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Comparative Evaluation of Hydroxyapatite Bone Alloplast with Combination Bone Alloplast (Hydroxyapatitie and ß-Tricalcium Phosphate) in Grade II Mandibular Furcation Involvements

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ABSTRACT

Background: The management of furcation involvements by regenerative surgery with bone alloplast have been used with varying degrees of success in periodontal therapy. The aim of the study was to clinically and radiographically compare the effectiveness of Hydroxyapatite bone alloplast with combination bone alloplast (Hydroxyapatite and β-Tricalcium phosphate) for the treatment of Grade II mandibular furcation involvements.

Methods: Thirty patients with bilateral Grade II mandibular furcation involvements were distributed in Group A (Hydroxyapatite) and Group B (Hydroxyapatite and β-Tricalcium phosphate). Clinical parameters such as Plaque Index, Gingival Index, Probing Pocket Depth, Clinical Attachment Level and Horizontal Probing Depth were recorded at baseline and at one, three and six mths postoperatively. Radiographic bone fill measurements were recorded at baseline and six months post-operatively.

Results: Both the groups showed statistically significant ($p < 0.01$) improvement in clinical and radiographic parameters at each recall visits. Inter-group comparison of clinical parameters showed no significant difference in both the groups whereas radiographic measurements following six months post-surgery showed significantly ($p < 0.05$) greater amount of bone fill in Group B compared to Group A.

Conclusions: It can be concluded that at six months post-operative, both the alloplastic materials resulted in significant improvement in clinical parameters and no significant difference was found between both groups. There was a statistically significant radiographic bone fill when a combination of Hydroxyapatite and β-Tricalcium phosphate was used demontrating its effectiveness in the treatment of Grade II Furcation involvement.

Keywords: Calcium phosphates; hydroxyapatite; periodontal index; tricalcium phosphate

INTRODUCTION

The management of furcation areas appears to be greatest challenges in periodontal therapy because of its complex anatomic morphology preventing proper oral hygiene maintenance.[1] Regenerative surgery with bone alloplasts have been used with varying degrees of success in such defects. Most commonly used alloplastic materials are Hydroxyapatite and ß-Tricalcium phosphate, which have shown significant clinical improvement at grafted sites compared to nongrafted sites.[2] A new synthetic biomaterial was introduced recently for bone regeneration termed as Biphasic calcium phosphate (HA/ß-TCP). Clinical evidence suggested that the use of this combination of 60% Hydroxyapatite and 40% ß-Tricalcium phosphate may result better control of the bioabsorbable ability and maintain its osteoconductive property, accelerating new bone formation.[2,] As there are paucity of literatures comparing both the materials in periodontal regeneration, it is therefore in the present study, both the bone alloplastic materials were used to establish their effectiveness in Grade II mandibular furcation involvements.

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METHODS

This quasi-experimental study was conducted over a period of two years (1st Nov 2016 to 1st Nov 2018). A total of 30 systemically healthy patients aged between 18 and 65 years with bilateral clinical and radiographic evidence of Grade II mandibular furcation involvement[3] were recruited for the study. Patients were selected from the Department of Periodontology and Oral Implantology, College of Dental Surgery, Universal College of Medical Sciences (UCMS), Bhairahawa, Rupandehi, Nepal, using convenience sampling method and surgical sites were randomized using coin toss. This study was reviewed and approved by Institutional Review Committee of UCMS, Bhairahawa, Nepal (Reference No. 057/16). Written informed consent were taken from the patients after explaining about the study.

Inclusion criteria were probing depth of ≥5 mm after non-surgical therapy at the mandibular first and second molars , bilateral Grade II furcation defects in the mandibular molars seen in intra-oral periapical radiographs, non-smokers[4], patients with good compliance. Patients with known systemic diseases like cardiovascular diseases, diabetes mellitus, malignancies, pneumonia, severe trauma, or renal transplant, history and/or presence of other infections, patients with aggressive forms of periodontitis, those who were on systemic antibiotic treatment in the preceding three months or had undergone treatment, pregnant or lactating females, physically or mentally challenged patients were excluded from the study. Selected patients were conveniently distributed into two treatment groups according to split mouth design. Group A: Consisted of 30 sites on the left side treated with Hydroxyapatite bone alloplast (SyboGraf™). Group B: Consisted of 30 sites on the right side treated with Hydroxyapatite and ß-Tricalcium phosphate (SyboGraf™- Plus).

All the patients underwent Phase I therapy consisting of scaling and root planing with oral hygiene instructions. Occlusal adjustment was performed if trauma from occlusion was present. A complete blood picture was advised for all the patients prior to the surgery which depicted values within normal limits.

Baseline recordings of the clinical and radiographic parameters were carried at the day of surgery after completion of Phase I therapy. Measurements of Clinical parameters such as Plaque Index (PI),[5] Gingival index (GI),[6] Probing pocket depth (PPD), Clinical attachment level measured using GDC UNC15 probe (CAL) and Horizontal probing depth measured using GDC Nabers' probe (HPD) was recorded at baseline (at the day of surgery) and post-surgically at one, three and six months. Customized acrylic occlusal stents with grooves were fabricated on the study cast and trimmed to the height of tooth contour.[7] The groove was used as a fixed reference guide to standardize the angulations and position of the periodontal probe. In this way, the probe was inserted into the pockets to record the PPD, CAL, HPD pre and post-surgically. Measurement of the radiographic parameter which is Radiographic bone fill (RBF) was done using intra-oral periapical radiographs with long cone paralleling technique for standardization. All the radiographs were digitalized and transferred to the computer as JPEG image to measure the area of radiolucency in the furcation area using Image J software, version 1.8.0_112. Polygon marks were used to mark the point where radiolucency was seen in the furcation area. The marking points were joined to cover an area of radiolucency and the area was calculated in mm^2 with the help of the Analyze tool of the software. In this way RBF in mm^2 was recorded at baseline and at the end of the evaluation period of six months.

After four weeks of initial Phase I therapy, surgical therapy was planned for the patient. Baseline recording were taken before administration of local anesthesia. Patients were prepared, draped according to standardized aseptic approach and anaesthetized using 0.2% Lignocaine with adrenaline in concentration of 1:200000. Intrasulcular and interdental incisions were given with the help of No.12 and No. 11 surgical blades followed by the reflection of full thickness mucoperiosteal flaps buccally as well as lingually using Molt's No. 9 periosteal elevator to expose the Grade II mandibular furcation involvement. The defect was cleared of granulation tissue and the exposed root surfaces were thoroughly planed to a smooth hard surface using Universal and Gracey's set of curettes. After complete removal of granulation tissue, defect sites in Group A were filled with SyboGraf™ (Hydroxyapatite) and in Group B: SyboGraf™-Plus (combination of Hydroxyapatite and ß-Tricalcium phosphate) was used. In both the groups, flaps were then sutured over the wound, using interrupted loop suturing technique with 4-0 silk sutures. The operated site was then protected with periodontal dressing (COE-PAK™ GC America) for a period of one week. Postoperative instructions were given to all the patients after the procedure. They were prescribed capsule Amoxicillin for one week at a dosage of 500 mg three times per day and Tablet Ibuprofen 400 mg three times per day for three days and warm saline rinse (3-4 times/ day for two weeks). To minimize traumatic injury to the wound, toothbrushing was avoided over the pack for the first week.[8] The nonsurgical areas of the mouth not covered

by the pack can be mechanically cleaned by toothbrush and dental floss. Chlorhexidine mouthrinse 0.2% (10ml) was prescribed two times daily for two weeks in order to control plaque accumulation.

Periodontal dressing and suture removal was done after one week postoperatively. Recall appointments were carried out at ,one three and six months post-surgically. Oral hygiene reinforcement, including initial gentle brushing, followed by normal brushing and flossing was advised to the patients.

The statistical analysis was carried out using IBM SPSS statistics software for windows version 16.0 (IBM Corp., Armonk, N.Y., USA). All the continuous variables were presented as Mean ± SD. Student's t-test was used to analyze the variation in mean between two groups of a variable with a normal distribution. The significance level was kept at 0.05 level.

RESULTS

A total of thirty patients with the age group of 18-65 years, fulfilling the inclusion and exclusion criteria were enrolled for the study. Percentage of subjects within each age group varied, with maximum number of subjects (46.67%) in age group 18-33 years. Males constituted about 63.37%, whereas females comprised 36.67% of the study sample.

Out of all the patients, 60 sites were treated. Twenty-eight Grade II furcation involved sites in first mandibular molars were treated at left side (Group A) and right side (Group B) each. Remaining four sites of left and right (Group A and B respectively) second mandibular molars were treated accordingly. During the course of the study, wound healing was uneventful. There were no postoperative complications in any patients, and none of the selected patients dropped out before the termination of the study.

All the enrolled patients successfully completed the study with uneventful healing. Intra-group comparison of mean score reduction for PI in Group A and Group B which showed statistically significant difference ($p < 0.01$) at each time intervals whereas inter-group comparison showed no significant difference ($p > 0.05$) in Group A and Group B between baseline to one month (0.03 ± 0.29), baseline to three months (0.00 ± 0.33) and baseline to six months (0.01 ± 0.31) (Table 1). Similarly, intra-group comparison of mean score reduction for GI in Group A and Group B depicts statistically significant difference at each time intervals but inter-group comparison showed no significant difference in both the groups between baseline to one month (0.05 ± 0.27), baseline to three months (0.01 ± 0.28) and baseline to six months (0.02 ± 0.30) (Table 2).

Intra-group comparison of mean score reduction for PPD in Group A and Group B which showed statistically significant difference at each time intervals whereas inter-group comparison showed no significant difference in Group A and Group B between baseline to one month (0.30 ± 1.31 mm), baseline to three months (0.50 ± 1.40 mm) and baseline to six months (0.56 ± 1.88 mm) (Table 3). Similarly, intra-group comparison of mean score reduction for CAL in Group A and Group B depicts statistically significant difference at each time intervals and inter-group comparison showed statistically significant difference in Group A and Group B between baseline to three months (0.73 ± 1.52 mm) and baseline to six months (0.80 ± 1.76 mm) (Table 4). Furthermore, intra-group comparison of mean score reduction for HPD in Group A and Group B depicts statistically significant difference at each time intervals but inter-group comparison showed no significant difference in Group A and Group B between baseline to one month (0.00 ± 1.36 mm) baseline to three months (0.13 ± 0.58 mm) and baseline to six months (0.16 ± 1.20 mm) (Table 5). Finally, when intragroup comparison of RBF in Group A and Group B was done, there was statistically significant improvement from baseline to 6 months and inter-group comparison showed significantly higher area of bone fill in Group B (13.57 ± 10.01 mm^2) compared to Group A (8.17 ± 9.64 mm^2) (Table 6).

Table 1. Intra and inter-group comparison of Plaque index in Group A and B.

Time intervals	Baseline to 1 month		Baseline to 3 months		Baseline to 6 months	
	Group A	Group B	Group A	Group B	Group A	Group B
Change in mean score	0.27 ±0.31	0.24 ±0.30	0.41 ±0.35	0.40 ±0.34	0.57 ±0.43	0.59 ±0.35
p value (Intra-group)	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*
Mean difference	0.03 ± 0.29		0.00 ± 0.33		0.01 ± 0.31	
p value (Inter-group)	0.53		0.88		0.77	

*Significance level at p <0.05.

Table 2. Intra and inter-group comparison of Gingival index in Group A and B.

Time intervals:	Baseline to 1 month		Baseline to 3 months		Baseline to 6 months	
	Group A	Group B	Group A	Group B	Group A	Group B
Change in mean score	0.23±0.35	0.18±0.29	0.36±0.36	0.34±0.30	0.48±0.38	0.50±0.32
p value (Intra-group)	0.01*	0.02*	<0.01*	<0.01*	<0.01*	<0.01*
Mean difference	0.05 ± 0.27		0.01 ± 0.28		0.02 ± 0.30	
p value (Inter-group)	0.30		0.74		0.70	

*Significance level at p <0.05.

Table 3. Intra and inter-group comparison of Probing pocket depth in Group A and B.

Time intervals:	Baseline to 1 month		Baseline to 3 months		Baseline to 6 months	
	Group A	Group B	Group A	Group B	Group A	Group B
Change in mean score (mm)	1.60±0.72	1.90±1.24	2.33±1.02	2.83±1.41	3.10±1.24	3.66±1.64
p value (Intra-group)	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*
Mean difference (mm)	0.30 ± 1.31		0.50 ± 1.40		0.56 ± 1.88	
p value (Inter-group)	0.22		0.06		0.11	

*Significance level at p <0.05.

Table 4. Intra and inter-group comparison of Clinical attachment level in Group A and B.

Time intervals:	Baseline to 1 month		Baseline to 3 months		Baseline to 6 months	
	Group A	Group B	Group A	Group B	Group A	Group B
Change in mean value (mm)	1.16±1.11	1.66±1.39	1.90±1.32	2.63±1.62	2.70±1.34	3.50±1.73
p value (Intra-group)	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*
Mean difference (mm)	0.50 ± 1.54		0.73 ± 1.52		0.80 ± 1.76	
p value (Inter-group)	0.08		0.01*		0.01*	

*Significance level at p <0.05

Table 5. Intra and inter-group comparison of Horizontal probing depth in Group A and B.

Time intervals:	Baseline to 1 month		Baseline to 3 months		Baseline to 6 months	
	Group A	Group B	Group A	Group B	Group A	Group B
Change in mean value (mm)	1.36±1.06	1.36±0.85	1.96±1.21	2.10±0.88	2.56±1.10	2.73±0.74
p value (Intra-group)	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*
Mean difference (mm)	0.00 ± 1.36		0.13 ± 0.58		0.16 ± 1.20	
p value (Inter-group)	1.00		0.58		0.45	

*Significance level at p <0.05

Table 6. Intra and inter-group comparison of Radiographic bone fill in Group A and B.

	Group A (mm^2)	Group B (mm^2)	Mean difference (mm^2)	p value (Inter-group)
Baseline to 6 months	8.17 ± 9.64	13.57 ± 10.01	5.40 ± 13.22	0.033*
p value (Intra-group)	<0.01*	<0.01*		

*Significance level at p <0.05

DISCUSSION

The results of the present study showed that the treatment of Grade II mandibular furcation involvements utilizing two different bone alloplasts were safe and did not cause any immunologic or antigenic reactions in any of the patients.

In this study, intra-group comparison for mean PI score was found to be significantly reduced in both Group A and B at each time intervals. Similar results have been shown by various authors.[2,9,10] On the contrary, non-significant reduction in mean PI scores has been reported by Pietruska et al.,[11] Okunda et al.,[12] and Jain et al.[13] The significant reduction in mean PI Score in both the groups at each time intervals found in the present study could be attributed to the rigorous oral hygiene maintenance regime, regular follow up visits, and reinforcement of

oral hygiene instructions for the patients throughout the study period. However, inter-group comparison revealed no significant difference between the groups in mean PI scores during the period of six months. Intra-group comparison for mean GI score was found to be significantly reduced in both Group A and B at each time intervals. This was in accordance with other similar studies.[9,11,12] Whereas, RCT conducted by Kasaj et al. found no significant difference in mean GI score between each time intervals.[14] Inter-group comparison for mean GI scores in the present study from baseline to six months revealed a non-significant difference between two groups. This improvement in gingival status in both the groups could be due to postsurgical healing and frequent supportive periodontal therapy provided.

In the present study, mean PPD was significantly reduced at each time intervals in Group A. The current finding was also supported by a longitudinal study.[15] There was significant reduction in mean PPD in Group B at each time intervals as well. This result can be compared with the findings from the recent studies by Peres et al. and Kinni et al.[16,17] Inter-group comparison of mean reduction in PPD at various time intervals was not statistically significant. This suggests that using either of the materials would be equally effective in treating Grade II mandibular furcation involvements for a period of six months.

The present study reports gain of 2.70 ± 1.34 mm in mean score of CAL at the end of six months for Group A. Likewise, RCT for assessing the use of HA in intrabony defects showed a mean gain in CAL of 2.0 ± 1.2 mm at the end of 12 months.[12] Intra-group comparison of gain in mean values of the CAL in Group B, at each time intervals were statistically significant. This was supported by similar follow up studies of duration of six months.[2,10,17] Inter-group comparison of gain in mean CAL at three months postoperatively was significantly greater in Group B as compared to Group A, indicating an early benefit of combination bone alloplast in terms of CAL in periodontal regeneration in furcation involvements. The same result was obtained even at the end of six months for Group B as compared to Group A and their differences was statistically significant.

The significant reduction in HPD in Group A can be compared with the results from previous studies.[18,19] A split mouth designed study showed no significant difference in HPD from baseline to three months using HA bone alloplast.[20] In contrast, the present study reports significant reduction in HPD at one month postoperatively, depicting early effectiveness of using HA in treatment of furcation involvements. A greater reduction in HPD at each time intervals in Group B was also observed. Similar results were shown by a recent study.[17] Inter-group comparison in terms of HPD showed no significant difference at each time intervals. This finding suggests similar healing pattern using both the materials for a period of six months. This reduction in HPD could either be due to bone fill or due to connective tissue attachment in the furcation area that might have hindered passage of the probe.

There was significant improvement in RBF from baseline to six months in Group A in this study. Similar result where an increase in radiopacity in the furcation area was also appreciated in a six months follow up study.[18] In Group B, statistically significant RBF from baseline to six months was observed. Such changes in radiographic parameters have also been shown by various studies.[2,9,10,13] Inter-group comparison in mean difference in RBF showed significantly higher area of bone fill in Group B (13.57 ± 10.01 mm^2) compared to Group A (8.17 ± 9.64 mm^2). Thus, indicating combination bone alloplast to be better than Hydroxyapatite alone in terms of RBF.

With certain limitations, this study compared the clinical and radiographic outcomes of two bone alloplastic materials for a period of six months. However, further studies with larger sample size and longer period of evaluation are necessary to completely ascertain the effectiveness of both materials for periodontal regeneration in Grade II mandibular furcation involvements. Similarly, histological evaluation would have cleared all doubts and provided details about the actual healing pattern. But, this could not be carried out in the present study due to ethical constraints.

CONCLUSIONS

It can be concluded from the results of the present study that combination of Hydroxyapatite and ß-Tricalcium phosphate bone alloplast is safe and effective in treating Grade II furcation involvement than Hydroxyapatite bone alloplasts alone. Further studies are required with larger sample size and longer follow up to reach at a reasonable level of confirmation about the efficacy of these materials.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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