Bioactive glass versus autologous platelet-rich fibrin for treating periodontal intrabony defects: A comparative clinical study

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INTRODUCTION

The anatomical sequelae to the apical spread of periodontitis are represented in the form of periodontal osseous lesions.[1] While minimal opportunity for restoring the lost supporting structures is noted in the case of horizontal bone loss, angular bone loss can facilitate regenerative therapy, depending on the characteristic of the defect.[2]

To arrest and control the periodontal infection and ultimately to regenerate the lost periodontal structures is the aim of periodontal therapy.[3] Successful periodontal regeneration relies on epithelial seal reformation, new acellular extrinsic fiber cementum deposition, root surface insertion of functionally oriented connective tissue fibers, and alveolar bone height restoration form the basis for periodontal regeneration.[4]

A recognized standard to manage residual pockets after cause-related therapy is access flap surgery.[5] However, conventional open flap debridement (OFD) alone is seen to lack the capacity for regenerating tissues destroyed by the disease.[6] In clinical practice, bioactive glass and autologous platelet-rich fibrin (PRF) with OFD is being considered to achieve the goal of regeneration.

Since some years, for the treatment of intrabony defects (IBDs), bioactive glass products have been considered.[7] Bioactive glass has been seen to exhibit properties such as hemostasis, ease of manageability, and also acting as a probable barrier for retarding epithelial down growth.[8-13]

Abstract:
Background: To compare treatment modalities: Open flap debridement (OFD) alone (Group I), OFD in combination with PerioGlas® (Group II), and OFD in combination with autologous platelet-rich fibrin (PRF) (Group III) for periodontal intrabony defects (IBDs). Aim: To evaluate on clinical and radiographic basis, effectiveness of PerioGlas®, and PRF in treating IBDs. Settings and Design: IBDs selected on the basis of the inclusion criteria were randomly assigned to Groups I, II, and III by coin toss method. Materials and Methods: The study was conducted on patients reporting to the department of periodontology and oral implantology. Thirty-eight patients with ninety periodontal IBDs of moderate to severe periodontitis were selected and assigned to Groups I, II, and III. In each patient, a minimum number of two sextants were present with pocket depths ≥5 mm in at least three teeth. Statistical Analysis: Statistical analysis based on mean values, standard deviation, and P values.

Results: Compared to baseline, 9 months postoperatively: (1) mean probing pocket depth reduction for Group I was 3.68 mm ± 0.72, for Group II was 5.57 mm ± 1.10, and for Group III was 6.11 mm ± 0.92. (2) The mean relative attachment level gain for Group I was 4.14 mm ± 0.76, for Group II was 6.57 mm ± 1.45, and for Group III was 6.74 mm ± 1.55. (3) Mean radiographic IBD fill for Group I was 69.29% mm ± 7.73, for Group II was 74.44% mm ± 8.57, and for Group III was 75.01% mm ± 7.85. Conclusion: This study shows marked improvements in the clinical parameters and radiographic outcomes with both PerioGlas® and autologous PRF to treat periodontal IBDs as compared to OFD alone.

Key words: Autologous platelet-rich fibrin, bioactive glass (PerioGlas®), intrabony defects, open flap debridement
Bioglass stimulates osteoconduction by bonding to bone, due to hydroxyl carbonate apatite layer formation when in contact with body fluid.131

Increase in signal-regulated protein kinase phosphorylation extracellularly and osteoprotegerin in periodontal ligament fibroblasts and alkaline phosphatase activity upregulation has been reported in a study on the effect of autologous PRF on human periodontal ligament fibroblasts and its application in periodontal IBD reported. Thus, concluding that IBDs exhibited periodontal pocket depth reduction and clinical attachment gain after 6 months with bone fill in defects.132

Till date, studies conducted to compare the periodontal regeneration capacity of PerioGlas® and PRF to treat periodontal osseous defects with a follow-up period of 9 months have been few in number. The aim of the study was to evaluate on clinical and radiographic basis, the effectiveness of PerioGlas® and PRF in the treatment of IBDs.

MATERIALS AND METHODS

Study design and sampling technique: Study was conducted on patients reporting to the department of periodontology and oral implantology. Thirty-eight patients with ninety periodontal IBDs of moderate to severe nature of periodontitis were selected for Group I (i.e., OFD alone), Group II (i.e., OFD in combination with PerioGlas®), and Group III (i.e., OFD in combination PRF) randomly by coin toss method. Clinical and radiographic evaluations were not performed by a blinded examiner. Ethical clearance was obtained. Furthermore, informed consent obtained from all the patients included in the study.

Inclusion criteria
Minimum twenty permanent teeth, age group of 20–55 years, two wall and three wall periodontal IBDs with radiographic evidence, periodontal pocket depth ≥5, and relative attachment level (RAL) ≥3 mm. In each patient, a minimum number of two sextants were present with pocket depths ≥5 mm in at least three teeth. Patients were assigned to Groups I, II, or III and assessment of clinical parameters was done with UNC 15.

Exclusion criteria
Systemically compromised patients, those on medications (corticosteroids/bisphosphonate therapy) that may interfere with wound healing, Grade III tooth mobility, smokers, alcoholic participants, and pregnant and lactating mothers, patients who underwent periodontal treatment within a period of 1 year.

Treatment protocol
Periodontal evaluation performed 4 weeks after phase I therapy. Persistence of ≥5 mm pocket depth and clinical attachment loss of ≥3 mm with radiographic evidence of bone loss were randomly assigned to either Groups I, II, or III. On the day of surgery, the customized acrylic stent was used to record the pocket probing depths using a manual UNC – 15 probe.

Two percent lignocaine hydrochloride solution with adrenaline, 1:80,000 was administered. Crevicular incisions were placed, and full thickness mucoperiosteal flaps both on buccal as well as palatal or lingual sides were elevated.

Granulation tissue was removed using Gracey curettes (HU-Friedy). Any residual debris and calculus were removed with ultrasonic scalers.

The IBD was assessed for its depth, width, and the number of walls of the defect. For Group I (OFD alone), after thorough debridement, flaps were approximated to the same level as they were presurgically and secured with 3–0 silk sutures.

For Group II and Group III, after thorough debridement, defect site was presutured using 3–0 silk suture. In case of Group II, a mixture of PerioGlas® with saline or patients’ own blood into a thick paste from the base of the defect coronally was placed. In Group III, care was taken to place the red blood cell (RBC) layer of PRF clot coming in contact with the base of the IBD site. Periodontal dressing was used to cover the treated sites of Groups I, II, and III [Figures 1a-h and 2a-h].

Intravenous blood was obtained by venipuncturing of the antecubital vein. This blood was immediately transferred into 10 ml disposable vacuum test tube without anticoagulant and centrifuged in centrifugation machine at 3000 revolutions per minute for 10 min.133 Blood centrifugation immediately after collection allows the composition of a structured fibrin clot in the middle of the tube, just between the RBCs at the bottom and acellular plasma at the top. PRF was obtained by preserving a small RBC layer using a sterile tweezers and scissors and then transferred onto a sterile Dappen Dish.

Postoperative instructions were given. Patients were prescribed capsule amoxicillin 500 mg thrice daily for 5 days and tablet diclofenac sodium 50 mg thrice a day for 3 days and also chlorhexidine gluconate 0.2% to rinse twice daily for 4 weeks.

Suture removal done after 7 days and patients were instructed to establish their manual oral hygiene measures after 7 days postoperatively. Radiographic assessment with radiovisiography (RVG) and AutoCAD software [Figures 1h, i and 2i, j]. Clinical assessment using customized acrylic stent was performed at baseline, 3, 6, and 9 months for Group I, II, and III.

Statistical analysis was based on mean values, standard deviation, and P values.

RESULTS

The reason for excluding a total of 6 patients (i.e., 2 in each group) at the time of data interpretation was because those 6 patients dropped out during the follow-up period. Hence, results were calculated by considering 84 periodontal IBDs in all the three groups.

Probing pocket depth
Compared to baseline, 3 months postoperatively after periodontal surgery: The mean probing pocket depth (PPD) reduction for Group I was 1.89 mm ± 0.74, for Group II was 3.64 mm ± 1.10, and for Group III was 3.82 mm ± 0.94. Compared to baseline, 6 months postoperatively after periodontal surgery: The mean PPD reduction for Group I was 2.93 mm ± 0.77, for Group II was 4.75 mm ± 1.14, and for Group III was 5.14 mm ± 0.89.
Compared to baseline, 9 months postoperatively: The mean PPD reduction for Group I was 3.68 mm ± 0.72, for Group II was 5.57 mm ± 1.10, and for Group III was 6.11 mm ± 0.92.

On comparative evaluation of PPD reduction values at 3 months of periodontal surgery, for Group I versus Group II, \( P < 0.05 \) and for Group I versus Group III, \( P < 0.05 \) which can be interpreted as
statistically significant reduction of PPD. Whereas for Group II versus Group III, \( P > 0.05 \) which can be interpreted as the PPD reductions were statistically insignificant.

**Relative attachment level**

Compared to baseline, 3 months postoperatively after periodontal surgery: The mean RAL gain for Group I was 2.75 mm ± 0.84, for Group II was 4.85 mm ± 1.42, and for Group III was 4.89 mm ± 1.97.

Compared to baseline, 6 months postoperatively after periodontal surgery: The mean RAL gain for Group I was 3.82 mm ± 0.77, for Group II was 5.57 mm ± 1.50, and for Group III was 5.97 mm ± 1.17.

Compared to baseline, 9 months postoperatively after periodontal surgery: The mean RAL gain for Group I was 4.14 mm ± 0.76, for Group II was 6.57 mm ± 1.45, and for Group III was 6.74 mm ± 1.55.

On comparative evaluation of RAL gain values at 3 months of periodontal surgery, for Group I versus Group II, \( P < 0.05 \) and for Group I versus Group III, \( P < 0.05 \) which can be interpreted as statistically significant gain of RAL. Whereas for Group II versus Group III, \( P > 0.05 \) which can be interpreted as the RAL gain was statistically insignificant.

**Radiographic intrabony defect fill in percentage**

RVG and long cone paralleling technique were selected for each surgical site. Radiographic images were saved to the computer as JPEG image to measure the linear radiographic depth (in mm) of the defect (DD) using software AutoCAD [Figures 1f, g and 2g, h].

Formula used for calculating:\[16\]

\[
\text{Bone fill percentage} = \frac{\text{Base line DD} - 6 \text{ or 9 months DD}}{\text{Base line DD}} \times 100
\]

\[(DD = \text{linear radiographic depth [in mm] of the defect})\]

Compared to baseline, 6 months postoperatively after periodontal surgery: The mean radiographic IBD fill for Group I was 54.22% mm ± 7.73, for Group II was 72.69% mm ± 6.97, and for Group III was 73.73% mm ± 5.76.

Compared to baseline, 9 months postoperatively after periodontal surgery: The mean radiographic IBD fill for Group I was 69.29% mm ± 7.73, for Group II 74.44% was mm ± 8.57 and for Group III was 75.01% mm ± 7.85.

On comparative evaluation of IBD fill values at 3 months of periodontal surgery, for Group I versus Group II, \( P < 0.05 \) and for Group I versus Group III, \( P < 0.05 \) which can be interpreted as statistically significant IBD fill. Whereas for Group II versus Group III, \( P > 0.05 \) which can be interpreted as the IBD fill was statistically insignificant.

**DISCUSSION**

One of the frequently encountered complications of periodontitis is IBD and when left untreated, may negatively affect long-term tooth prognosis. Absence of bleeding on probing, presence of shallow pockets associated with periodontal regeneration, and no soft-tissue recession are considered as positive indications of a successful periodontal therapy.\[17\]

Results of meta-analysis reports with respect to the treatment of intrabony defects, support the following conclusions: When compared to OFD procedures alone, using bone grafts in combination with OFD increase bone level, reduce bone loss, increase clinical attachment level, and reduce PPDs. Taking into account the results obtained, it can be said that bone grafting is one of the most promising forms of regenerative therapy.\[18\]

Autologous PRF has been widely used to accelerate soft and hard tissue healing. Autologous PRF helps in early wound closure, bone graft maturation, and improved esthetics of the periodontal and peri-implant soft tissues. Its advantages include a simple preparatory method, ease of application, lack of biochemical modification, and cost-effectiveness.\[19\]

The integration of fibrin network into the regenerative site facilitates endothelial cells migration necessary for the neoangiogenesis, allows gradual release of platelet cytokines from the fibrin matrix, thus creating a perpetual process of healing. Furthermore, presence of leukocytes and cytokines in the fibrin network can play a significant role in the self-regulation of inflammatory and infectious phenomena within the grafted material. Furthermore, PRF is a supportive matrix for bone morphogenetic proteins as well.\[20\]

Our study, intergroup comparative evaluation showed a significant PPD reduction between Group I versus Group II, Group I versus Group III at 3, 6, and 9 months from baseline \((P < 0.05)\), but no significant PPD reduction was observed in values between Group II and Group III values at 3, 6, and 9 months \((P > 0.05)\). This study results do match with that of the previous studies.\[14,21-23\]

The intergroup comparative evaluation of RAL mean values showed significant RAL gain in Group II versus Group I and Group III versus Group I at 3, 6, and 9 months from baseline \((P < 0.05)\) with no statistically significant RAL gain between Group II versus Group III values at 3, 6, and 9 months from baseline \((P > 0.05)\). This study showed similar results as seen in previous studies.\[22-25\]

The intergroup comparative evaluation of radiographic IBD fill percentage mean values showed statistically significant bone fill between Group II versus Group I and Group III and Group I at 6 and 9 months \((P < 0.05)\), but no statistically significant difference between IBD fill percentage was observed between Group II and Group III at 6 and 9 months \((P > 0.05)\). This study showed similar results as seen in previous studies.\[12,26-28\]

The improvement in clinical and radiographic parameters can be attributed to the beneficial effects of both PerioGlas® and PRF. Thus, our study is in accordance with the systematic review conducted by Trombelli et al.\[29\]
CONCLUSION

The present study demonstrated that in the treatment of periodontal IBDs, using regenerative material either PerioGlas® or PRF with OFD shows better results than OFD alone. Our study also concludes that though statistically insignificant differences were noted in the treatment outcomes between OFD with PerioGlas® versus OFD with autologous PRF, clinical and radiographic outcomes for autologous PRF when used along with OFD, showed better results than PerioGlas® when used along with OFD in treating periodontal IBDs.

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Conflicts of interest
There are no conflicts of interest.

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