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Evaluation Of Platelet Rich Fibrin With And Without Low Level Laser In Treating Periodontal Intrabony Defects: A Randomized Clinical And Radiographic Study

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Abstract: Background: Periodontal intrabony defects represent a challenging clinical condition requiring regenerative therapy. Platelet Rich Fibrin (PRF) has demonstrated promising regenerative potential due to its growth factor content. Diode laser therapy offers bactericidal and biostimulator effects that may enhance periodontal healing. Aim- To compare the clinical and radiographic efficacy of PRF with and without adjunctive diode laser application in the treatment of periodontal intrabony defects. Materials and Methods -Ten systemically healthy patients presenting with chronic periodontitis and bilateral intrabony defects were included in this randomized split-mouth study. Experimental Site A was treated with open flap debridement (OFD) + PRF, while Experimental Site B received OFD + PRF + diode laser disinfection. Clinical parameters including Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD), and Clinical Attachment Level (CAL) were recorded at baseline, 1 month, 3 months, and 6 months. Radiographic defect depth was assessed at baseline and 6 months using standardized intraoral periapical radiographs. Results: Both groups showed statistically significant reduction in PI, GI, and PPD with gain in CAL at 6 months. However, the laser-assisted PRF group demonstrated comparatively greater improvement in clinical parameters and radiographic bone fill. Conclusion: PRF is an effective regenerative material in the management of periodontal intrabony defects. The adjunctive use of diode laser with PRF may enhance clinical and radiographic outcomes.

Keywords: Platelet Rich Fibrin, Diode Laser, Intrabony Defect, Periodontal Regeneration, Chronic Periodontitis.

I. INTRODUCTION

Periodontitis is a chronic inflammatory disease characterized by irreversible destruction of the periodontal ligament and alveolar bone, ultimately leading to attachment loss and pocket formation. The primary objective of periodontal therapy is not only to arrest disease progression but also to regenerate the lost periodontal structures[1].

Intrabony defects are periodontal osseous defects surrounded by one, two, or three bony walls. Due to their morphology and contained nature, these defects present favorable conditions for regenerative therapy. Over the years, various regenerative approaches such as bone grafts, guided tissue regeneration, enamel matrix derivatives, and growth factor-based therapies have been introduced; however, achieving predictable regeneration remains a challenge[2, 3].

Platelet Rich Fibrin (PRF) is a second-generation platelet concentrate prepared without anticoagulants. It contains platelets, leukocytes, cytokines, and a dense fibrin matrix that enables sustained release of growth factors such as Platelet-Derived Growth Factor (PDGF), Transforming Growth Factor-β (TGF-β), and Insulin-Like Growth Factor (IGF). These biologically active molecules promote angiogenesis, fibroblast proliferation, osteoblastic differentiation, and extracellular matrix formation, thereby enhancing periodontal regeneration[2, 4].

Diode lasers are widely used in periodontal therapy for soft tissue procedures and pocket disinfection. They exhibit bactericidal properties and have been reported to stimulate fibroblast activity and bone matrix formation. Low-level laser therapy (LLLT) enhances wound healing, reduces inflammation, and improves tissue response, making it a valuable adjunct in periodontal therapy[3, 5].

Although PRF and diode laser therapy independently demonstrate beneficial effects in periodontal regeneration, limited evidence exists regarding their combined efficacy in intrabony defects. The potential synergistic effect of combining PRF with diode laser therapy may enhance clinical and radiographic outcomes. Hence, the present study was undertaken to compare the clinical and radiographic outcomes of PRF with and without adjunctive diode laser therapy[2,3,4,5].

II. MATERIALS AND METHODS

The present study was undertaken to comparatively evaluate the efficacy of autologous platelet-rich fibrin (PRF) with and without adjunctive diode laser therapy in the management of periodontal intrabony defects.

Objectives was to clinically evaluate and compare Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD), and Clinical Attachment Level (CAL) at baseline, and at 1 month, 3 months, and 6 months following surgical intervention, also radiographically assess bone fill by measuring the distance from the cementoenamel junction (CEJ) to the base of the defect at baseline and 6 months postoperatively, and to compare the therapeutic outcomes between PRF alone and PRF combined with adjunctive diode laser therapy.

Inclusion Criteria was Patients aged between 20 and 60 years presenting with probing pocket depth (PPD) ≥ 5 mm and radiographic evidence of intrabony defects at contralateral sites were included. Exclusion Criteria Patients with aggressive periodontitis. Patients with systemic diseases (including diabetes mellitus), Patients on medications affecting periodontal healing within the past 6 months, Smokers or tobacco users in any form, Pregnant or lactating women, Patients who had received periodontal therapy in the recent past.

All patients underwent Phase I therapy, including scaling and root planing, along with oral hygiene instructions. Following initial therapy, patients were maintained for a period of 6–8 weeks and re-evaluated to confirm suitability for surgical intervention. Baseline clinical and radiographic parameters were recorded prior to surgery.

III. SURGICAL PROCEDURE

All surgical procedures were performed under strict aseptic conditions. Patients were advised to perform a preoperative antimicrobial mouth rinse. Intraoral and extraoral antisepsis was achieved using povidone-iodine solution. Following administration of local anesthesia (2% lignocaine with 1:80,000 adrenaline), intrasulcular and interdental incisions were made using a No. 15 BP blade. Full-thickness mucoperiosteal flaps were elevated, and thorough debridement and root planing were performed using area-specific Gracey curettes. Intrabony defects were identified and irrigated with sterile normal saline.

A split-mouth design was followed Group Allocation: Site A (Test Group): Open flap debridement (OFD) + PRF & Site B (Control Group): OFD + PRF + adjunctive diode laser disinfection.

At Site B, diode laser disinfection (Biolase system) was performed prior to placement of PRF to enhance bacterial reduction and improve the healing environment. Autologous PRF was prepared according to standard protocol and gently packed into the intrabony defect without overfilling, ensuring optimal adaptation within the defect.

Site A received identical surgical treatment except for the omission of laser therapy. Flaps were repositioned to achieve primary closure and secured using 3-0 non-resorbable black braided silk sutures.

Postoperative instructions included: Avoidance of mechanical trauma to the surgical site, Gentle rinsing as advised, Maintenance of oral hygiene using a soft toothbrush. Sutures were removed one week postoperatively. Patients were recalled weekly for the first month and subsequently followed up to 6 months. Clinical parameters were recorded at 1, 3, and 6 months, and radiographic evaluation was performed at 6 months.

PRF PREPARATION PROCEDURE: -

Figure-1 Collecting 10ml of blood

Figure-2 Collecting blood in Clot Activator Tube

Figure-3 Centrifugation

Figure-4 After Centrifugation formation of PRP

Figure-5 Platelet Rich Fibrin

SURGICAL PROCEDURE – EXPERIMENTAL SITE A :-

Figure-6 Pre operative probing pocket depth

Figure-7 Sulcular Incision given

Figure-8 Full thickness flap elevated and debridement done

Figure- 9 Pre – sutures placed

Figure- 10 &11 Procurement of Platelet rich fibrin Placement of PRF into defect site

Figure- 12 Sutures placed

Figure-13 Post operative probing Pocket depth

SURGICAL PROCEDURE – EXPERIMENTAL SITE B: -

Figure- 14 Pre operative probing depth

Figure-15 Sulcular Incision given

Figure-16 Full thickness flap elevated and debridement done

Figure- 17 Laser debridement

Figure- 18 Pre – sutures placed

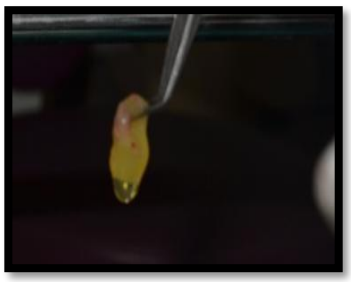

Figure- 19 Procurement of Platelet rich fibrin

Figure- 20 Placement of PRF into defect site

Figure- 21 Suture placed

Figure- 22 Post operative probing pocket depth

IV. STATISTICAL ANALYSIS

All clinical and radiographic parameters were subjected to statistical analysis-

- Descriptive statistics including mean and standard deviation were calculated
- Intragroup comparison: Paired t-test
- Intergroup comparison: Unpaired t-test

A *p*-value ≤ 0.05 was considered statistically significant

V. RESULTS

The present split-mouth clinical study evaluated the efficacy of PRF with and without adjunctive diode laser therapy in the treatment of periodontal intrabony defects. A total of 10 patients with 20 sites were included and randomly allocated:

- **Site A (OFD + PRF):** 10 sites
- **Site B (OFD + PRF + Laser):** 10 sites

Plaque Index (PI)- A progressive and statistically highly significant reduction in plaque scores was observed in both groups over the study period. The mean PI score decreased from 1.43 ± 0.09 at baseline to 0.10 ± 0.05 at 1 month, 0.04 ± 0.02 at 3 months, and 0.02 ± 0.02 at 6 months ($p < 0.001$). This reduction reflects effective plaque control and patient compliance following initial and surgical therapy.

Gingival Index (GI)- A marked reduction in gingival inflammation was observed over time.mThe mean GI score decreased from 1.03 ± 0.30 at baseline to 0.08 ± 0.06 at 1 month, 0.03 ± 0.02 at 3 months, and 0.03 ± 0.02 at 6 months, which was statistically highly significant ($p < 0.001$). This indicates substantial resolution of gingival inflammation following treatment.

Probing Pocket Depth (PPD)- Site A (OFD + PRF): - Mean PPD reduced from 8.4 ± 1.5 mm at baseline to 4.3 ± 0.9 mm at 6 months, with a mean reduction of 4.1 ± 0.9 mm, which was statistically highly significant ($p < 0.001$). **Site B** (OFD + PRF + Laser**): -** Mean PPD reduced from 8.3 ± 2.5 mm to 3.6 ± 1.1 mm, with a mean reduction of 4.7 ± 1.6 mm, also highly significant ($p < 0.001$). Intergroup comparison demonstrated a statistically significant greater reduction in PPD in Site B ($p = 0.010$), suggesting an added benefit of adjunctive laser therapy.

Clinical Attachment Level (CAL)- Site A: Gain of 3.7 ± 1.4 mm ($p < 0.001$). **Site B**: Gain of 4.3 ± 1.8 mm ($p < 0.001$). Intergroup comparison revealed no statistically significant difference ($p = 0.244$). Intergroup comparison showed no statistically significant difference ($p = 0.542$).

VI. DISCUSSION

Periodontal therapy primarily aims at arresting disease progression and preserving the integrity of the periodontium. However, in cases of advanced periodontal destruction, mere elimination of infection is insufficient, and regeneration of the lost periodontal apparatus becomes essential. True periodontal regeneration involves the formation of new cementum, periodontal ligament, and alveolar bone on a previously diseased root surface.

The process of periodontal regeneration is highly complex and involves a coordinated cascade of biological events, including cell adhesion, migration, proliferation, and differentiation. These events are regulated by growth factors, extracellular matrix components, and cellular interactions. Consequently, regenerative approaches utilizing biological mediators such as platelet concentrates have gained considerable attention in recent years.

Among these, Platelet-rich fibrin **(**PRF) has emerged as a promising biomaterial due to its autologous nature and sustained release of growth factors. PRF forms a fibrin matrix rich in platelets and leukocytes, which acts as a scaffold for tissue regeneration. It gradually releases key growth factors such as platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β), and insulin-like growth factor (IGF), thereby promoting angiogenesis, cellular proliferation, and matrix formation. In addition to biologic mediators, adjunctive use of lasers has been explored to enhance periodontal regeneration. Diode lasers, particularly gallium–aluminum–arsenide (GaAlAs) lasers, have demonstrated bactericidal effects, reduction in inflammation, and biostimulatory effects that enhance wound healing and bone formation.

Rationale of the present split-mouth study was clinico-radiographic study was designed to evaluate whether the adjunctive use of diode laser therapy could enhance the regenerative potential of PRF in the treatment of periodontal intrabony defects. The split-mouth design minimized inter-individual variability and allowed direct comparison between, Site A: OFD + PRF, Site B: OFD + PRF + diode laser.

Plaque Index and Gingival Index- In the present study, both Plaque Index (PI) and Gingival Index (GI) showed a statistically highly significant reduction over the 6-month period ($p < 0.001$). This can be attributed to effective Phase I therapy, strict oral hygiene maintenance, and patient compliance. Reduction in plaque accumulation leads to decreased bacterial load, thereby reducing gingival inflammation and improving tissue tone. These findings are consistent with studies by Miron RJ et al. (2021) and Fujioka-Kobayashi M et al. (2020), who reported significant improvements in gingival health following PRF-based therapies.[7]

A statistically highly significant reduction in PPD was observed in both groups. However, **Site B (PRF + laser)** demonstrated a significantly greater reduction compared to Site A ($p = 0.010$). This enhanced reduction can be explained by the combined effect of PRF and laser therapy-PRF promotes soft tissue healing and regeneration, Laser provides bacterial reduction and detoxification of root surfaces, Laser bio stimulation enhances fibroblast activity and collagen synthesis. These findings are in agreement with a recent study by Akansel, F. et al. (2023), which reported improved PPD reduction with adjunctive diode laser therapy[8].

Clinical Attachment Level (CAL)- Both groups showed significant CAL gain; however, the intergroup difference was not statistically significant (p = 0.244). Although Site B demonstrated slightly higher CAL gain, the lack of statistical significance may be attributed to-small sample size, short follow-up duration (6 months), Biological variability in attachment formation. The gain in CAL observed in both groups may be due to- Resolution of inflammation, Formation of new connective tissue attachment, Improved tissue adaptation, Similar findings were reported by Pullishery, F et al. (2024), where PRF showed significant CAL improvement but no significant intergroup differences when combined with adjuncts[9].

Radiographic Bone Fill- Radiographic evaluation showed statistically significant bone fill in both groups. However, no significant intergroup difference was observed (p = 0.542). This suggests that while PRF significantly contributes to bone regeneration, the additional effect of laser therapy on hard tissue regeneration may be limited within a 6-month period. Bone regeneration is a slow process and may require longer follow-up (9–12 months) to demonstrate significant differences. These findings are consistent with **]** Pradhan S, Shetty N (2023), who concluded that PRF improves bone fill, but adjunctive therapies may not always yield statistically significant additional benefits in short-term studies[10].

Biological Interpretation-The improved clinical outcomes observed in this study can be explained by the synergistic action of PRF and laser therapy, PRF acts as a scaffold and reservoir of growth factors, Laser therapy reduces microbial load and enhances cellular activity, Combined therapy enhances angiogenesis, collagen synthesis, and osteoblastic activity, However, while soft tissue healing (PPD reduction) responds

quickly, true periodontal regeneration (CAL gain and bone fill) requires longer time and may not show significant differences within short-term follow-up.

The findings of the present study are in accordance with earlier studies by Sharma A (2011) and Thorat M (2011), which demonstrated significant clinical improvements using PRF in intrabony defects. Recent studies further support these findings, PRF enhances soft and hard tissue healing, Laser improves disinfection and early healing response, Combination therapy shows better clinical outcomes but limited radiographic superiority in short term.

Clinical Implications- Within the limitations of this study, it can be inferred that, PRF is an effective regenerative material for intrabony defects, Adjunctive diode laser enhances clinical outcomes, particularly PPD reduction, However, its additional benefit in hard tissue regeneration remains limited in short-term evaluation.

VII. CONCLUSION

The present split-mouth clinico-radiographic study was conducted to evaluate and compare the efficacy of platelet-rich fibrin (PRF) used alone and in combination with adjunctive diode laser therapy in the management of periodontal intrabony defects.

Within the limitations of the study, both treatment modalities demonstrated significant improvements in clinical parameters over a 6-month period. A statistically significant reduction in Plaque Index (PI), Gingival Index (GI), and Probing Pocket Depth (PPD), along with a gain in Clinical Attachment Level (CAL), was observed in both groups, indicating effective resolution of inflammation and improvement in periodontal health.

The adjunctive use of diode laser with PRF resulted in a comparatively greater reduction in probing pocket depth, suggesting an added clinical benefit, likely due to its bactericidal and biostimulatory effects. However, this additional benefit did not translate into statistically significant differences in clinical attachment gain or radiographic bone fill when compared to PRF alone. Radiographic evaluation revealed significant defect fill in both groups; however, no statistically significant intergroup difference was observed, indicating that the regenerative potential of PRF remains the primary contributing factor in bone healing within the study period.

Furthermore, both treatment modalities were found to be safe and well-tolerated, with no adverse or immunological reactions reported in any of the patients. In conclusion, platelet-rich fibrin is an effective and reliable regenerative material for the treatment of periodontal intrabony defects. While the adjunctive use of diode laser may enhance certain clinical outcomes, particularly probing depth reduction, its additional benefit in terms of true periodontal regeneration appears limited within a short-term follow-up period.

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