental group whereas two male andthree females in control group demonstrating no gender bias (p >0,05).

Clinical parameters such as Plaque Index, Gingival Index, Probing Pocket Depth (PPD), and Clinical Attachment Level (CAL) were similar initially between groups.Over time, the experimental group(PRF membrane+Bioactive Synthetic Bone Glass) consistently demonstrated greater clinical improvements compared to the control group (Bioactive Synthetic Bone Glass alone).

- Plaque Index and Gingival Index significantly improved at 3 months in the experimental group ($p < 0.05$).
- Probing Pocket Depth (PDR) and Clinical Attachment Level gain (CAL)were significantly greater in the experimental group at both 3 months and 6 months ($p < 0.05$).
- Bone defect area (BDR) showed a statistically significant reduction at 6 months in the experimental group compared to the control group ($p = 0.013$).

Table 1: Baseline Demographics

Variable	Experimental Group (n=5)	Control Group (n=5)	Mean Difference	Statistic	df	P-value
Age (years)	38.20 ± 5.11	42.40 ± 5.30	-4.20	t = -1.412	8	0.198 (NS)
Gender (M/F)	3 / 2	2 / 3	-	$\chi^2 = 0.400$	1	0.527 (NS)

Table 2: Comparative Evaluation of Clinical Parameters

Variable	Time Interval	Experimental Group	Control Group	Mean Difference	Statistic	P-value
Plaque Index	Baseline	1.70 ± 0.35	1.85 ± 0.28	-0.15	t = -0.775	0.463 (NS)
Plaque Index	3 Months	1.20 ± 0.42	1.45 ± 0.50	-0.25	t = -1.237	0.041*
Plaque Index	6 Months	1.00 ± 0.28	1.10 ± 0.34	-0.10	t = -0.588	0.570 (NS)
Gingival Index	Baseline	1.85 ± 0.28	1.90 ± 0.30	-0.05	t = -0.414	0.688 (NS)
Gingival Index	3 Months	1.10 ± 0.37	1.30 ± 0.43	-0.20	t = -0.881	0.022*
Gingival Index	6 Months	0.80 ± 0.28	1.00 ± 0.41	-0.20	t = -0.967	0.038*
Probing Pocket	Baseline	6.40 ± 0.66	6.30 ± 0.72	0.10	t = 0.278	0.788 (NS)

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Depth (PPD)						
Probing Pocket Depth (PPD)	3 Months	4.00 ± 0.50	4.70 ± 0.68	-0.70	t = -2.134	0.034*
Probing Pocket Depth (PPD)	6 Months	3.00 ± 0.36	3.90 ± 0.72	-0.90	t = -2.847	0.009*
Clinical Attachment Level (CAL)	Baseline	7.00 ± 0.73	6.90 ± 0.67	0.10	t = 0.273	0.790 (NS)
Clinical Attachment Level (CAL)	3 Months	4.60 ± 0.39	5.40 ± 0.78	-0.80	t = -2.528	0.018*
Clinical Attachment Level (CAL)	6 Months	3.60 ± 0.39	4.70 ± 0.55	-1.10	t = -4.630	0.000* (*=Sig)

Table 3: Bone Defect Area Reduction (BDR) (mm^2)

Time Interval	Experimental Group	Control Group	Mean Difference	Statistic	P-value
Baseline	24.00 ± 9.50	25.50 ± 8.80	1.50	t = 1.580	0.760 (NS)
6 Months	10.50 ± 2.60	13.40 ± 4.20	2.90	t = 1.688	0.013* (*=Sig)

Discussion

The main objective of periodontal therapy is to halt the progression of periodontal disease and promote the regeneration of lost periodontal tissues. Periodontal regeneration is a complex process that requires the coordinated interaction of various cell types. Therefore, for periodontal regeneration of intraosseous defect, guided tissue regeneration (GTR) therapy, root conditioning agents, bone graft, growth factors and their combinations have been employed, yielding varying degree of success[12]. Bone replacement graft supports soft tissue walls of the defect and results in gain in clinical attachment level thereby facilitating regeneration of periodontal structures lost during the disease process. Recently bioactive glass with excellent regenerative properties has been extensively used for treatment of periodontal osseous defects[13]. Bioactive glass can develop a chemicalbond with living hard tissues through the development ofa surface layer of carbonated hydroxyapatite. When BG isexposed to tissue fluid, it is covered by silica rich gel onthe top of which calcium phosphate rich layer is formedthat promotes absorption andconcentration of osteoblastcells to form an extracellular matrix and mineralization[6]. PRF, a second-generation platelet concentrate, actively drives tissue regeneration by boosting osteoblast activity, stimulating angiogenesis and enhancing collagen synthesis, making it a powerful catalyst for accelerated healing and bone formation[14]. The present study was conducted to evaluate the regenerative potential of combining PRF membrane with bioactive glass and comparing when bioactive glass is used alone, clinically and radiographically. In the present study,

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there was no statistically significant difference in plaque scores at baseline between both the groups (p = 0.463).However, both treatment modalities achieved a statistically significant reduction in the mean plaque scores at the treated sites during follow-up evaluations compared with baseline scores. At all evaluation periods, the reduction in PI scores in both groups may be attributed to patient compliance and effective oral hygiene.Gingival index scores showed no statistically significant difference at baseline betweenboth groups (p = 0.688). At 3 months (p = 0.028) and 6 months (p = 0.043) significant improvement in mean GI scores in the experimental group than control group were seen, demonstrating long-term benefits of adding PRF to the Bioactive Synthetic Bone Glass in terms of gingival healing and inflammation control. A significant improvement in PDR, CAL gain,and BDR was observed in both test andcontrol group at 6-month postoperatively compared withbaseline yet a greater reduction in pocket depth and gain in clinical attachment level from baseline to 3 months and 6months in experimental group as compared to control group was observed. The results are in agreement with the previous study done by **Naqvi et al**[15],who compared the combination of PRF and bioactive glass putty and bioactive glass putty alone in intrabony defects and demonstrated a greater probing depth reduction in the test group (bioactive glass putty and PRF) than in the control group (bioactive glass putty alone). The mean CAL gain was also greater in the test group as compared to the control group.These results were also in accordance with the study conducted by **Elgendy et al**[16]in which they evaluated the clinical and radiographical outcome of NcHA bone graft with or without PRF, in the treatment of intrabony periodontal defects. They found, significantly greater PPD reduction and clinical attachment gain when PRF was added to NcHA. Our study is also in accordance with the study conducted by **Pavani and colleagues**[17]**.** The study showed a greater PD reduction in β TCP with PRF group compared to β TCP alone.Although, **Agrawal et al**[18]**in their study** compared, PRF and Calcium phosphosilicate putty alone and in combination in the treatment of intrabony defects and found statistically significant changes in GI, PD reduction, CAL gain from baseline to 6 months in all the groups. On intergroup comparison, no statistically significant changes were seen in all the clinical parameters. However, the difference in defect fill and defect depth resolution between the Groups I (OFD with placement of PRF) and III (OFD with placement of PRF and NovaBone putty) and Group II (OFD with placement of NovaBone putty) and III was significant. The difference in results might be due to the lack of any objective measurable method.A similar, study was conducted by **Ashawan et al**[19],who compared bioactive glass bone graft with platelet rich fibrin in treatment of intrabony defects, and found thatthe changes in PPD, CAL and BF were not quite statistically significant when compared between test and control groups, which could probably be due to the difference in the radiographic assessment technique. In our study, a significant radiographic bone defect areareduction (BDR) was observed in both test and control group at 6-month postoperatively. Mean defect area reduction in experimental group treated with PRF membrane meshed with bioactive glass was 10.50 ± 2.60 mm^2 compared to 13.40 ± 4.20 mm^2 in control group treated with bioactive glass alone. However, an increased bone defectarea reduction in experimental compared with control group was observed. This may be due to the additive effect of PRF membrane with bone graft used in the present study.The results of this study are similar to the findings of **Naqvi et al**[15], who have found significantly greater mean bone fill was found in the test group as compared to the control group. Similar results have been found in the study conducted by **Bahammam et al**[20], who have found the most significant increase in bone density and fill in Group III which was treated with OFD and PRF concentrate with nano-HA bone graft. However, **Ashawan et al**[19],found the mean value of bone fill similar in both test and control group**.**

Conclusion

Our study highlights that while both bioactive glass alone and in combination with PRF membrane are effective in treating intrabony defects, the integration of PRF membrane introduces a synergistic advantage. The addition of PRF membrane not only amplifies clinical and radiological outcomes but also enhances the regenerative potential by supporting graft stability and accelerating soft tissue healing. These findings position PRF membrane as bioactive enhancer, transforming conventional grafting into a more biologically responsive and efficient therapeutic approach.

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