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ORIGINAL RESEARCH

Clinical and Radiographic Evaluation of Regenerative Potential of GTR Membrane (Biomesh®) along with Alloplastic Bone Graft (Biograft®) in the Treatment of Periodontal Intrabony Defects

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ABSTRACT

Background and objectives: The primary goal of periodontal therapy is to restore the tooth supporting tissues lost due to periodontal disease. The aim of the present study was to compare the efficacy of combination of GTR membrane and alloplastc bone graft with open flap debridement (OFD) in treatment of periodontal intrabony defects.

Methods: Twenty paired intrabony defects were surgically treated using split mouth design. The defects were randomly assigned to treatment with OFD, GTR membrane + bone graft (test) or OFD alone (control). The clinical efficacy of two treatment modalities was evaluated at 6 months postoperatively by clinical, radiographical parameters. The measurements included probing pocket depth (PD), clinical attachment level (CAL), gingival recession (GR), bone fill (BF), bone density (BD).

Results: The mean reduction in PD at 0 to 6 months was 3.20 ± 0.82 mm and CAL gain of 3.10 ± 1.51 mm occurred in the GTR membrane + bone graft (test) group; corresponding values for OFD (control) were 2.10 ± 0.63 mm and 1.90 ± 0.57 mm. Similar pattern of improvement was observed when radiographically postoperative evaluation was made. All improvement in different parameters was statistically significant ($p < 0.01$).

Conclusion: Treatment with a combination of collagen membrane and bone graft led to a significantly more favorable clinical outcome in intrabony defects as compared to open flap debridement alone.

Keywords: Periodontal regeneration, Bone grafts, Guided tissue regeneration, GTR membrane.

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INTRODUCTION

Periodontal disease is one of the most prevalent afflictions worldwide. The most serious consequence is the loss of the periodontal supporting structures which includes gingiva, cementum, periodontal ligament and alveolar bone. Periodontal osseous lesions represent the anatomical sequelae of the apical spread of periodontitis, and in particular relate to the interplay between site specific progression and the local anatomy.[1]

Among treatment modalities, grafting of biomaterials has been used with varying success to accomplish the reconstruction of lost attachment apparatus in deep intraosseous defects. The overall results indicate that the implantation of bone substitutes produce a more favorable probing pocket depth (PPD) reduction, clinical attachment level (CAL) gain and increased bone fill when compared to open flap debridement alone.[2]

Guided tissue regeneration (GTR) can be considered as an effective and predictable surgical approach for the treatment of periodontal intrabony defects[3] which involves placement of either resorbable or nonresorbable barrier membranes to seclude a space around the diseased root surface, and allows cells from periodontal ligament and alveolar bone to repopulate the defects.

The membrane used in the study has special characteristics, including interconnective porous structure which promotes good nutrient flow and blood vessel formation, cell occlusiveness and biodegradability.[4]

Alloplastic grafts are synthetic, inorganic, biocompatible or bioactive bone graft substitutes.

Promote bone healing through osteo conduction.[5]

The purpose of this study was to compare and evaluate regenerative potential of biodegradable membrane (Biomesh®) with alloplastic bone graft (Biograft®) with open flap alone in treatment of periodontal intrabony defects and to evaluate it clinically as well as radiographically.

METHODS

A total of 10 patients were diagnosed with generalized chronic periodontitis having two or more vertical defects, were selected for this study from the department. Patients were selected, and the selection criteria include patients with good systemic health with no contraindication for periodontal surgery, nonsmokers and clinically having bilateral infrabony pockets of more than 5 mm depth, with radiographic evidence of vertical bone loss. Verbal and written informed consent was obtained from all patients before the commencement of the study. Split mouth design was planned and the sites were divided randomly into test site and control site according to the type of treatment rendered to them by using split mouth design.[6]

Clinical Parameters

Clinical examination was performed at baseline and 6 months after the surgical procedure. The oral hygiene status was evaluated by the plaque index[7] (PI) as an expression of the level of an individual's supragingival plaque accumulation. Gingival inflammation was assessed by the gingival index[8] (GI). Clinical outcome variables like probing depth[9] (PD), clinical attachment level[10] (CAL) and gingival recession[11] (GR) were measured using the acrylic occlusal stent.

Radiographic Parameters

Intraoral periapical (IOPA) radiographs of the selected sites were taken using long cone paralleling (LCP) technique with 70 KVp, 10 mA and exposure time of 0.8 seconds and were subjected to linear measurement and densitometric analysis at baseline and 6 months.

MATERIALS

Biograft®: Biograft® (IFGL Bioceramics Limited, Calcutta) is a biphasic calcium phosphate consisting of hydroxyapatite that is biocompatible, nontoxic, resorbable, non-inflammatory and bioactive. It causes no immunological, foreign-body or irritating response and has excellent Osteoconductive ability.

Biomesh®-S: Biomesh®-S (Samyang Corp, Korea) is a yellowish-white, microporous membrane and is made of biodegradable polyglycolide, poly (d,l-lactide-co-glycolide), poly (L-lactide) copolymer. It is supplied in two designs for good adaption to the tooth.

Presurgical Procedure

Following initial examination and treatment planning, the selected patients underwent nonsurgical therapy. Detailed instructions regarding self-performed plaque control measures were given. After 4 weeks, only those patients maintaining optimum oral hygiene were subjected to the surgical procedure.

Surgical Procedure (Figs 1 to 7)

A similar surgical protocol was followed for all the cases. Periodontal surgical procedures were performed on an outpatient basis under aseptic conditions. After providing local anesthesia to the subjects, sulcular incisions were made, and mucoperiosteal flaps were elevated. Meticulous defect debridement and root planing were carried out to remove visible subgingival plaque, calculus, inflammatory

Fig. 1: Measuring the probing pocket depth using Williams graduated probe

Fig. 2: Measuring the CAL using silver point and occlusal stent

granulation tissue and pocket epithelium. The surgical sites were rinsed thoroughly with sterile saline, and care was taken to keep the area free of saliva and blood. The required quantity of the bone graft material was mixed with normal saline placed in to the defect, taking care not to overfill it.

Template was prepared according to the morphology of defect and subsequently the membranes were trimmed according to the template. Later membrane was adapted over the defect which was filled with biograft.®

The flaps were repositioned and secured in place by interrupted suture using the black braided (3-0) silk. All patients were prescribed systemic antibiotics and analgesics.

Fig. 3: Measuring the intrasurgical defect depth

Fig. 4: Template adapted

Fig. 5: Bone graft placed

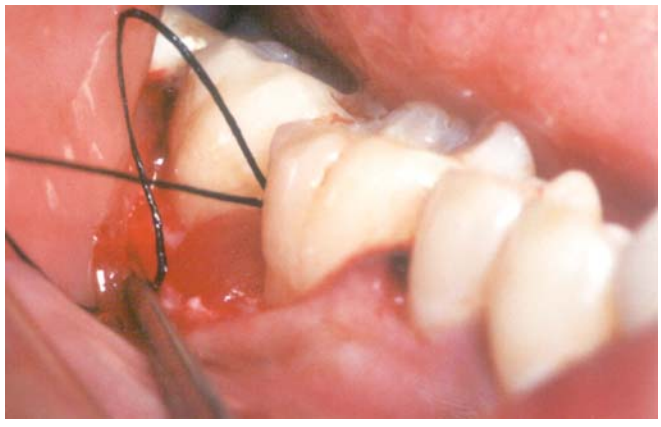

Fig. 6: Membrane adapted

Fig. 7: Sutures placed

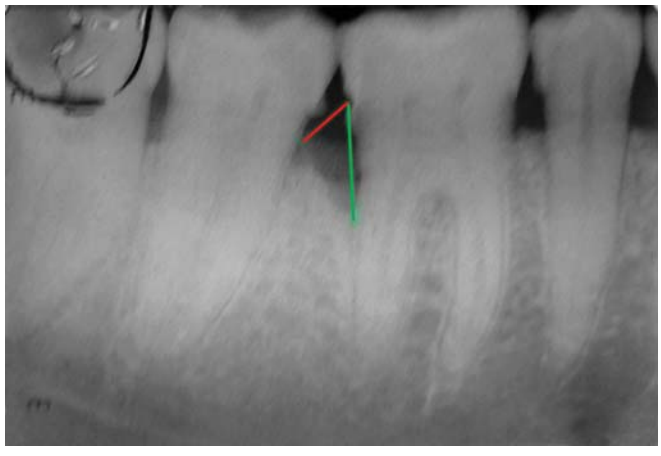

Fig. 8: Linear radiographic interpretation with Computer Image analysis software (Green line indicates CEJ to base of defect and red line indicates CEJ to alveolar bone crest)

Post Surgical Procedure

After 1 week following surgery, sutures were removed and the area was irrigated thoroughly with saline. Patients were evaluated clinically and radiographically at 6 months postoperatively. At this visit, oral hygiene instructions were reinforced and scaling was done if necessary.

Interpretation of Radiographs (Figs 8 and 10)

Standardized intraoral periapical (IOPA) radiographs were taken at baseline and 6 months postoperatively for each

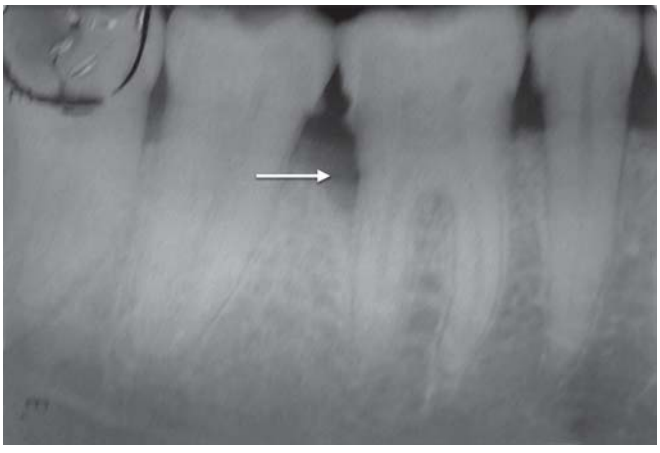

Fig. 9: Preoperative radiographs (baseline)

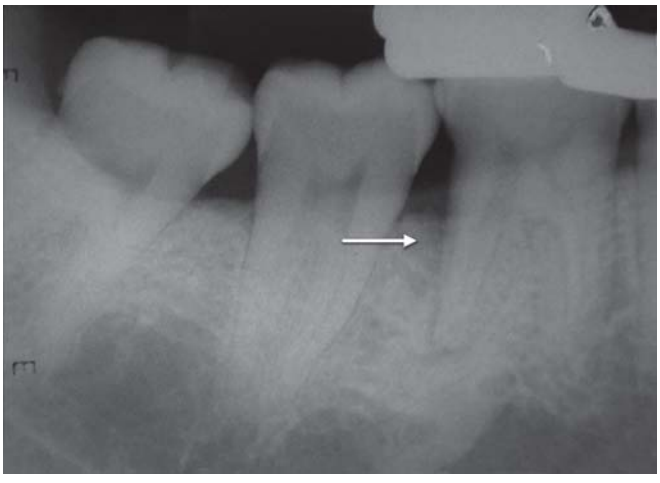

Fig. 10: Postoperative radiographs (after 6 months)

defect. Interpretation of radiographs was carried out by means of Image J analysis for both linear and density measurements.[12]

RESULTS

All 10 patients completed the 6 months study period. Both test and control group sites in all 10 patients healed uneventfully. No evidence of flap dehiscence or infection were reported in any of the surgical site. The soft tissue response in both test and control groups was excellent.

Both test and control groups showed significant pocket depth reduction at 6 months when compared to baseline. The mean pocket depth reduction in test group was 3.20 ± 0.82 and in control site was 2.10 ± 0.63 mm. The difference between the groups was statistically significant ($p < 0.01$) in favour of test groups (Table 1).

The gain in clinical attachment level was 3.10 ± 1.51 mm for test and, for control group, it was 1.90 ± 0.57; the difference was statistically significant ($p < 0.01$) in favor of test groups (Table 1). However, the postoperative gingival recession in both test and control groups was comparable, i.e. –0.70 ± 1.14 mm and –0.60 ± 0.82 mm respectively, without any significant difference between the two groups (Table 1).

Radiographically, the bone fill in test and control groups was recorded as 1.84 ± 0.95 and 0.36 ± 0.46 mm respectively at 6 months postoperatively (Table 2); the difference between the two groups was statistically significant ($p < 0.01$) in favor of test group. Similarly when both groups were compared with respect to the density of the regenerated bone at the defect site, it was 4.22 ± 0.86 mm^2 in test group as compared to the control 0.65 ± 0.36 mm^2; the difference being statistically significant ($p < 0.01$) in favor of test group (Table 3).

DISCUSSION

The ultimate goal of periodontal therapy is to provide a dentition that functions in health and comfort for the life of the patient. A shortcoming encountered with the currently available modalities of periodontal regeneration is the limited predictability. Even though various regenerative procedures, like GTR, osseous grafting or the combination of both, have been shown to be effective in promoting clinical, radiographical and histologic periodontal regeneration, complete restoration of the attachment apparatus in every treated defect is still not a reality. The present study was designed to compare the combined effect of GTR + bone graft (test group) with the open flap debridement in the treatment of periodontal intrabony defects.[13]

Only three wall intrabony defects were included in the present study because bone regeneration is believed to be improved with increasing number of bony walls facing the root surface. The three wall defect allows better containment and increased blood supply to the graft.[14]

The clinical outcome measures for determining the effect of therapy on the anatomical defects produced by periodontal diseases are probing pocket depth and clinical attachment level and both these treatment measures are considered as the widely accepted therapeutic end point after periodontal regenerative therapy.[15,16] In the present study, the combination of membrane and alloplastic bone graft used in the treatment of periodontal intrabony defects in a 6 months study, demonstrated positive clinical outcome (e.g. reduction in probing pocket depth and gain in clinical attachment level). The results obtained are comparable with those of previous studies.[17-19] Radiographic monitoring of alveolar bone changes following regenerative procedures is a noninvasive, painless alternative to direct bone measurements; regeneration in periodontal defects is usually measured by bone fill in angular defects. In the present study, the radiographic assessment was carried out by analyzing

Table 1: Clinical parameter at baseline and 6 months of both groups

Parameters	*BL*	*6 months*	*BL-6 months*	*Significance test vs control*
Probing depth				
Test	7.40 ± 1.41	3.60 ± 1.01	3.20 ± 0.82	<0.01 S
Control	8.20 ± 6.2	6.00 ± 1.56	2.10 ± 0.63	
CAL				
Test	12.40 ± 1.26	9.00 ± 2.00	3.10 ± 1.51	<0.01 S
Control	11.50 ± 1.78	9.60 ± 1.78	1.90 ± 0.57	
Gingival recession				
Test	5.10 ± 0.99	5.90 ± 1.73	–0.70 ± 1.14	NS
Control	3.30 ± 2.21	4.00 ± 2.40	–0.60 ± 0.82	

S: Significant; NS: Nonsignificant

Table 2: Radiographic measurements at baseline and 6 months of both groups

Parameters	*BL*	*6 months*	*BL-6 months*	*Significance test vs control*
CEJ TOBD(A)				
Test	5.60 ± 2.68	3.57 ± 1.9	2.03 ± 1.17	<0.01 S
Control	4.85 ± 2.38	25.11 ± 1.96	0.74 ± 0.56	
CEJ TOBC(B)				
Test	3.22 ± 1.43	2.59 ± 1.39	0.70 ± 0.88	<0.01 S
Control	3.01 ± 1.12	2.65 ± 0.99	0.36 ± 0.24	
INTRA(A-B)				
Test	2.38 ± 1.51	1.23 ± 0.8	1.84 ± 0.95	<0.01 S
Control	2.84 ± 2.25	22.46 ± 1.87	0.36 ± 0.46	

S: Significant

Table 3: Comparison of radiographic amount of mean change in density (in mm^2)

Density	*BL*	*6 months*	*BL-6 months*	*Significance test vs control*
Test	7.61 ± 0.89	11.93 ± 0.94	4.22 ± 0.86	<0.01 S
Control	8.26 ± 0.89	7.91 ± 0.75	0.65 ± 0.36	

S: Significant

linear distances and bone density changes using Image J analysis as the digitizing unit gives the precise value.[20,21] There was significant bone fill in the test group than in the control group when the bone level was compared radiographically from baseline to 6 months postoperatively. Similar trend was observed when bone density was compared between test and control sites. This observation was in agreement with the previous studies.[22] The selection of regenerative material and technique in the present study was based on some evidence and clinical experience. The bone graft material (Biograft®) acts as a filler material in defect, supporting the overlying GTR membrane and avoiding the membrane collapse. It also acts as a framework into which bone forming cells and blood vessels integrate leading to the formation of healthy new bone and subsequent repair of the osseous defect.

The membrane used in the study has special characteristics, including interconnective porous structure, which promotes good nutrient flow and blood vessel formation, cell occlusiveness and biodegradability.

CONCLUSION

The finding of this study indicated that the use of GTR membrane in combination with bone graft material was beneficial for the treatment of periodontal intrabony defects. This combination technique provided improved outcomes in terms of clinical, radiographic parameters. Further studies are required with larger sample size and longer follow-up.

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