Comparative evaluation of platelet-rich fibrin and autogenous bone graft for the treatment of infrabony defects in chronic periodontitis: Clinical, radiological, and surgical reentry

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ABSTRACT

Context: Both intraoral autogenous bone grafting (ABG) and platelet-rich fibrin (PRF) offer a useful treatment modality for periodontal regeneration of infrabony defects (IBDs). However, predictable regeneration in patients with severe attachment loss is a challenge to the practitioners.

Aim: The aim of this study was to compare the clinical efficacy of PRF with ABG for the treatment of IBDs in chronic periodontitis.

Settings and Design: This is a randomized controlled trial.

Materials and Methods: Twenty chronic periodontitis patients with IBDs were randomly treated by PRF or ABG. Probing pocket depth (PPD), relative attachment level (RAL), surgical reentry bone fill, and radiographic bone fill (RBF) were recorded at baseline, 3, 6, and 9 months postsurgery, respectively.

Statistical Analysis: Student’s t-test was used for continuous variables. All means were expressed as mean ± standard deviation and proportions were expressed in percentage. The level of significance was set at P < 0.05.

Results: Both PRF and ABG sites produced a significant improvement from baseline to 9 months for all the parameters. However, there was no significant difference between the two treatment modalities in the reduction of PPD and RAL gain at 9 months. In addition, ABG showed significantly greater RBF (30.34%) as compared to PRF (20.22%). Similar findings were supported by surgical reentry, where a surgical reentry of 65.31% at ABG sites and 43.64% at PRF sites was seen.

Conclusion: Both ABG and PRF can be used predictably to reconstruct lost periodontal structures as indicated by PPD reduction and RAL gain. However, in terms of osseous defect fill, ABG yields more definitive outcome than PRF.

Key words: Autogenous bone, intrabony defect, platelet-rich fibrin, surgical reentry

The ultimate goal of periodontal reconstructive therapy is regeneration. Regeneration requires healing of all periodontal components to be coordinated and integrated in a well-orchestrated sequence of biologic events. Growth factors that modulate periodontal and bone wound healing are platelet-derived growth factor (PDGF), insulin-like growth factor, and transforming growth factor β (TGF-β). The TGF-β superfamily also includes bone morphogenic proteins (BMPs) which possess high osteogenic potential. Autogenous bone cells, especially osteoblast, release TGF-β and are thus considered as the superior most bone graft by various authors.
Another convenient and economical approach to procure these growth factors at the surgical site is the use of platelet-rich fibrin (PRF).\(^5\) Therefore, the purpose of this study was to compare the efficacy of PRF to autogenous bone grafting (ABG) in the treatment of intrabony defects (IBDs) in chronic periodontitis patients.

**MATERIALS AND METHODS**

**Study population**

In this 9-month, follow-up, longitudinal interventional study, a total of twenty systemically healthy patients with chronic periodontitis (age range of 30–55 years) were selected from the outpatient section of the Department of Periodontics, Hitkarini Dental College and Hospital, Jabalpur, India. Ethical clearance for research protocol was initially obtained from the Ethical Committee of the college. The study was conducted from July 2013 to September 2014. All the patients received verbal information regarding the nature of the study and surgical procedure, thereafter a written informed consent was obtained from each participant of the study.

The inclusion criteria were the presence of 3-wall IBD ≥ 3 mm deep (the distance between alveolar crest and base of the defect on an intraoral periapical radiograph [IOPA]) along with interproximal probing depth (PD) ≥5 mm after Phase I therapy (scaling and root planing in an asymptomatic tooth). Patients with an insufficient platelet count (<200,000/mm\(^3\)), poor oral hygiene (plaque index [PI] >1.5) after the reevaluation of Phase I therapy, smokers, pregnant and lactating women were excluded from the study.

**Presurgical therapy**

Initially, a full mouth scaling and root planing procedure was performed for all patients, and each patient was given careful instructions regarding oral hygiene measures. They were reviewed after 6–8 weeks of Phase I therapy for a detailed periodontal evaluation. The selected sites were divided randomly (by using a coin-toss method) to be treated with PRF or ABG. A single operator performed all surgeries as well as clinical and radiographic measurements.

**Clinical and radiographic measurements**

The following measurements were recorded at baseline, 3, 6, and 9 months after the surgery.

- PI (Silness and Loe, 1964)
- Gingival index (GI) (Loe and Silness, 1963)
- Probing pocket depth (PPD)
- Relative attachment level (RAL) (distance between the most apical portion of the stent and base of the pocket) was recorded
- IOPA was obtained using long cone paralleling technique with grid
- PPD and RAL were obtained using UNC-15 probe.

**Platelet-rich fibrin preparation**

The PRF was prepared by Choukroun’s method just before placement, 10 ml of intravenous blood from antecubital vein was collected in tube without any anticoagulant and centrifuged immediately for 10 min at 3000 revolutions per minute (≈400 × g).\(^6\) The resultant product was a structured fibrin clot in the middle of the tube just between the red blood corpuscles (RBCs) at the bottom and acellular platelet-poor plasma (PPP) at the top. Among these, the uppermost layer of PPP was discarded and the PRF was easily separated from the RBC base (preserving only a small layer of 1–2 mm) using sterile tweezers and scissors. A stable fibrin membrane was obtained by transferring PRF onto a sterile compress and squeezing serum out of the PRF clot [Figure 1].

**Method of harvesting autogenous bone graft**

An incision was given 2 mm apical to the roots of the central and lateral mandibular anterior teeth extending from the labial frenum till 3 mm short of the mental foramen. ABG was obtained using Neo Auto Chip Maker\(^\text{®}\) (Neobiotech Co., Ltd. Seoul, Korea) of 6 mm diameter, 14 mm length, and 4 mm drill stop; an instrument to collect autogenous cortical bone chips from molars or incisor area [Figure 2].

**Procedure**

Auto chip maker (ACM) with dental implant motor was located on the surface of operation area by pressing it slightly with profuse saline irrigation (to prevent bone heating). Recommended drilling speed is 300–500 rpm with a maximum torque of 50 Ncm. To collect high-quality autograft bone, it was drilled until 3-4 mm depth and then moved to different areas to collect the bone chip, and the procedure was repeated until enough autograft bone was obtained. The graft carrier was used to fill the defect site [Figure 3].
Surgical procedure
A preprocedural mouth rinse with 0.12% chlorhexidine digluconate (CHX) rinse was followed by the administration of adequate local anesthesia. Buccal and lingual intrasulcular incisions were made while preserving the interproximal soft tissue as far as possible. Mucoperiosteal flap was then reflected for meticulous debridement and root planing, but no osseous recontouring was done. Surgical site was well irrigated with normal saline. The selected sites were randomly assigned for PRF or ABG placement [Figure 4].

The flaps were repositioned and secured in place using black-braided (3-0) interrupted silk sutures to obtain primary closure of the interdental space, and the site was protected with a periodontal dressing.

Postsurgical protocol
All patients were prescribed antibiotics and analgesics (amoxicillin 500 mg, thrice a day and 800 mg ibuprofen thrice a day for 5 days) along with CHX rinses (0.12%) twice daily for 2 weeks.

Periodontal dressing and sutures were removed, and the surgical site was irrigated thoroughly with saline, 1 week postoperatively. Patients were instructed to continue rinsing (0.12% CHX) for another week. Thereafter, gentle brushing with a soft toothbrush was recommended. Recall appointments were made at 3-, 6-, and 9-month intervals. No subgingival instrumentation was attempted at any of these subsequent appointments. Postoperative care included reinforcement of oral hygiene instructions, and the surgical sites were professionally maintained whenever necessary.

At the end of 3, 6, and 9 months posttherapy, the patients were evaluated clinically and radiographically for comparison. Clinical parameters (PI, GI, PPD, and RAL) and radiographic measurements were repeated for all sites similar to previous presurgical measurements [Figures 5-8] After completion of 9 months, surgical reentry was performed at the operated site to evaluate the amount of bone fill obtained [Figures 9 and 10].

Surgical reentry
Under adequate local anesthesia, intrasulcular incision was given at the operated site to elevate only the buccal mucoperiosteal flap. The surgical site was debrided to expose the underlying bone and irrigated with saline. Defect fill was measured using UNC-15 probe. Sling sutures were given using black-braided silk (3-0) to reposition the mucoperiosteal flap. Periodontal dressing was placed. The patients were prescribed analgesic (800 mg ibuprofen thrice a day for 3 days).
Statistical analysis
The statistical analysis was carried out using Student’s t-test for the continuous variable (e.g., RAL, PPD, GI, and bottom of the defect). All means were expressed as mean ± standard deviation, and proportions were expressed in percentage. The critical levels of significance of the results were considered at 0.05 level, i.e., \( P < 0.05 \) was considered statistically significant.

RESULTS
Both PRF and ABG produced a statistically significant reduction in PPD, gain in RAL, radiographic bone fill (RBF) and bone fill at surgical reentry from baseline to 9 months. Although there was no statistically significant difference between clinical parameters, surgical reentry measurements and RBF indicated a significant improvement in bone fill by ABG as compared to PRF.

Mean PPD reduction was more by ABG (4.8 ± 0.57 [64.86%]) than by PRF (4.1 ± 0.63 [56.16%]). RAL gain was also more as compared to PRF (4.5 ± 0.61 [34.35%]) and (3.9 ± 0.57 [30.95%]), respectively. However, the difference was not statistically significant, even though a significant improvement was seen in both the groups from baseline. Furthermore, both the groups showed statistically significant RBF from baseline with 1.787 ± 0.277 (30.34%) of bone fill with ABG and 1.166 ± 0.344 (20.22%) of bone fill with PRF when evaluated. However, bone fill by ABG was significantly greater than PRF. Similar findings were supported by surgical reentry, where a mean bone fill of 3.2 ± 0.434 (65.31%) by ABG and 2.4 ± 0.572 (43.64%) by PRF was seen.

DISCUSSION
In the development of effective regenerative therapies, useful therapeutic approaches have been introduced. However, the extent of attachment apparatus that can be restored with the currently available modalities has limited predictability. Numerous treatment modalities of periodontal regeneration include guided tissue regeneration, root conditioning agents, bone replacement grafts, PepGen-15, polypeptide growth factors, and combinations, thereof for osseous defects.\(^7\)

Growth factors are naturally occurring polypeptides which stimulate chemotaxis, proliferation of fibroblasts, and synthesis of extracellular matrix, as well as promote differentiation of cementoblasts and osteoblasts. Thus, the
importance of growth factors in enhancing wound healing and promoting periodontal regeneration has become the focus of research in the present day.

Therefore, the purpose of this prospective, randomized controlled clinical trial is to compare the clinical, radiographic, and surgical reentry outcomes, obtained by PRF and ABG, in the treatment of IBDs in chronic periodontitis patients.

After 9 months postsurgery, the reduction in pocket PD was 4.1 ± 0.63 mm and 4.8 ± 0.57 mm for PRF and ABG, respectively. The reduction was statistically significant from baseline for both the groups, but intergroup variation was not statistically significant. However, when radiographic defect fill and surgical reentry data were analyzed, statistically significant intergroup difference was found in favor of ABG-treated sites.

Autogenous grafts are still considered to be the gold standard as they are the most predictable material for regeneration. They provide the added benefits of eliminating the risk of immunologic reaction or disease transmission. However, the limited amount of autogenous bone obtained by time-consuming methods as well as their susceptibility to microbial contamination is the major drawback during procurement from intraoral sites.[8]

To overcome these limitations, advances in periodontal therapy are being focused on improved methods of ABG procurement or utilization of growth factors. To obtain the benefits of BMPs in cortical bone, ACM instrument was used in the current study. ABG of desired quantity and in comparatively less time was harvested (1 cc of bone chip within 10 s). Several authors have found histological evidence of new attachment as early as 3 months after grafting periodontal defects using autogenous bone, with complete maturation of the attachment apparatus at 8 months.[9]

In the present study, cortical bone from the incisor/molar area was primarily used to fill the IBDs. It has been shown that dense cortical grafts contain high concentrations of morphogenetic proteins and growth factors. This is the main reason why cortical grafts were used in the present study.

Choukroun’s PRF, which is a second-generation platelet concentrate, consists of an intimate assembly of cytokines, glycanic chains, and structural glycoproteins enmeshed within a slowly polymerized fibrin network.[10] The slow polymerization mode confers to the PRF membrane a particularly favorable physiologic architecture to support the healing process coordinated by growth factors.

PDGF and TGF-β growth factors induce the differentiation and proliferation of osteoblastic cells (osteoinduction), while inhibiting the formation of osteoclast precursors and mature osteoclast. It also acts as a scaffold for osteoblasts to produce new bone (osteocoduction) and allows penetration of new blood vessels for rapid revascularization and migration of osteoprogenitor cells.[3] This has been shown to exert a favorable effect on periodontal regeneration as measured by the increase in clinical attachment levels and osseous defect fill in humans.[11] In addition, topical application of TGF-β stimulates proliferation of gingival fibroblastic cells, formation of blood vessels, and remodeling of extracellular matrix, which results in increased proliferation of granulation tissue within healing periodontal tissues.[12]

| Clinical parameters  | Mean±SD PRF   | Mean±SD ABG   | P   |
|---------------------|---------------|---------------|-----|
| GI*                 | 1.330±0.3093  | 1.300±0.2708  | >0.05 |
| PPD†                | 7.30±1.767    | 7.40±1.578    | >0.05 |
| RAL‡                | 12.60±1.430   | 13.10±1.595   | >0.05 |
| RDD§                | 5.7650±0.832  | 5.89±0.739    | >0.05 |
| SE¦                 | 5.50±1.51     | 4.9±1.197     | >0.05 |

*Gingival index, †Pocket probing depth, ‡Relative attachment level, §Radiographic defect depth, Defect depth at surgical reentry

| Clinical parameters  | Mean±SD PRF   | Mean±SD ABG   | P   |
|---------------------|---------------|---------------|-----|
| GI                  | 1.330±0.3093  | 0.930±0.2708  | <0.05 |
| PPD                 | 7.30±1.767    | 3.20±0.919    | <0.05 |
| RAL                 | 12.60±1.430   | 8.70±1.059    | <0.01 |
| RDD                 | 5.7650±0.832  | 4.5990±0.701  | <0.05 |
| SE                  | 5.50±1.51     | 3.10±0.994    | <0.05 |

*G=gingival index, PPD=Pocket probing depth, RAL=Relative attachment level, RDD=Radiographic defect depth, SE=Defect depth at surgical reentry, PRF=Platelet-rich fibrin, ABG=Autogenous bone grafting
**Table 3: Nine months postsurgery changes in clinical and radiographic parameters of platelet-rich fibrin and autogenous bone grafting sites**

| Clinical parameters | Mean±SD | p   |
|---------------------|---------|-----|
|                     | Group PRF | Group ABG |
| GI                  | 0.930±0.1703 | 0.910±0.2079 | >0.05 |
| PPD                 | 3.20±0.919 | 2.60±0.843 | >0.05 |
| RAL                 | 8.70±1.059 | 8.60±1.075 | >0.05 |
| RDD                 | 4.599±0.701 | 4.103±0.475 | <0.05 |
| SE                  | 3.10±0.994 | 1.7±0.674 | <0.05 |

SD=Standard deviation, GI=Gingival index, PPD=Pocket probing depth, RAL=Relative attachment level, RDD=Radiographic defect depth, SE=Defect depth at surgical reentry, PRF=Platelet-rich fibrin, ABG=Autogenous bone grafting

Fibrin network of PRF presents a particularly homogeneous three-dimensional organization and progressive polymerization. This allows increased incorporation of the circulating cytokines which increases their lifespan and thus plays a role in initial cicatricial matrix remodeling. In addition, PRF shows a continuous release of the growth factors over the subsequent 300 min since its preparation.

The beneficial effects of PRF in the treatment of infrabony defects over open flap debridement are well established. Lekovic et al. reported that bovine porous bone mineral can augment the effects of PRF when utilized for periodontal infrabony defects. However, when PRF was used in combination with ABG and compared with ABG alone for the treatment of Grade II mandibular molar furcation defects, no differences between the study groups were observed.

**CONCLUSION**

Intraoral ABG and autologous PRF can be used predictably to reconstruct lost supporting structures in patients with severe periodontitis which successfully results in pocket depth reduction and clinical attachment gain. However, in terms of osseous defect fill alone, ABG yields more definitive outcome than PRF. Further, long-term studies and histologic evaluation are needed to assess the true nature of healing after the placement of PRF in periodontal osseous defect.

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**Conflicts of interest**

There are no conflicts of interest.

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