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Research Article

Comparative evaluation of bioactive glass bone graft material with platelet rich fibrin and bioactive glass bone graft material alone for the treatment of periodontal intrabony defects: a clinical and radiographic study

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ABSTRACT

Background: The primary goal of periodontal therapy is to arrest the progression of periodontal disease and maintain the natural dentition in health and comfortable function. Growth factors that seem to play an important role in periodontal and bone wound healing are PDGF, IGF combined with PDGF and TGF-ß. Platelet-rich fibrin (PRF) seems to be an appropriate and economical method to obtain these growth factors. The cell type-specific actions of PRF may be beneficial for periodontal regeneration. The purpose of this study is to compare the clinical and radiographic outcomes obtained by a combination of bioactive glass with PRF and bioactive glass alone in treatment of periodontal intrabony defects.
Methods: The present study was carried out in Rajnandgaon city (C.G.) India, during study period May 2013 to October 2014. After initial examination, the following recording was made using Plaque index and Gingival index. Preparation of PRF was done by Choukroun criteria. Surgical procedure was performed. Post-surgical findings were noted. Student t test (Paired and unpaired) were applied with value of <0.05 was considered statistically significant for interpretation of finding.
Results: The mean probing pocket depth, clinical attachment level and bone level for the Test group at baseline were 7.45mm with S.D±1.38, 9.9.mm with S.D±1.32 at 3 month and 6.45 mm with S.D±1.53 mm at 6 month. (Significant p<0.0001) Similar significant findings were also noted in control group.
Conclusions: The study showed significant improvements in clinical and the radiographic parameters in each group.

Keywords: Bioactive glass, Platelet rich fibrin, Periodontal intrabony defects, Chhattisgarh

INTRODUCTION

The primary goal of periodontal therapy is to arrest the progression of periodontal disease and maintain the natural dentition in health and comfortable function.[1,2] This goal can be accomplished by non-surgical therapy in patients with mild to moderate periodontitis, whereas in advanced cases, particularly in the presence of intrabony defects surgical procedures that regenerate the supporting periodontal tissues may be employed. Regulators of periodontal regeneration include root conditioning agents, growth and attachment factors, guided tissue regeneration (GTR) and bone replacement grafts.[2] Different types of bone grafts are used to fill the periodontal defects and restore the lost periodontal attachment apparatus. Among the grafts, only autogenous bone grafts provide viable

osteogenic cells.[2,4] However, the routine use of autografts in regenerative periodontal treatment is limited. To overcome these problems, use of other materials such as allografts, xenografts or alloplasts have been proposed.[5]

Bioactive glass is composed of elements naturally occurring in the body. Clinical and histological studies have indicated that bioactive glass not only results in gain in clinical attachment and radiographic fill of osseous defects, but may also act as a barrier retarding the down growth of the epithelium.[4,5]

Growth factors that seem to play an important role in periodontal and bone wound healing are platelet derived growth factor (PDGF), insulin-like growth factor (IGF) combined with PDGF and transforming growth factor ß (TGF-ß).[1,7] Platelet-rich fibrin (PRF) can stimulate cell proliferation. These cell type-specific actions of PRF may be beneficial for periodontal regeneration.[7,8] With the above background, the present study was conducted to evaluate the clinical and radiographic outcomes obtained by a combination of bioactive glass with PRF and bioactive glass alone in treatment of periodontal intrabony defects.[7,8]

METHODS

The present prospective study was carried out during study period May 2013 to October 2014. In this study, 13 systemically healthy patients with a mean age of 35 years with a total of 20 periodontal intrabony defects were selected from the outpatient department. Each patient was explained about the surgical procedure and the expected results. Each patient signed an informed consent. The study protocol was approved by The Institutional Ethical Committee. The complete information regarding the case history of the patient was recorded before performing the procedure in the specially designed patient proforma. The selected patients were randomly assigned to test and control groups. The test group was treated with bioactive glass bone graft material with PRF and control groups were treated with bioactive glass bone graft material alone.

Inclusion criteria

- Systemically healthy subject.
- Presence of at least 1 or 2 radiographically detectable interproximal intrabony osseous defect with probing pocket depth ≥5mm and clinical attachment loss ≥5mm following initial therapy.
- Depth of intra osseous component of the defect ≥3mm by clinical and radiographic means.
- Presence of adequate zone of attached gingiva.

Exclusion criteria

- Patients who are medically compromised or under therapeutic regimen that may alter the probability of soft tissue and bone healing.
- Pregnant females or lactating mothers.
- Smokers or who uses any forms of tobacco products.
- Tooth mobility more than grade II and Furcation involvement.
- History of periodontal surgery of the selected quadrant.
- Evidence of localized aggressive periodontitis.

After initial examination, the following recording was made using plaque index and gingival index (Silness and Loe) as follows-I. Probing pocket depths (PPD) measured from the gingival margin to the base of the pocket II.[10] Clinical attachment levels (CAL) measured from the (FRP- Apical extension of acrylic guide stent) fixed reference point to the bottom of the probable pocket III. Bone levels from the cemento-enamel junction to the base of the defect (Digital Radiography).

As an Initial therapy, Pre-treatment data collection, Scaling and root planning, Polishing using low abrasive paste was performed for each patient. Preparation Of PRF was done by Choukroun criteria.[11] The patient is asked to rinse his mouth with 0.2% chlorhexidine gluconate for 1 minute to ensure asepsis and infection control prior to the surgical procedure. The area to be treated was thoroughly anaesthetized by means of regional block and local infiltration; using 2% lignocaine hydrochloride with adrenaline (1:80,000).

After adequate anesthesia, a sulcular incision was made, to preserve the existing gingival tissue as much as possible. The incision extends to minimum of two teeth anteriorly and one tooth distally to the tooth being treated, on both buccal and lingual/palatal sides of the operated teeth. Vertical incision was placed, only when necessary, for adequate access to surgical site.

A periosteal elevator is used to elevate the full thickness mucoperiosteal flap from the bone by moving it mesially, distally and apical until the desired reflection is achieved. The procedure is followed by scaling and root planning, if required. The osseous lesion was carefully curetted, so that the entire bone and the root surface adjacent to teeth can be assessed. The PRF preparations were started 20 minutes before surgery. After debridement the combination of BG with PRF were placed in sites treated as (test site) while BG alone were placed in sites treated as (Control site). While placing the Graft material into defect proper care was taken not to over fill. Every effort was made to avoid contamination of debrided root surface with saliva and blood until the graft material is placed. After grafting, flap was repositioned and sutured using black silk suture (4-0) and surgical area was covered with non-eugenol dressing (Coe pak, G, C America Inc, USA).

All Patients were prescribed with systemic antibiotics (Amoxicillin 500 mg 3 times a day for 5 days) and analgesic (Ibuprofen 400 mg 3 times a day for 3 days). The patients were instructed to avoid tooth brushing and

to chew carefully, in the operated site for 2 weeks. Mouth rinse (Hexidine) 10 ml of 0.2% chlorhexidine gluconate solution, were prescribed twice daily for 4 weeks to maintain oral hygiene in the operated site. On the second day following surgery, patients were recalled, and asked regarding any swelling, discomfort, pain and/or sensitivity. After 2 weeks, periodontal dressing and sutures were removed. The patients were re-evaluated clinically and radiographically at 3 months and 6 months interval.

The customized acrylic guide stent was placed on each defect site to ensure the reproducibility of the measurements. Using UNC–15 graduated periodontal probe, the measurements for gain in clinical attachment level, and reduction in probing pocket depth were repeated similar to the pre-surgical measurement procedures. All the sites in both test and control groups were subjected to radiographic assessment. Digital intraoral Radiovisiograph were taken for each site after 3 months and 6 months.

Statistical test

Data was compiled in MS Excel and checked for its completeness and correctness. Then it was analyzed using online statistical calculator and student t test (Paired and unpaired) were applied with value of <0.05 was considered statistically significant for interpretation of finding.

RESULTS

In the current study, 3 baseline parameters (mean probing pocket depth, mean clinical attachment level and mean bone level) were assessed in test group and comparison was done with the control group. The mean probing pocket depth for the Test group at baseline was 7.45mm with S.D±1.38 whereas values after 3 month post-surgery were 5.40±0.99 and after 6 month post-surgery were 3.50±1.08.The mean pocket depth reduction, compared from baseline to 3 and 6 month was 2.05 mm±0.89 and 3.95 mm±1.27mm (p<0.0001).

Table 1: Change in probing pocket depth (in mm) in test and control group at different time interval.

	Mean	Number	Std. deviation	Std. error Mean
Test group				
Baseline	7.45	10	1.38	0.43
3 months	5.40	10	0.99	0.31
6 months	3.50	10	1.08	0.34
Control group				
Baseline	7.15	10	1.52	0.48
3 months	4.75	10	1.08	0.34
6 months	3.10	10	0.96	0.30

	Paired differences			95% Confidence interval of the difference		t-value	df	p-value
	Mean	Std. deviation	Std. error mean	Lower	Upper			
Test group								
Baseline-3 months	2.05	0.89	0.28	1.40	2.69	7.23	9	0.000S, p<0.05
Baseline-6 months	3.95	1.27	0.40	3.03	4.86	9.76	9	0.000S, p<0.05
3 months-6 months	1.90	0.61	0.19	1.46	2.33	9.77	9	0.000S, p<0.05
Control group								
Baseline-3 months	2.40	0.69	0.22	1.89	2.90	10.85	9	0.000 S, p<0.05
Baseline-6 months	4.05	0.86	0.27	3.43	4.66	14.81	9	0.000 S, p<0.05
3 months-6 months	1.65	0.33	0.10	1.40	1.89	15.46	9	0.000 S, p<0.05

Whereas mean probing pocket depth for the Control group at baseline was 7.15mm with S.D±1.52 whereas values after 3 month post-surgery were 4.75±1.08 and after 6 month post-surgery were 3.10±0.96.The mean pocket depth reduction, compared from baseline to 3 and 6 month was 2.40mm±0.69 mm and 4.05mm±0.86mm (p<0.0001) (Table 1). The mean clinical attachment level at baseline for test group was 9.9.mm with S.D±1.32 whereas values after 3 month post-surgery were 7.90 mm±1.32 mm and after 6 month post-surgery were 6.15±1.45. The clinical attachment level, compared from baseline to 3 and 6 month was 2.00 mm±0.74 mm and 3.75 mm±0.85 mm. (p<0.0001) Whereas mean clinical attachment level at baseline for Control group was 10.05mm with S.D±1.21 mm whereas values after 3 month post-surgery were 7.65±1.00 and after 6 month post-surgery were 6.05± 1.06.

The mean gain in clinical attachment level, compared from baseline to 3 and 6 month was 2.40 mm±0.69 mm

and 4.00 mm±0.91 mm (p<0.0001) (Table 2). The mean bone level at baseline for test group was 6.45 mm with S.D±1.53 mm, whereas value after 3 month and 6 month post-surgery was 5.40 mm with S.D±1.41 mm and 4.35 mm with S.D±1.47mm. The mean bone fill (BF), compared from baseline to 3 month and 6 month was 1.05mm±0.36 mm and 2.10mm±0.56mm (p<0.0001).

Table 2: Comparison of Level of Attachment (in mm) in test and control group at different time interval.

	Mean	N	Std. Deviation	Std. Error Mean
Test group				
Baseline	9.90	10	1.32	0.42
3 months	7.90	10	1.32	0.42
6 months	6.15	10	1.45	0.45
Control group				
Baseline	10.05	10	1.21	0.38
3 months	7.65	10	1.00	0.31
6 months	6.05	10	1.06	0.33

	Paired Differences			95% Confidence interval the difference		t-value	df	p-value
	Mean	Std. deviation	Std. error mean	Lower	Upper			
Test group								
Baseline- 3 months	2.00	0.74	0.23	1.46	2.53	8.48	9	0.000 S, p<0.05
Baseline- 6 months	3.75	0.85	0.27	3.135	4.36	13.82	9	0.000 S, p<0.05
3 months- 6 months	1.75	0.42	0.13	1.44	2.057	13.02	9	0.000 S, p<0.05
Control group								
Baseline- 3 months	2.40	0.69	0.22	1.89	2.90	10.85	9	0.000 S, p<0.05
Baseline- 6 months	4.00	0.91	0.28	3.34	4.65	13.85	9	0.000 S, p<0.05
3 months- 6 months	1.60	0.31	0.10	1.37	1.82	16.00	9	0.000 S, p<0.05

Table 3: Comparison of change in bone level gain (in mm) in test and control group at different time interval.

	Mean	N	Std. Deviation	Std. Error Mean
Test group				
Baseline	6.45	10	1.53	0.48
3 months	5.40	10	1.41	0.44
6 months	4.35	10	1.47	0.46
Control group				
Baseline	5.55	10	1.03	0.32
3 months	4.55	10	1.14	0.36
6 months	3.55	10	1.09	0.34

	Paired Differences			95% Confidence interval of the difference		t-value	df	p-value
	Mean	Std. deviation	Std. error mean	Lower	Upper			
Test group								
Baseline-3 months	1.05	0.36	0.11	0.78	1.31	9.00	9	0.000 S,p<0.05
Baseline-6 months	2.10	0.56	0.17	1.69	2.50	11.69	9	0.000 S,p<0.05
3 months-6 months	1.05	0.49	0.15	0.69	1.40	6.67	9	0.000 S,p<0.05
Control group								
Baseline-3 months	1.00	0.40	0.12	0.70	1.29	7.74	9	0.000 S,p<0.05
Baseline-6 months	2.00	0.57	0.18	1.58	2.41	10.95	9	0.000 S,p<0.05
3 months-6 months	1.00	0.40	0.12	0.70	1.29	7.74	9	0.000 S,p<0.05

The mean bone level at baseline for control group was 5.55mm with S.D±1.03 mm, whereas value after 3 month and 6 month post-surgery was 4.55 mm with S.D±1.14 mm and 3.55 mm with S.D±1.09mm. The mean bone fill (BF), compared from baseline to 3 month and 6 month was 1.00mm±0.40mm and 2.00mm±0.57mm. (p<0.0001) (Table 3). The mean pocket depth reduction, gain in clinical attachment level and gain in Bone fill were found not statistically significant when compared between test and control groups at baseline to 3 month and 6 month post-surgery (Table 4).

Table 4: Comparison of probing pocket depth, level of attachment and change in bone fill (in mm) in both the groups at different time interval.

	t-test for equality of means					95% Confidence interval of the difference	
	t	df	p-value	Mean difference	SD of difference	Lower	Upper
Probing Pocket Depth							
Baseline	0.46	18	0.651	0.30	0.65	-1.06	1.66
3 months	1.39	18	0.180	0.65	0.46	-0.32	1.62
6 months	0.87	18	0.394	0.40	0.45	-0.56	1.36
Level of Attachment							
Baseline	0.26	18	0.795	-0.15	0.56	-1.34	1.04
3 months	0.47	18	0.640	0.25	0.52	-0.85	1.35
6 months	0.17	18	0.863	0.10	0.57	-1.09	1.29
Change in Bone fill							
Baseline	1.53	18	0.142	0.90	0.58	-0.33	2.13
3 months	1.48	18	0.156	0.85	0.57	-0.35	2.05
6 months	1.38	18	0.185	0.80	0.57	-0.41	2.01

DISCUSSION

The ideal goal for periodontal therapy is the reconstitution of bone and connective tissue attachment that has been destroyed by the disease process.[1, 12]. Bone grafting is the most common form of regenerative therapy and is usually essential for restoring all types of periodontal supporting tissues.[13]

Various bone grafts have been used in treatment of intrabony defects like autografts, allografts, xenografts and alloplasts. They act like a filler material in the defect, although the use of intra-oral autogenous bone graft is a well accepted treatment option in periodontal community, but limited availability of donor sites, requirement for an additional surgery to obtain the graft material are the limitations of this technique and has risk of disease transmission.[14,15]

Alloplastic bone graft bioactive glass (BG) is a synthetic material composed of sodium and calcium salts, phosphates and silicon dioxide. It has been suggested that BG has advantages of forming strong bond with both bone and soft connective tissue and to having modulus of elasticity similar to that of bone, thus preventing the formation of intervening fibrous connective tissue interface. BG has an osteostimulatory effect in addition to its osteoconductive properties, and it has also shown to have antibacterial effect against subgingival and supragingival bacteria. Low et al. and Zamet et al in reported good clinical results in intrabony defects in sites treated with a BG when compared to debridement.[2,6]

The clinical parameters used, to determine the effects of regenerative therapy for the intrabony defects are probing pocket depths and clinical attachment level and radiographic methods are commonly utilized to assess periodontal bone changes following regenerative procedures. These measures are widely accepted clinical parameters used for evaluating periodontal regeneration.[17,18]

The mean PPD levels and CAL levels in both the groups at baseline were comparable. Following the treatment, the mean reduction in pocket depth and clinical level of attachment was statistically significant (p=0.000) for both the test and the control group from baseline to 6 months. For the test group the mean values were PPD- 3.95 mm, CAL-3.75 mm, BONE FILL-2.10 mm. For the control group the mean values were PPD- 4.05 mm, CAL- 4.00 mm, BONE FILL-2.00 mm. whereas the changes in PPD, CAL and BF were not quite statistically significant when compared between test and control groups.

The results of this study are similar to the findings of Demir et al, who had similar study designs, tested platelet-rich plasma and bioactive glass in intrabony defects and resulted in comparable improvements with a statistical significance (p<0.0001). Laurell et al demonstrated notable improvement in the reduction of

pocket depth and gain in the CAL, and Pamela et al tested bioactive glass with or without platelet-rich plasma and their findings were also comparable. There was statistically significant PPD reduction at 3 months and CAL gain at 6 months for BG with PRP compared to BG alone, but no significant difference was observed in defect fill.

The changes in BF shown by Kishore et al, who evaluate DFDBA and bioactive glass found significant changes in all clinical parameters ($p<0.001$*). However, sites treated with DFDBA exhibited statistically more changes compared to the bioactive glass in probing depth reduction and, Pavan et al, who evaluate Porous Hydroxyapatite Graft material Combined with Platelet-Rich Fibrin in treatment of intrabony defects. PRF results in significant improvements of Clinical parameters compared with baseline. Whereas HA when added to PRF increases the regenerative potential in intrabony defects.[1,7,19]

In the present study, the radiographic assessment was carried out using digital Radiovisiograph (RVG) technique.

A digital image may be enhanced by increasing or decreasing the contrast, and increasing the size of the image to spread the digital data over a wider range, the measurements were done using Grid which has 1mm of cubic marking. The linear measurements were done using cemento-enamel junction (CEJ) as a fixed reference point to the point showing the change in the density in the bone after bone fill post-operatively in the digital image.[20,21]

In the present study, no significant difference was found between both the groups. A larger sample size may have reflected significant differences between the test and the control groups.

Variations in the results between the studies may be explained by many factors like differences in measuring technique, the morphology of the defect, patient's oral hygiene maintenance, and adherence to post operative instructions and care, and variability in the osteoinductive properties of the bone graft material.[4,22]

It was with these factors keeping in mind that the present study was planned to evaluate, and to compare the clinical and radiographic outcomes obtained by a combination of bioactive glass bone Graft with PRF and bioactive glass Bone Graft alone in treatment of periodontal intrabony defects. Twenty defects were randomly allocated in the test and control group.

In this study clinical and radiographic parameters were compared. Measuring the success in the regenerative procedures require an analysis of parameters used in the comparative studies. The most reliable outcome for assessing periodontal regeneration is human histological investigation, however the morbidity associated with this technique and the practical and ethical restrains preclude this. The surgical closure of the periodontal intrabony defects and improvements in PPD and CAL serve as suitable and practical outcome measures.

CONCLUSION

The study showed significant improvements in clinical and the radiographic parameters in each group whereas there was no statistically significant difference, found between the test and control groups. Thus, it can be concluded that the use of bioactive glass bone graft combined with platelet rich fibrin and bioactive glass bone graft alone are equally effective for the treatment of periodontal intrabony defects in humans. The findings of the present study will be useful for dental surgeons for decision making during regenerative procedures.

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