AL-AZHAR
Dental Journal
For Girls

The Official Publication
of The Faculty of Dental
Medicine For Girls,
Al-Azhar University
Cairo, Egypt.

Print ISSN 2537-0308 • Online ISSN 2537-0316

ADJ-for Girls, Vol. 5, No. 1, January (2018) — PP. 29:35

Effect of Platelet Rich Fibrin on the Healing of Intra-bony Defects: A Clinical Study

Riham El-banna [1]; Mai Shafik [2] *and* Eatemad Shoreibah [3]

Codex : 05/1801

azhardentj@azhar.edu.eg

http://adjg.journals.ekb.eg

ABSTRACT

Objectives: The aim of the present study was to evaluate the effect of platelet rich fibrin (PRF) on the healing of intra-bony defects. This evaluation was accomplished Clinically and radiograp- hically on patients.

Subjects and Methods: A total of twenty one intra-bony defects in 14 patients were randomly divided into three groups; group A, treated with minced PRF placed inside the defects and covered with a PRF membrane, group B, treated with minced PRF placed in the defects and covered with a collagen membrane and group C, treated with xenograft placed in the defects and covered with a collagen membrane (control group). Clinical parameters including probing pocket depth (PPD), clinical attachment level (CAL) and radiographic parameters including linear radiographic measurements were measured at day of surgery (baseline) then 6 months post-operatively in all groups.

Results: Clinical and radiographic results showed statistically significant differences between baseline and post operatively in all the groups. However inter-group comparisons showed no statistically significant differences after 6 months.

Conclusion: The use of PRF as a regenerative material in managing periodontal intrabony defects resulted in pocket depth reduction, clinical attachment gain and defect fill with comparable results to bone graft and collagen membrane.

KEYWORDS

Periodontal regeneration, platelet rich fibrin, intra bony defects

INTRODUCTION

The regeneration of the lost periodontal structures is the ultimate goal of the periodontal therapy in order to restore the health, function

Paper extracted from Ph.D thesis entitled

1. Postgraduate student "Doctor degree" faculty of Dental Medicine, Al-Azhar University.
2. Assiociate professor of Oral Medicine, Periodontology, Oral Diagnosis, and Radiology Department Faculty of Dental Medicine, for girls, Al-Azhar University
3. Professor of Oral Medicine, Periodontology, oral diagnosis and Radiology. Faculty of Dental Medicine, for girls, Al-Azhar University

and esthetics of periodontium. Various techniques have been attempted to regenerate the lost periodontal tissues including open flap procedures combined with bone grafts, guided tissue regeneration (GTR), various biological mediators such as growth factors, application of extracellular matrix proteins and attachment factors, the use of mediators of bone metabolism and applications of tissue engineering. [1,2]

The principle of GTR was based on the exclusion of epithelial and gingival connective tissue cells from the healing area by the use of a physical barrier to guide the periodontal ligament progenitor cells to repopulate the root surface[2]. Different studies had suggested that GTR is an effective treatment modality for the management of intrabony defects (IBD). GTR was associated with the shallowest remaining defects and the best results in improving CAL gain, reducing PPD, less increase in gingival recession and more gain in hard tissue probing at re-entry surgery when compared to open flap debridement or the use of bone grafts alone. [3,4]

On the other hand bone grafting procedures have been advocated for the reconstruction of the lost supporting apparatus through the following mechanisms; osteoinduction, osteoconduction, and osteoneogenesis. Bone grafts used include autografts, allografts, xenografts and alloplasts[5,6].

For enhanced periodontal regeneration, delivery of growth factors in the local environment holds a great deal either used alone or in adjunct to other materials such as bone grafts.[7] PRF is considered as second generation platelet concentrate, consisting of viable platelets, releasing various growth factors such as Platelet derived growth factor, Vascular endothelial growth factor, Transforming growth factor, Insulin-like growth factor, epidermal growth factor and basic fibroblast growth factor.[8] The strong fibrin matrix offered by the PRF clot provide a scaffold for carrying cells that are essential for tissue regeneration and also protect growth factors from proteolysis. In addition PRF has the advantage of being completely autologous in nature and cost effective.[9,10]

Thus, the present study aimed to investigate the effectiveness of autologous PRF to regenerate periodontal intrabony defects either alone or in conjunction with GTR and results were compared with the combined use of bone graft and GTR. Evaluation was accomplished clinically and radiographically on patients.

SUBJECTS AND METHODS

This study included 14 patients (8 females and 6 males) with age range 25-45 years. Patients were selected on the bases of having at least one site with clinical attachment loss ≥ 5mm and radiographic evidence of an interproximal defect with an intrabony component (at least 2mm). Initial preparation was performed to all patients including full mouth supra and subgingival debridement. After a period of 4 weeks, patients with residual pockets ≥ 5mm were divided into three groups; group A treated with minced PRF placed inside the defects and covered with a PRF membrane, group B treated with minced PRF placed in the defects and covered with a collagen membrane and group C treated with xenograft placed in the defects and covered with a collagen membrane (control group).

PRF preparation: The protocol developed in (2001)[11] was used as a guide for PRF preparation. Intravenous blood around 10ml (by venepuncture of the antecubital vein) was collected in two sterile tubes without anticoagulant and immediately centrifuged in centrifugation machine at 3,000 revolutions per minute for 10 minutes. This leads to the formation of a structured fibrin clot in the middle of the tube, red corpuscles at the bottom and platelet-poor plasma (PPP) at the top (Fig.1). PRF was easily separated from red corpuscles base preserving a small red blood cell layer using a sterile tweezer and scissor after removal of PPP. For successful preparation of PRF, speedy blood collection and immediate centrifugation before the clotting cascade starts, was absolutely essential.

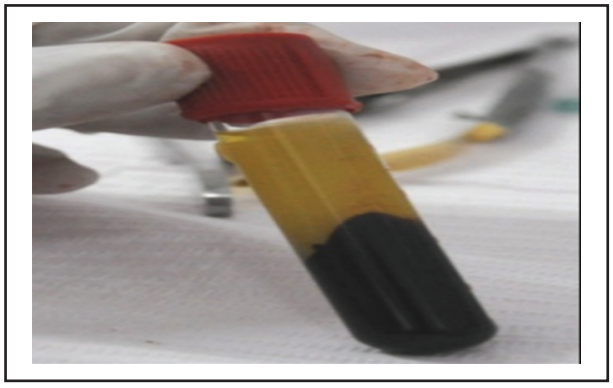

Fig. (1) The centifugated tube shows fibrin clot in the middle, red corpuscles at the bottom and platelet-poor plasma at the top.

Clinical parameters including probing pocket depth (PPD) and clinical attachment level (CAL) were measured at day of surgery (baseline) then 6 months post-operatively in all groups. Radiographic parameters including defect fill (the distance from the CEJ to the base of defect), alveolar crest resorption (the distance from the CEJ to the alveolar crest level) and defect resolution (the distance from the alveolar crest to the base of the defect) were also obtained at baseline then after 6 months in all groups.

RESULTS

The clinical results of the current study (Table 1) demonstrated a high reduction in the PPD after six months in the three groups. The highest PPD reduction was associated with group C (4±1.23mm), followed by group A (3±0.94mm), then group B (2.6±0.89mm). However, the differences in the PPD reduction between the three groups was statistically insignificant. Similarly, the CAL gain after six months in the three groups was higher than the baseline measurements. The highest CAL gain was associated with group C which was 4±1.23 mm, followed by group A which was 2.3±0.675mm, then group B which was 2±1.73 mm. However, the differences in the CAL gain between the three groups was statistically insignificant. Regarding the gingival recession after six months, no statistically significant difference was found in all the groups after 6 months.

Radiographic results (Table 2), including the amount of defect fill and defect resolution, showed significant changes for all groups after six months when compared with baseline defects. Defect fill for Group A was 4.28±1.14 mm, 3.99±0.43mm for group B and 4.8±1.4 mm for group C. While defect resolution was 2.47±1.45 mm in Group A, 1.68±1.17 mm for group B and 2.62±1.78 mm for Group C. However, when the three groups were compared together no significant differences was found between them.

Table (1): *Clinical results of the three groups used throughout the study period.*

	PPD		PPD reduction	P-value	CAL		CAL gain	P-value
	Baseline	Six Months			Baseline	Six Months		
Group A(PRF)	7.7[a]±1.77	4.7[a]±1.57	3±0.94	**0.005***	7.7[a]±2	5.4[a]±1.71	2.3±0.675	**0.039***
Group B (PRF + Collagen Membrane)	7.6[a]±1.95	5[a]±1.41	2.6±0.89	**0.0144***	8.6[a]±2.51	6.6[a]±1.14	2±1.73	**0.079***
Group C (Bone Graft + Collagen Membrane)	9.6[a]±1.95	5.6[a]±1.67	4±1.23	**0.0014***	10.2[a]±2.17	6.2[a]±1.64	4±1.23	**0.0021***
P-value	**0.1115**	**0.5547**			**0.134**	**0.3437**		

*Insignificant at P-value > 0.05 *Significant at P ≤ 0.05*

Table (2): *Radiographic results of the three groups used throughout the study period.*

	Distance from CEJ to base of defect		Defect fill	P-value	Distance from alveolar crest to base of defect		Defect resolution	P-value
	Baseline	Six Months			Baseline	Six Months		
Group A	6.34[a]±2.01	2.06[a]±1.67	4.28±1.14	**0.001***	3.58[a]±2.68	1.11[a]±0.71	2.47±1.45	**0.0362***
Group B	7.82[a]±2.33	3.83[a]±2.1	3.99±0.43	**0.005***	5.1[a]±0.15	3.42[a]±1.65	1.68±1.17	**0.05***
Group C	9.99[a]±3.72	5.19[a]±3.5	4.8±1.4	**0.029***	7.14[a]±0.6	4.52[a]±0.59	2.62±1.78	**0.0057***
P-value	**0.073**	**0.0973**			**0.0665**	**0.06**		

*Insignificant at P-value > 0.05 *Significant at P ≤ 0.05*

DISCUSSION

The present study aimed to investigate the effectiveness of autologous PRF to regenerate periodontal IBDs. PRF is used in several forms such as minced form (fragments), membrane form, PRF plug and PRF gel.[10] In the current study, the minced form was packed inside the IBDs to evaluate its efficacy to be used as a grafting material. Also the membrane form of PRF was utilized to cover the IBD in an attempt to investigate its ability to prevent the downward growth of junctional epitheluim into the healing area, hence it can be used as a resorbable membrane for GTR.

Bioabsorbable barrier membranes have been selected to avoid several drawbacks that were documented with non absorbable barriers including: the risk of bacterial contamination on exposure of the membrane and the need for second reentry procedure which may disrupt healing and create further bone and attachment loss.[12] In the present study, the collagen membrane was selected among bioabsorbable barrier membranes, owing to the following properties; it is chemotactic to fibroblasts, provides a scaffold for periodontal ligament cell migration, is considered as a weak immunogen and can be easily manipulated and adapted.[13,14,15]

In the present study, collagen membrane was employed in two groups. In group B, minced PRF was placed inside the defects and covered with collagen membrane to test the efficacy of PRF as a grafting material and to benefit from the advantages of GTR, while in group C, collagen membrane was combined with bone graft as a successful approach for periodontal regeneration[16-18] and was used as a control group.

In the current study, Xenograft was also used as a grafting material since a number of in vivo and in vitro studies have highlighted the potential for xenografts as an effective regenerative scaffold[16,18,19]. Xenograft has the advantage of being osteoconductive where its trabecular hydroxyapatite structure is similar to human cancellous bone upon which revascularization, osteoblast migration, and woven bone formation occur.[20]

In the present study, the defects treated were three wall and two wall osseous defects. Most angular defects appear as combinations of one-, two- and three-wall defects and one has to consider that the potential for bone fill may differ depending on the morphology of the angular bone defect. Periodontal regeneration is believed to be improved with increasing the number of bony walls facing the root surface due to increasing tissue resources, cells and vascularity from the surrounding periodontal

and bone surfaces. At the same time, increasing the number of defect walls increase wound stability and provide sufficient soft tissue support during early wound healing. The three wall defect allows the best containment of the regenerative material and increased blood supply to the healing tissues.[21,22]

On the light of studying the events of wound healing, the process of wound healing was considered as a rapid process. Studies have observed new tissue formation, indicating periodontal regeneration within 4 weeks following surgical intervention.[23,24] while maturation of the newly formed tissues may continue for 9-12 months.[25] Therefore follow up was carried after 6 months in this study in accordance with other studies which employed similar regenerative techniques for the management of periodontal IBD.[26,27,28]

The clinical results of the current study demonstrated a high reduction in the PPD after six months in the three groups. The highest PPD reduction was associated with group C (bone graft and collagen membrane) which was 4±1.23mm, followed by group A (PRF only) which was 3±0.94mm, then group B (collagen membrane and PRF) which was 2.6±0.89mm. However, the differences in the PPD reduction between the three groups was statistically insignificant (P-value > 0.05).

Similarly, the CAL gain after six months in the three groups was higher than the baseline measurements. The highest CAL gain was associated with group C which was 4±1.23 mm, followed by group A which was 2.3±0.675mm, then group B which was 2±1.73 mm. However, the differences in the CAL gain between the three groups was statistically insignificant (P-value > 0.05). Regarding the gingival recession after six months, no statistically significant difference was found in all the groups after 6 months.

Radiographic results, including the amount of defect fill and defect resolution, showed significant changes (P-value ≤ 0.05) for all groups after six months when compared with baseline defects. Defect fill for Group A was 4.28±1.14mm, 3.99±0.43mm for group B and 4.8±1.4mm for group C. While defect resolution was 2.47±1.45mm in Group A, 1.68±1.17 mm for group B and 2.62±1.78mm for Group C. However, regarding the amount of alveolar crest resorption, no significant differences (P-value > 0.05) was found between the three treatment modalities after six months.

The clinical and radiographic results in **group A** was in agreement with a study done[26] which used the split mouth design on 17 paired IBD to study the effect of PRF versus PRF+ bone graft and followed up for 6 months. Their results for the PRF group showed PPD reduction and CAL gain of 3.35±0.68mm and 2.24±0.73mm respectively and defect fill of 2.21±0.68mm. Similarly a study done[27] compared the use of PRF versus OFD in treating periodontal IBD and followed up for 6 months. They showed PPD reduction and CAL gain of 3.6±1.48mm and 2.97±1.42mm respectively. However, a study done[29] which compared PRF versus OFD, showed superior results regarding PPD reduction and CAL gain (4.56±0.37mm and 3.69±0.44mm respectively) and this may be attributed to the larger sample size which was 32 patients and the longer follow up period which was 9 months.

In **Group B,** the clinical and radiographic results were inferior to those achieved by a previous study done[30] which compared in a split mouth study the use of resorbable collagen membrane combined with PRF (test group) and resorbable collagen membrane alone (control group) in managing periodontal IBD. They showed PPD reduction of 3.88 ±1.15mm, CAL gain of 4.44±1.5mm and defect resolution of 2.10mm. Their superior results may be attributed to the defect characteristics chosen in their study, where only 3-osseous wall defects were included in the study.

Regarding The clinical and radiographic results obtained in **Group C,** were comparable with those obtained by a study[18] which compared

treating periodontal IBD either by collagen membrane + Xenogenic bone graft or open flap debridement alone (control) and showed in the test group after 9 months follow up, PPD reduction 3.3±0.82mm, CAL gain 3.40±1.51mm and defect fill 3.03±1.17mm. Similarly, another study[31] showed PPD reduction of 3.94±1.81mm, CAL gain of 3.94±1.51mm, defect fill of 3.25±2.32mm and defect resolution of 3.5±2.34mm when periodontal IBD were managed using collagen membrane + bone graft (Synthetic bioactive glass combined with hydroxy-apatite) and followed up for 6 months. However, compared managing periodontal IBD either by bone graft (Anorganic cancellous bovine bone mixed with patient venous blood) + collagen membrane versus collagen membrane alone (control group) and showed superior results regarding PPD reduction (5.76±1.6mm), CAL gain (5.05±1.56mm) and defect fill (5.76±1.49mm). These superior results may be attributed to the longer follow up period which was 1 year. In addition, only single rooted teeth with deep intra-osseous probing depths ≥ 4mm were included in the study. [32]

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