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Comparative evaluation of platelet rich fibrin and intramarrow penetration with and without demineralized freeze-dried bone graft in the treatment of periodontal horizontal bone defects – A clinical and radiographic study

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Abstract

Aim: To compare clinically and radiographically the efficacy of Platelet Rich Fibrin and Intramarrow Penetration with and without Demineralized Freeze-Dried Bone Allograft in the treatment of Periodontal horizontal bone defects. Methods: A split mouth study was carried out in twenty patients suffering from generalized Chronic Periodontitis showing evidence of probing pocket depth ≥ 5mm with radiographic evidence of horizontal defects bilaterally. The selected sites were randomly divided into: Group I- Open Flap Debridement with Intramarrow Penetration followed by placement of Platelet Rich Fibrin & Group II- Open Flap Debridement with Intramarrow Penetration followed by placement of Platelet Rich Fibrin and Demineralized Freeze-Dried Bone Allograft. Probing pocket depth and clinical attachment level were evaluated at baseline, 3 months & 6 months post-operatively and linear bone fill was

evaluated at 6 months post-operatively. The recorded data was compiled, tabulated and put to statistical analysis. Results: Both the groups showed significant improvement in all parameters at different time intervals. On intergroup comparison, Group II showed significantly better results between baseline and 3 months & between baseline and 6 months in terms of probing pocket depth reduction and clinical attachment level gain and at 6 months post-operatively in terms of linear bone fill. Conclusion: Within the confines of the study, it may be concluded that Open Flap Debridement along with Intramarrow Penetration, Platelet Rich Fibrin and Demineralized Freeze-Dried Bone Allograft is a promising treatment modality for the management of horizontal bone defects in terms of probing pocket depth reduction, clinical attachment gain and radiographic bone fill, supporting its possible role in future.

Keywords: Platelet Rich Fibrin, Intramarrow Penetration, Demineralized Freeze-Dried Bone Allograft.

Introduction

The periodontal disease alters the morphologic features of bone in addition to reducing height. It leads to various patterns of bone loss of which horizontal and vertical bone loss are the most common bone destruction patterns.[1] The rationale for periodontal therapy is to re-establish and maintain periodontal health and function.[2] Among the various surgical techniques used to achieve the ideal biologic conditions required for periodontal regeneration, Open Flap Debridement was among the earliest procedures used.[3] Scaling and root planing (SRP) with open flap debridement resulted in greater probing depth (PD) reductions and clinical attachment level (CAL) gains in deeper pockets.[2] Regeneration of lost structure has become the primary therapeutic goal in periodontics.[4] However, conventional surgical approaches offer only limited potential in restoring or reconstituting component periodontal tissues.[5] Periodontal regenerative procedures include bone grafts, root biomodifications, guided tissue regeneration, growth factors and biomaterials and combination of these procedures.[6]

A wide range of bone grafting materials, including bone grafts and bone graft substitutes, have been applied and evaluated clinically, including autografts, allografts, xenografts, and alloplasts.[5] Decalcified freeze-dried bone allograft (DFDBA) contains bone morphogenetic proteins (BMPs) that aid in mesenchymal cell migration, attachment and osteogenesis; have both osteoinductive as well as osteoconductive activity and the ability to create and maintain the space.[7] Results of human histologic studies have shown that decalcified freeze-dried bone graft (DFDBA) can promote the formation of a new attachment apparatus on previously diseased root surfaces.[8]

The most common pattern of bone loss experienced is horizontal bone loss which is also called a zero-wall defect as stated by Kern et al 1984. It was observed that vertical bone loss with a prevalence of 7.8% received 96.8% treatment options whereas horizontal bone loss, with a prevalence of 92.2%, received only 3.2% treatment modalities.[9] Thus, horizontal defect demands more attention by researchers with the use of various commercially available bone grafts and autologous growth factors which when compared would give a better overview of its success rate and would also offer a new dimension in the management.[10

]Intramarrow penetration of bone prior to placing a bone graft is often performed as part of a Guided Bone Regeneration procedure.[11] The rationale may include: (1) to enhance the healing process by promoting bleeding and blood clot formation; (2) to allow

progenitor cells and blood vessels to reach the bone graft site which facilitate angiogenesis; and (3) to improve the physical interlocking of grafted bone and a recipient site.[12] The use of intramarrow penetration (IMP) in conjunction with open flap debridement (OFD) resulted in significant clinical and radiographic outcomes in the treatment of intrabony defects.[3] Platelet-rich fibrin, a second generation platelet concentrate, is an autologous growth factor, which has shown significant results in clinical and radiologic parameters when evaluated in the treatment of intrabony defects.[13]The effect of platelet rich fibrin (PRF) as a regenerative material with or without its placement in horizontal periodontal defects along with intramarrow penetration in open flap debridement has been evaluated and has shown statistically significant results in clinical and radiologic parameters.[10]

Demineralized freeze-dried bone allograft has been proposed as an effective regenerative material for osseous defects and is the most widely used allograft material in periodontics. Its role in the treatment of horizontal bone defects has not been evaluated. Thus, in this study an attempt is being made to compare clinically and radiographically the efficacy of platelet rich fibrin (PRF) and intramarrow penetration (IMP) with and without demineralized freeze-dried bone allograft (DFDBA) in the treatment of periodontal horizontal bone defects.

Materials & Methods

Twenty patients amongst those visiting the Department of Periodontology, Punjab Government Dental College and Hospital, Amritsar and suffering from generalized Chronic Periodontitis were selected for this randomized control split mouth study design.

Patients in the age group of 28 - 55 years, with presence of bilateral horizontal defects, one on each side of the arch based on radiographic observations with clinical probing depth equal to or more than 5 mm were included in this study. Patients with systemic problems that contraindicate periodontal surgery, smokers and alcoholics, pregnancy or lactating mother, patients with systemic conditions affecting the periodontium, teeth with furcation defects, patients undergoing orthodontic treatment and patients unable to perform routine oral hygiene procedure were excluded from this study.

All subjects were treated with initial phase I therapy involving oral hygiene instructions, scaling and root planing. This contributed to a greater reduction of inflammation of gingival tissues and saved the treatment time during surgical phase.[2] Following phase I therapy the subjects were re-evaluated after six weeks and those who still satisfied the selection criteria were finally taken up for the study.

Selected sites will be randomly divided into two groups: Group I, open flap debridement with intramarrow penetration followed by placement of platelet rich fibrin will be done. Group II, open flap debridement with intramarrow penetration followed by placement of platelet rich fibrin and demineralized freeze-dried bone graft will be done.

For each patient, the clinical parameters Probing pocket depth (PPD) and Clinical attachment level (CAL) were recorded at baseline, 3 months and 6 months post operatively using UNC-15 periodontal probe. Pre- and post- operative radiographs were taken using Radiovisiography (RVG) at baseline and at six months after surgery. Radiographic parameter assess the linear bone fill.

Platelet Rich Fibrin (PRF)

The PRF was prepared in accordance with the protocol developed by Choukroun et al. Intravenous blood (5ml) was obtained from the patient's antecubital vein and was collected in a sterile tube without anticoagulant and immediately centrifuged in centrifugation machine at 3,000 revolutions per minute for 10 minutes. Blood centrifugation immediately after collection allows the composition of a structured fibrin clot in the middle of the tube, just between the red corpuscles at the bottom and platelet poor plasma at the top. Platelet Rich Fibrin was easily separated from red corpuscles base, preserving a small red blood cell layer, using sterile tweezers and scissors just after removal of platelet poor plasma and then transferred onto a sterile dappen dish.

Demineralized Freeze-Dried Bone Allograft

The graft was procured form Tissue bank of Tata Memorial Hospital, Mumbai. It is distributed in 0.5 cc quantities. The graft is terminally sterilized with 25kGy of gamma radiation using Gamma Chamber with a Cobalt60 source.

Surgical Procedure

All patients were operated under local anaesthesia with a solution of 2% lignocaine with 1: 2,00,000 adrenaline. Anaesthetic solution was administered by nerve block to adequately anaesthetize the surgical site. The patients were then subjected to periodontal flap surgery.

Periodontal flap surgery was done by giving sulcular incision (Kirkland) and a full thickness mucoperiosteal flap was reflected both on the facial and lingual side. Thorough debridement and root planning of the exposed sites was performed by hand instrumentation. The area was irrigated with sterile saline. The horizontal defect was penetrated at the recipient site using a 1 mm round carbide bur to reach the marrow space. Multiple perforations were performed not closer than 1 mm from each other and deep enough to obtain bleeding from the spongiosa. Then the flap was pre-sutured using 3-0 black braided silk sutures without tying the knot. Then, the prepared Platelet Rich Fibrin was then carried to the defect and carefully packed into the defect in Group I [figure 1] & rehydrated DFDBA and prepared Platelet Rich Fibrin was placed into the defect in Group II [figure 2]. The flap was replaced to its original position followed by tying of the knot to complete the interrupted interdental sutures.

The surgical site was dried using gauze and non-eugenol periodontal dressing (Coe-Pak) was then placed over the surgical site in both groups which acted as a mechanical barrier to the oral environment during the healing phase and protected the postsurgical wound from postoperative trauma, saliva and food debris.[14]

Amoxycillin 500 mg thrice daily was prescribed for 5 days. Ibuprofen 400mg thrice daily and vitamin-B complex, 1 capsule daily was also prescribed for 5 days. The subjects were instructed not to brush the operated area for one week and to rinse the oral cavity twice a day with Chlorhexidine (0.12%) mouthwash daily. Periodontal dressing and sutures were removed after 10 days post-operatively.

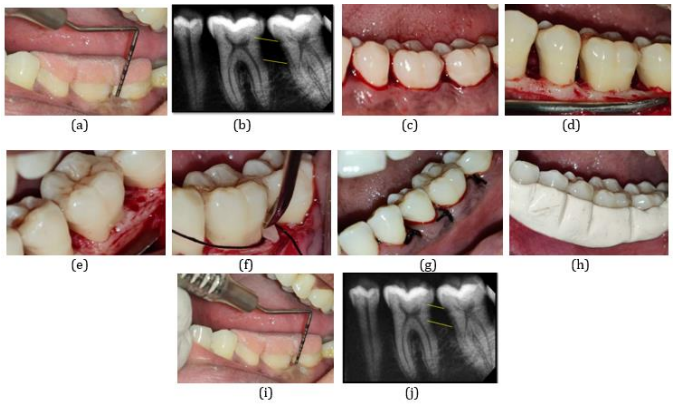


Figure 1: showing (a) PPD at baseline (b) radiograph at baseline (c)crevicular incision (d) defect (e) intramarrow penetration (f) prf placement (g) sutures (h) periodontal

dressing (i) PPD at 6 months post-operative (j) radiograph at 6 months post-operative in Group I

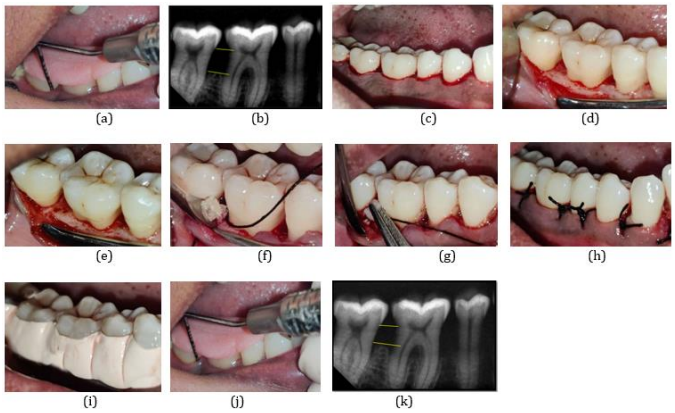


Figure 2: showing (a) PPD at baseline (b) radiograph at baseline (c)crevicular incision (d) defect (e) intramarrow penetration (f) DFDBA placement (g) prf placement (h) sutures (i) periodontal dressing (j) PPD at 6 months post-operative (k) radiograph at 6 months post-operative in Group II

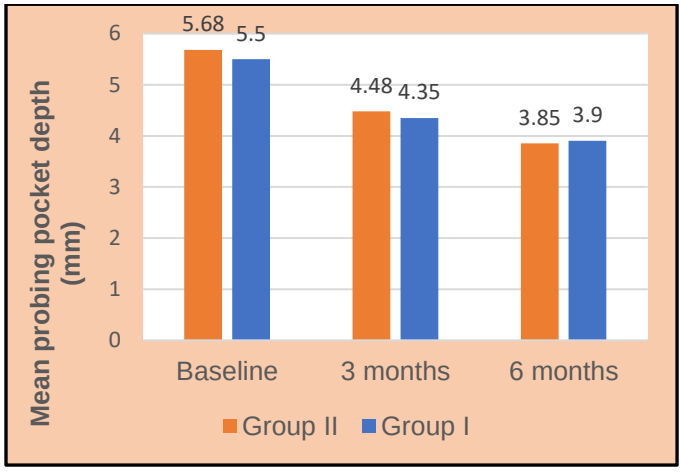
Results & Discussion

Probing Pocket Depth (PPD)

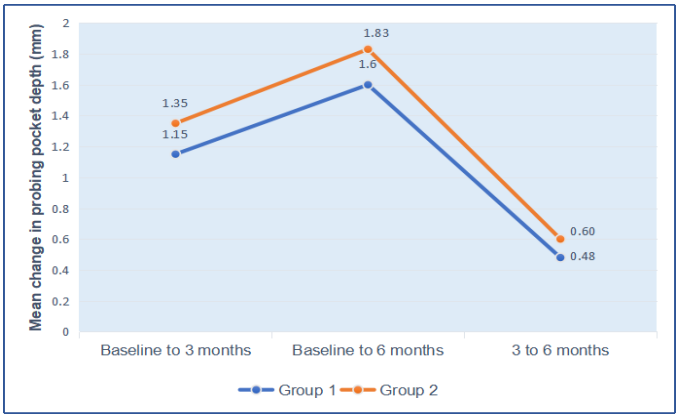
Graph 1 shows the mean values of probing pocket depth in Group I and Group II which were 5.50 ± 0.49 mm at baseline, 4.35 ± 0.54 mm at 3 months and 3.90 ± 0.58 mm at 6 months post-operatively in Group I & were 5.68 ± 0.47 mm at baseline, 4.48 ± 0.64 mm at 3 months and 3.85 ± 0.65 mm at 6 months post-operatively in Group II.

Graph 2 shows intragroup comparison of mean change in probing pocket depth in Group I and Group II, which were all statistically highly significant.

Table 1 shows the intergroup comparison of mean change in probing pocket depth between Group I and Group II. The mean difference in probing pocket depth of Group I and Group II between baseline and 3 months was 0.20 ± 0.09 mm (significant), between baseline and 6 months was 0.23 ± 0.10 mm (significant) and between 3 months and 6 months was 0.13 ± 0.07 mm (non-significant).



Graph 1: Mean probing pocket depth (mm) in Group I and Group II at different time intervals



Graph 2: Mean change in probing pocket depth (mm) in Group I and Group II at different time intervals

Time	Difference Mean ± SEm	t-value	p value	S
Baseline to 3 months	0.20 ± 0.09	2.179	0.042	S
Baseline to 6 months	0.23 ± 0.10	2.269	0.035	S
3 months to 6 months	0.13 ± 0.07	1.751	0.096	NS

Table 1: Comparative analysis of mean change in probing pocket depth (mm) of Group I and Group II at different time intervals

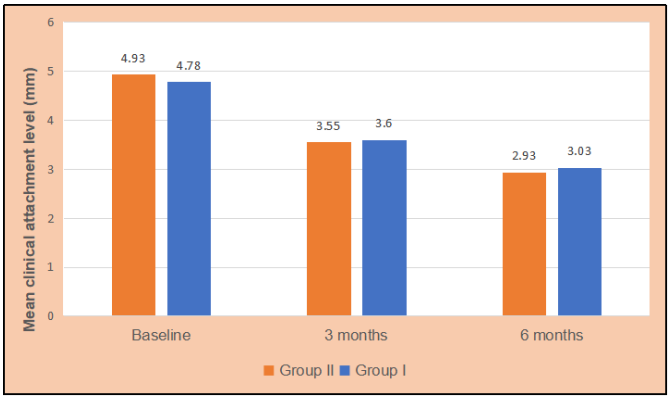
Clinical Attachment Level (CAL)

Graph 3 shows the mean values of clinical attachment level in Group I which were 4.78 ± 1.62 mm at baseline, 3.60 ± 1.56 mm at 3 months and 3.03 ± 1.70 mm at 6

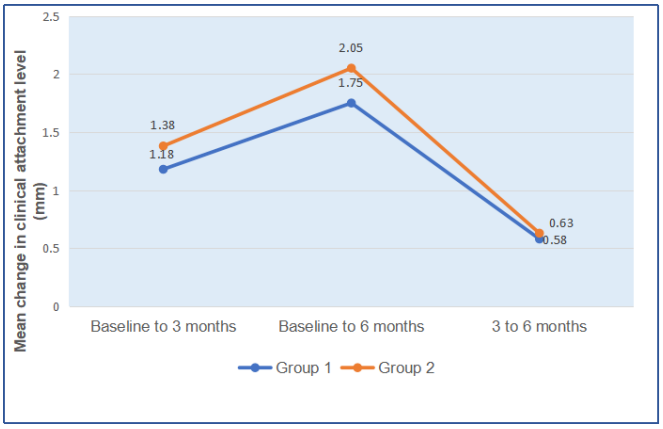
months post-operatively and in Group II which were 4.93 ± 1.37 mm at baseline, 3.55 ± 1.38 mm at 3 months and 2.93 ± 1.50 mm at 6 months post-operatively.

Graph 4 shows intragroup comparison of mean change in clinical attachment level of Group I and Group II, which were all statistically highly significant.

Table 2 shows the intergroup comparison of mean change in clinical attachment level between Group I and Group II. The mean difference in clinical attachment level of Group I and Group II between baseline and 3 months was 0.20 ± 0.08 mm (significant), between baseline and 6 months was 0.30 ± 0.52 mm (significant) and between 3 months and 6 months was 0.05 ± 0.11 mm (non-significant).



Graph 3: Mean clinical attachment level (mm) in Group I and Group II at different time intervals



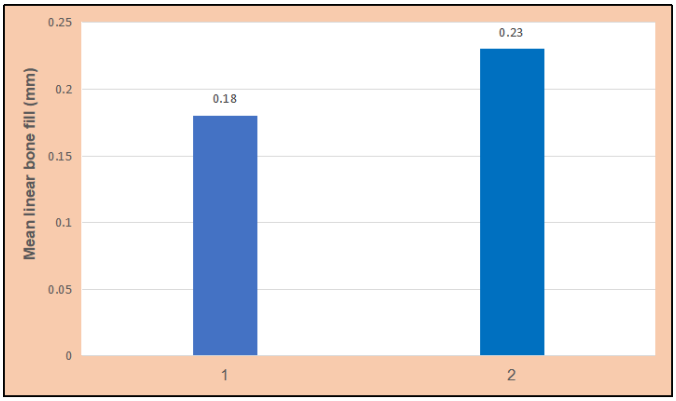
Graph 4: Mean change in clinical attachment level (mm) in Group I and Group II at different time intervals

Time	Difference Mean ± SEm	t-value	p value	S
Baseline to 3 months	0.20 ± 0.08	2.629	0.017	S
Baseline to 6 months	0.30 ± 0.52	2.565	0.019	S
3 months to 6 months	0.05 ± 0.11	0.462	0.649	NS

Table 2: Comparative analysis of mean change in clinical attachment level (mm) of Group I and Group II at different time intervals

Linear Bone Fill

Graph 5 shows mean linear bone fill of the horizontal defects in Group I and Group II at 6 months post-operatively. The linear bone fill between baseline and 6 months were 0.18 ± 0.03 mm in Group I and 0.23 ± 0.04 mm in Group II which were highly significant.The mean difference in linear bone fill of the horizontal defects of Group I and Group II between baseline and 6 months was 0.05 ± 0.01 which was statistically highly significant.



Graph 5: Mean linear bone fill (mm) in Group I and Group II between baseline and 6 months.

The mean reduction in probing pocket depth in Group I between baseline and 3 months, between baseline and 6 months and between 3 months and 6 months were found to be statistically highly significant, suggesting a

significant reduction in probing pocket depth in defects treated with Open Flap Debridement with Intramarrow Penetration followed by placement of Platelet Rich Fibrin. Similar results were obtained by Debnath and Chatterjee (2018), who found significant reduction in probing pocket depth in group where Open Flap Debridement along with Intramarrow Penetration and Platelet Rich Fibrin Matrix placement was done for the treatment of horizontal bone defect.[10] This was attributed to the beneficial effect of Intramarrow Penetration and Platelet Rich Fibrin Matrix. Similar results were also obtained by Yilmaz, Kuru and Altuna-Kirac (2003), who used Open Flap Debridement along with Enamel Matrix Proteins for the treatment of horizontal bone defects, proving the regenerative potential of Enamel Matrix Proteins that encourages substantial periodontal attachment apparatus.[15] Both Group I and Group II showed significant reduction in probing pocket depth. But it was found to be significantly more in the Group II where Demineralized Freeze-Dried Bone Allograft was used along with Platelet Rich Fibrin and Intramarrow Penetration in the treatment of horizontal bone defects.

The mean gain in clinical attachment level in Group I between baseline and 3 months, between baseline and 6 months and between 3 months and 6 months were found to be statistically highly significant, suggesting a significant gain in clinical attachment level in defects treated with Open Flap Debridement with Intramarrow Penetration followed by placement of Platelet Rich Fibrin. Similar results were obtained by Debnath and Chatterjee (2018), who studied the effect of Open Flap Debridement along with Intramarrow Penetration and Platelet Rich Fibrin in the treatment of horizontal bone defect.[10] This was attributed to the beneficial effect of Intramarrow Penetration and Platelet Rich Fibrin Matrix. Similar results were also obtained by Yilmaz, Kuru and Altuna-Kirac (2003), who used Open Flap Debridement along with Enamel Matrix Proteins for the treatment of horizontal bone defects, proving the regenerative potential of Enamel Matrix Proteins that encourages substantial periodontal attachment apparatus.[15] Both Group I and Group II showed significant gain in clinical attachment level. But it was found to be significantly more in the Group II where Demineralized Freeze-Dried Bone Allograft was used along with Platelet Rich Fibrin and Intramarrow Penetration in the treatment of horizontal bone defects.

In Group I the mean linear bone fill observed radiographically, at 6 months post-operatively was found to be statistically highly significant. Similar results were obtained by Debnath and Chatterjee (2018), who studied the effect of Open Flap Debridement along with Intramarrow Penetration and Platelet Rich Fibrin in the treatment of horizontal bone defect.[10] This was attributed to the beneficial effect of Intramarrow Penetration and Platelet Rich Fibrin Matrix. Both Group I and Group II showed significant linear bone fill. However, it was found to be significantly more in Group II where Demineralized Freeze-Dried Bone Allograft was used along with Platelet Rich Fibrin and Intramarrow Penetration in the treatment of horizontal bone defects.

Conclusion

Within the confines of this study, it seems that Open Flap Debridement with Intramarrow Penetration followed by placement of Platelet Rich Fibrin and Demineralized Freeze-Dried Bone Allograft may be a promising treatment modality in the management of Periodontal horizontal bone defects. But, the short follow up time period and relatively small sample size of the present study may be the limiting factor for the

power of the statistical analysis. Therefore, a further large and long term multicentric, randomized controlled clinical trials may be carried out to affirm the results of this study.

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