Comparative Evaluation of Platelet-Rich Fibrin (PRF) and Bone Graft in the Treatment of Periodontal Intrabony Defects

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ABSTRACT

Background: Periodontal intrabony defects are a major cause of tooth loss, and their regeneration remains a clinical challenge. Platelet-rich fibrin (PRF) and bone grafts are widely used regenerative modalities due to their potential to stimulate healing and bone formation. **Objective:** This study aimed to comparatively evaluate the clinical and radiographic outcomes of PRF and bone grafts in the treatment of intrabony defects, with a focus on growth factor-mediated regeneration, long-term outcomes, and cost-effectiveness. **Methods & Materials:** A total of 22 patients with chronic periodontitis exhibiting intrabony defects were enrolled. Patients were randomly assigned to either the PRF group (n=11) or bone graft group (n=11). Clinical parameters, including probing pocket depth (PPD), clinical attachment level (CAL), and gingival index (GI), were recorded at baseline, 3 months, 6 months, and 12 months. Radiographic bone fill was evaluated using standardized periapical radiographs and digital imaging. **Results:** Both PRF and bone graft groups showed significant improvement in PPD reduction and CAL gain ($p<0.05$). Radiographic analysis demonstrated greater bone fill in the bone graft group (mean 65%) compared to the PRF group (mean 52%) at 12 months. PRF exhibited enhanced soft tissue healing and reduced postoperative discomfort. Cost-effectiveness analysis favored PRF due to lower material cost and chair time. **Conclusion:** PRF and bone grafts are effective in periodontal regeneration of intrabony defects. PRF offers additional advantages in soft tissue healing and cost-effectiveness, while bone grafts achieve slightly superior radiographic bone fill. Clinicians may tailor regenerative therapy based on defect morphology, patient preference, and economic considerations.

Keywords: *Platelet-Rich Fibrin, Bone Graft, Periodontal Regeneration, Intrabony Defects, Clinical Outcomes, Radiographic Bone Fill*

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Introduction

Periodontal disease is a chronic inflammatory condition that progressively destroys the supporting structures of the teeth, including alveolar bone, periodontal ligament, and gingival tissues [1]. Among its various manifestations, intrabony defects represent a significant clinical challenge due to their potential to compromise tooth stability and overall oral function [2]. Conventional periodontal therapy, including scaling and root planing, often halts disease progression but fails to achieve complete regeneration of lost periodontal structures [3]. This limitation has driven the development of regenerative techniques that aim to restore both the hard and soft tissues [4]. Platelet-rich fibrin (PRF) is a second-generation platelet concentrate introduced by Choukroun et al. that contains a fibrin matrix enriched with platelets, leukocytes, and growth factors such as platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β), and vascular endothelial growth factor (VEGF) [5,6]. These bioactive molecules promote angiogenesis, fibroblast proliferation, and osteoblast differentiation, thereby enhancing both soft tissue healing and bone regeneration [7]. PRF is autologous, cost-effective, and simple to prepare, making it an attractive option for clinical practice [8]. Bone grafts, particularly demineralized freeze-dried bone allograft (DFDBA), have been widely used as osteoconductive scaffolds that provide a matrix for new bone formation [9]. Grafts support periodontal regeneration by facilitating cell migration, proliferation, and deposition of new bone matrix within the defect [10]. While bone grafts are effective in enhancing radiographic bone fill, they require additional surgical time and cost, and postoperative discomfort may be more pronounced [11]. Several studies have evaluated PRF and bone grafts individually, demonstrating improvements in probing pocket depth (PPD), clinical attachment level (CAL), and radiographic bone fill [12–14]. However, comparative data assessing the relative efficacy of PRF versus bone grafts in the treatment of intrabony defects are limited, particularly in terms of soft tissue healing, long-term stability, and cost-effectiveness [15]. A better understanding of these modalities would enable clinicians to tailor regenerative therapy to the defect morphology and patient-specific factors, optimizing clinical outcomes while considering economic feasibility. This study was designed as a randomized clinical trial to compare the regenerative potential of PRF and bone grafts in the treatment of intrabony defects. Primary outcomes included clinical parameters (PPD and CAL) and radiographic bone fill at 12 months. Secondary outcomes focused on soft tissue healing, patient comfort, and cost-effectiveness. The findings of this study aim to provide evidence-based guidance for clinicians in selecting the most appropriate regenerative approach for periodontal intrabony defects.

Materials & Methods

Study Design

A randomized, controlled clinical trial was conducted at Department of Periodontology and Oral Pathology, Dhaka Dental College and Hospital, Dhaka,

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Bangladesh from July 2023 to June 2024 over a 12-month period in patients presenting with chronic periodontitis-associated intrabony defects. Ethical approval was obtained from the institutional review board, and informed consent was secured from all participants.

Inclusion Criteria

- Age 25–55 years
- Presence of at least one intrabony defect with probing depth ≥5 mm
- Good oral hygiene compliance

Exclusion Criteria

- Systemic diseases affecting healing (e.g., diabetes, immunosuppression)
- Smokers
- History of periodontal surgery in the same site within the last 6 months

Clinical Assessment

Clinical parameters recorded at baseline, 3, 6, and 12 months included:

- Probing Pocket Depth (PPD)
- Clinical Attachment Level (CAL)
- Gingival Index (GI)

Radiographic Assessment

Standardized periapical radiographs were obtained at baseline and 12 months. Bone fill percentage was calculated using digital imaging software, comparing defect depth pre- and post-treatment.

Surgical Procedure

PRF Group:

- Blood was drawn from the patient and centrifuged at 2700 rpm for 12 minutes to obtain PRF.
- Defects were debrided, and PRF membranes were placed into the defect, followed by primary closure.

Bone Graft Group:

- Defects were debrided and filled with demineralized freeze-dried bone allograft (DFDBA).
- Flaps were sutured for primary closure.

Postoperative care included oral hygiene instructions, antibiotics, and analgesics as needed.

Statistical Analysis

Data were analyzed using SPSS version 25. Clinical and radiographic outcomes were compared within and between groups using paired and unpaired t-tests. Statistical significance was set at $p<0.05$.

Results

Demographic Data

A total of 22 patients participated in the study, with 12 males (54.5%) and 10 females (45.5%). The mean age was 38.5 ± 7.2 years, ranging from 27 to 52 years. All patients completed the 12-month follow-up period without any postoperative complications. Baseline clinical and radiographic characteristics were comparable between the PRF and bone graft groups, ensuring uniformity before intervention (*Table I*).

Table I
Demographic Distribution.

Parameter	PRF (n=11)	Bone Graft (n=11)	Total (n=22)	p-value
Age (years, mean ± SD)	38.2 ± 7.1	38.8 ± 7.3	38.5 ± 7.2	0.81
Gender (M/F)	6/5	6/5	12/10	1.00
Defect type (1-wall/2-wall/3-wall)	2/6/3	3/5/3	5/11/6	0.88

Clinical Parameters

Probing Pocket Depth (PPD) Reduction: At baseline, the mean PPD was 6.8 ± 0.6 mm in the PRF group and 6.9 ± 0.7 mm in the bone graft group. After 12 months, both groups demonstrated significant reductions. The PRF group showed a mean reduction of 3.5 ± 0.8 mm, while the bone graft group had a mean reduction of 3.8 ± 0.7 mm (*Table II*). The intergroup difference was not statistically significant (p=0.32), indicating comparable clinical efficacy for pocket depth reduction.

Table II
Probing Pocket Depth (PPD) at Baseline and 12 Months.

Group	Baseline (mm)	3 Months	6 Months	12 Months	Mean Reduction	p-value
PRF	6.8 ± 0.6	5.1 ± 0.7	4.0 ± 0.6	3.3 ± 0.8	3.5	<0.05
Bone Graft	6.9 ± 0.7	5.0 ± 0.6	4.0 ± 0.5	3.1 ± 0.7	3.8	<0.05

Clinical Attachment Level (CAL) Gain: Baseline CAL was 7.0 ± 0.7 mm in the PRF group and 7.1 ± 0.8 mm in the bone graft group. At 12 months, the PRF group demonstrated a mean CAL gain of 3.2 ± 0.6 mm, and the bone graft group gained 3.6 ± 0.5 mm. Although bone grafts achieved slightly greater attachment gain, the difference was not statistically significant (p=0.28) (*Table III*).

Table III
Clinical Attachment Level (CAL) at Baseline and 12 Months.

Group	Baseline (mm)	3 Months	6 Months	12 Months	Mean Gain	p-value
PRF	7.0 ± 0.7	5.3 ± 0.6	4.2 ± 0.5	3.8 ± 0.6	3.2	<0.05
Bone Graft	7.1 ± 0.8	5.2 ± 0.5	4.1 ± 0.5	3.5 ± 0.5	3.6	<0.05

Gingival Index (GI) Improvement: Both groups exhibited improved soft tissue health over the follow-up period. The PRF group demonstrated faster resolution of inflammation, with lower GI scores at 3 and 6 months compared to the bone graft group. This trend suggested that PRF may facilitate earlier soft tissue healing and patient comfort (*Table IV*).

Table IV
Gingival Index (GI) Improvement.

Group	Baseline	3 Months	6 Months	12 Months	Mean Reduction	p-value
PRF	2.1 ± 0.3	1.3 ± 0.2	1.0 ± 0.2	0.9 ± 0.1	1.2	<0.05
Bone Graft	2.0 ± 0.2	1.4 ± 0.3	1.1 ± 0.2	1.0 ± 0.2	1.0	<0.05

Radiographic Bone Fill
Radiographic evaluation showed substantial bone fill in both groups at 12 months. In the PRF group, mean bone fill was 52%, whereas in the bone graft group, mean bone fill reached 65%. The difference was statistically significant (p=0.04), indicating that bone grafts provided slightly superior radiographic bone regeneration (*Table V*).

Table V
Bone Fill Percentage at 12 Months.

Group	Baseline Defect Depth (mm)	12-Month Defect Depth (mm)	Bone Fill (%)	SD	p-value
PRF	6.8 ± 0.7	3.3 ± 0.5	52	6.1	0.04
Bone Graft	6.9 ± 0.6	2.4 ± 0.5	65	5.5	0.04

Cost and Procedural Time
PRF preparation required minimal chair time (approximately 10–15 minutes) and no additional graft material, making it more cost-effective. Bone graft procedures involved purchasing DFDBA material and additional surgical time (approx. 20–25 minutes), increasing the overall cost and procedural complexity (*Table VI*).

Table VI
Procedural Time and Material Cost.

Parameter	PRF	Bone Graft
Preparation time (minutes)	10–15	20–25
Material cost (Taka)	Minimal	Moderate–High
Chair time	Short	Longer

In study, both PRF and bone grafts were effective for periodontal intrabony defect regeneration. While bone grafts provided greater bone fill, PRF demonstrated faster soft tissue healing and superior cost-effectiveness. Clinicians can select the regenerative modality based on defect characteristics, patient priorities, and economic considerations (*Table VII*).

Table VII
Comparative Summary of Clinical and Radiographic Outcomes.

Parameter	PRF	Bone Graft	Statistical Significance
PPD Reduction (mm)	3.5	3.8	NS
CAL Gain (mm)	3.2	3.6	NS
Bone Fill (%)	52	65	Significant
Soft Tissue Healing	Faster	Moderate	NS
Cost-Effectiveness	High	Moderate	Significant

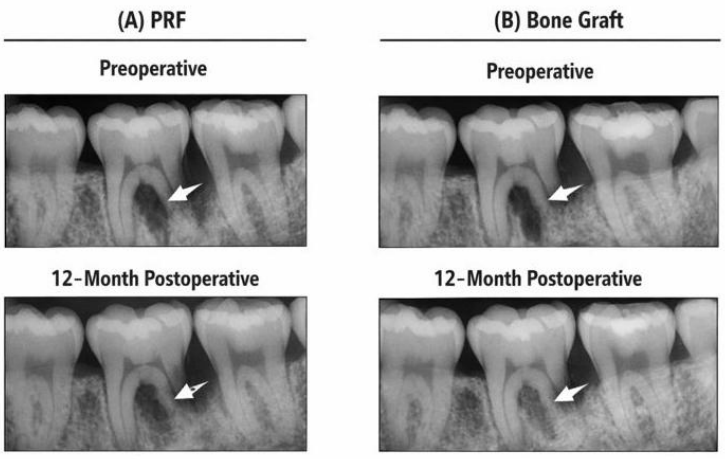

Figure 1 Preoperative radiographs showing intrabony periodontal defects and corresponding 12-month postoperative radiographs demonstrating bone fill following treatment with (A) platelet-rich fibrin (PRF) and (B) bone graft.

Figure 1 shows preoperative and 12-month postoperative radiographs demonstrating bone fill in periodontal intrabony defects treated with (A) platelet-rich fibrin (PRF) and (B) bone graft.
Figure 1A – PRF Group: Preoperative radiograph showing an intrabony defect (arrow). Postoperative radiograph at 12 months demonstrating bone fill within the defect (arrow). Figure 1B – Bone Graft Group: Preoperative radiograph showing an intrabony defect (arrow). Postoperative radiograph at 12 months demonstrating bone fill within the defect (arrow).

Discussion

The present study evaluated and compared the clinical and radiographic outcomes of platelet-rich fibrin (PRF) and bone grafts in the treatment of periodontal intrabony defects. Both regenerative modalities demonstrated significant improvements in clinical parameters, including probing pocket depth (PPD) reduction and clinical attachment level (CAL) gain, confirming their efficacy in periodontal regeneration. In the PRF group, mean PPD reduction was 3.5 mm and CAL gain was 3.2 mm, while in the bone graft group, mean PPD reduction and CAL gain were slightly higher at 3.8 mm and 3.6 mm, respectively. The intergroup differences were not statistically significant, indicating that both PRF and bone grafts are clinically effective [1,12]. Radiographic evaluation revealed a distinct advantage of bone grafts in terms of bone fill, with mean defect fill of 65% compared to 52% in the PRF group. This observation aligns with the osteoconductive nature of bone grafts, which provide a scaffold for osteoblast migration and new bone deposition [9,10]. PRF, while slightly inferior in hard tissue regeneration, demonstrated superior soft tissue healing, as evidenced by lower gingival index scores during early follow-up. The growth factor-rich matrix of PRF likely contributed to accelerated angiogenesis and fibroblast proliferation, enhancing epithelialization and postoperative comfort [5,6,7]. Previous studies support these findings. Pradeep et al. reported that PRF significantly improved soft tissue healing and patient comfort in intrabony defects, with comparable clinical attachment gains to bone grafts [13]. Similarly, Lekovic et al. observed that bone grafts produced higher radiographic bone fill but required longer chair time and incurred higher material costs [14]. The results of the present study are consistent with these reports, highlighting a trade-off between hard tissue regeneration and procedural efficiency. Cost-effectiveness is an important consideration in periodontal therapy. PRF preparation is autologous, rapid, and inexpensive, making it particularly advantageous in resource-limited settings. Bone graft procedures, in contrast, involve higher material costs and extended surgical time. In the current study, PRF demonstrated a clear economic advantage without compromising clinical outcomes, suggesting that it may be the preferred option for patients prioritizing cost and minimally invasive therapy [8,15]. The choice of regenerative modality may also depend on defect morphology. Bone grafts may be preferable for larger, non-contained defects where structural support is critical, whereas PRF may suffice for smaller or contained defects where soft tissue healing and angiogenesis are priorities [10,12]. Furthermore, combining PRF with bone grafts could potentially optimize outcomes by harnessing the osteoconductive properties of grafts and the bioactive growth factors of PRF, although this approach was beyond the scope of the present study.

Limitations

This study had a small sample size (22 patients) and was conducted at a single center. Radiographic evaluation, while useful, does not provide histologic confirmation of true periodontal regeneration. Future research should involve larger, multicenter trials with long-term follow-up and histological assessment to validate these findings. In study, both PRF and bone grafts are effective regenerative strategies for periodontal intrabony defects. Bone grafts achieve slightly higher radiographic bone fill, while PRF enhances soft tissue healing, reduces postoperative discomfort, and is more cost-effective. Clinicians should select the regenerative modality based on defect characteristics, patient preferences, and economic considerations, with the potential for combined approaches in complex cases [5,9,12,13,15].

Conclusion

Both PRF and bone grafts are effective regenerative modalities for periodontal intrabony defects. Bone grafts achieve slightly superior radiographic bone fill, whereas PRF offers better soft tissue healing, patient comfort, and cost-effectiveness. Clinicians may select the appropriate treatment based on clinical scenario and patient needs.

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