Original Article

Efficacy of combination therapy using anorganic bovine bone graft with resorbable GTR membrane vs. open flap debridement alone in the management of grade II furcation defects in mandibular molars – A comparative study

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Abstract

Context: Invasion of the bifurcation and trifurcation of the multi-rooted teeth resulting in furcation involvement is one of the serious complications of periodontitis. **Aim:** The purpose of the study was to evaluate the efficacy of combination therapy using anorganic bovine bone graft and resorbable guided tissue regeneration (GTR) membrane versus open flap debridement alone in the management of Grade II furcation defects in mandibular molars. **Materials and Methods:** The study included a total number of 20 sites in 10 patients with bilateral mandibular furcation defects, out of which 10 sites were treated as test group and 10 as control group. The test group was treated with combination therapy and the control group with open flap debridement alone. The parameters were recorded on 0 day (baseline), 90th day, and 180th day, which included vertical probing depth and horizontal probing depth of the furcation defect, clinical attachment level, and defect fill. **Statistical Analysis Used:** Mean and standard deviation were calculated for different variables in each study group at different time points. Mean values were compared by using Wilcoxon signed ranks test, after adjusting the P values for multiple comparison by using Bonferroni correction method. **Results:** Both the test and control groups showed a definitive improvement in clinical parameters, which was statistically significant. On comparison, the vertical probing depth showed significant reduction in the test group with a mean reduction of 3.1 ± 0.7 mm, when compared to the control group which showed a mean reduction of 1.5 ± 0.5 mm. The horizontal probing depth of furcation defects was also significantly reduced in the test group with a mean reduction of 2.2 ± 0.6 mm, when compared to the control group in which the mean reduction was 0.9 ± 0.3 mm. There was also significant gain in attachment level in the test group which showed a mean gain of 3.2 ± 0.6 mm, when compared to the control group which showed a gain of 1.2 ± 0.6 mm. Radiographic defect fill was found to be more in the test group with a mean gain of 2.0 ± 0.1 mm, when compared to the control group which showed a defect fill of 0.2 ± 0.1 mm. **Conclusions:** The results of this study demonstrated that the combined use of anorganic bovine bone graft and resorbable GTR membrane is effective than open flap debridement alone in the treatment of mandibular grade II furcation defects.

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INTRODUCTION

Periodontal disease is defined as a multifactorial disease characterized by the destruction of periodontal tissues and loss of connective tissue attachment. Invasion of the

bifurcation and trifurcation of the multi-rooted teeth resulting in furcation involvement is one of the serious complications of periodontitis.[1]

Guided tissue regeneration (GTR) is a non–graft-associated regenerative procedure based on the concept that regeneration of periodontal supporting structures is possible by repopulation of the previously diseased root surface with selective progenitor cells and preventing the gingival epithelium and the connective tissue from contacting the root surface during healing.[2]

Numerous studies have demonstrated that the use of various bone graft materials in combination with a barrier improves defect fill, probing depth reduction, and clinical attachment gain versus using a barrier alone in human Class II and III furcations.[3-5] Xenografts are made of naturally derived deproteinized cancellous bone from another species (such as bovine or porcine bone). The advantages of the material are that it is available in large quantities and is similar to human bone in porous architecture.[6] Barrier membranes presumably promote selective cell repopulation of the root surface, whereas bone grafts act as scaffold for clot formation and cellular infiltration.[7] The barrier membrane also promotes graft containment, which is considered important for enhancing the regenerative response.

The present study was designed to evaluate the efficacy of combination therapy using anorganic bovine bone graft with resorbable GTR membrane versus open flap debridement alone in the management of grade II furcation defects in mandibular molars.

MATERIALS AND METHODS

The subjects for this study were recruited from the patient pool of Department of Periodontology, Meenakshi Ammal Dental College and Hospital, Chennai. The "Meenakshi institutional review board" approved the study and all participants gave written informed consent.

Inclusion criteria

Patients within the age group of 35-55 years with bilateral grade II furcation involvement in first and second mandibular molars and with radiographic evidence of inter-radicular bone loss were selected.

Exclusion criteria

Patients with systemic diseases contraindicating periodontal therapy, patients showing unacceptable oral hygiene, and patients treated with periodontal surgery within the last 12 months were excluded.

A total of 10 patients with bilateral grade II furcation in 20 sites (mandibular molars) were selected; of these sites, 10 sites were treated as control and 10 sites as test, in a split-mouth design. The test group was treated with combination therapy, i.e. an organic bovine bone graft (Bio-oss) and resorbable GTR membrane (Healiguide), and the control group was treated with open flap debridement alone.

Clinical measurements

The clinical parameters were recorded with customized acrylic stents. The parameters recorded were clinical attachment level (CAL), vertical probing depth component of furcation (VPD) [Figure 1a and 1b], and horizontal probing depth component of furcation (HPD) [Figure 2a and 2b]. All the clinical parameters were recorded at baseline and on 90th and 180th days. Lower border of stent was taken as the fixed reference point (FRP). Vertical measurements were recorded for determining the gingival margin (GM) position, probing depths, and CALs, respectively, by referring the following points/positions:

- FRP to the GM position
- FRP to base of the pocket (BOP)
- FRP to cemento-enamel junction (CEJ).

The VDP and CAL were calculated using the following formulae:

- VPD = (FRP to BOP) − (FRP to GM)
- CAL = (FRP to BOP) – (FRP to CEJ).

All the clinical measurements were recorded by an examiner who was trained and calibrated in measuring and recording the periodontal parameters and not involved in any aspect of therapy.

Radiographic measurements

Standardized radiographs using direct digital radiography were taken to assess the bone fill. The radiographs are

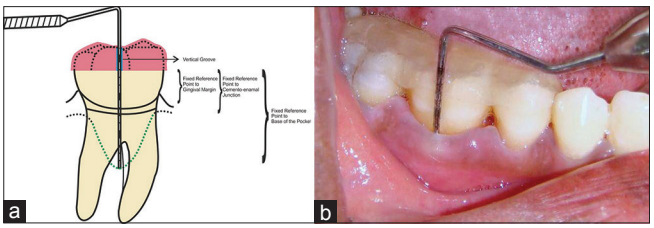

Figure 1: (a) Schematic representation of VPD measurement. (b) Customized stent for VPD measurement

then imported to CorelDraw to measure the defect depth. This was measured at baseline and at 180 days postoperatively [Figure 3a and 3b].

Surgical procedure

After proper isolation of the surgical field, the operative sites were anesthetized using 2% xylocaine hydrochloride with adrenaline (1:200,000). Sulcular incisions were given and the muco-periosteal flap was raised. Furcation defects were debrided thoroughly. Flaps were sutured using black silk 3-0 suture in the control group. In the test group, anorganic bovine bone was reconstituted for 5 min in saline solution and then packed into the furcation. Once the furcation was completely filled, the collagen membrane was trimmed to adapt to the furcation region. The margins of the membrane should be extended 3-5 mm beyond the defect onto alveolar bone for stability. No sutures were placed to stabilize the membrane. The flap was repositioned and sutured using black silk 3-0 sutures. Periodontal dressing was given.

Postoperative care

Postoperative instructions were given. Antibiotic (500 mg Amoxycillin, 3 times a day for 5 days) and analgesic (400 mg Ibuprofen, 3 times a day for 3 days) were prescribed. Patients were instructed to rinse their mouth daily with a solution of 0.2% chlorhexidine digluconate for 7 days. Patients were recalled after 14 days for pack and suture removal.

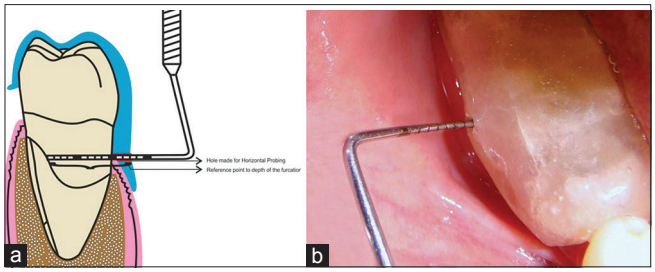

Figure 2: (a) Schematic representation of HPD measurement. (b) Customized stent for HPD measurement

Statistical analysis

Mean and standard deviation were calculated for different variables in each study group at different time points. Mean values were compared by using Wilcoxon signed ranks test, after adjusting the *P* values for multiple comparison by using Bonferroni correction method.

RESULTS

Intra-group comparisons

The results of the intra-group comparisons are presented in Table 1.

On comparing the VPDs at various time points in the test group (6.3 ± 0.5 vs. 3.2 ± 0.6) (P = 0.012) and in the control group (6.8 ± 1.0 vs. 5.3 ± 1.1) (P = 0.012), the reduction in VPD in both groups was statistically significant. On comparing the HPDs at various time points in the test group (4.7 ± 0.7 vs. 2.5 ± 0.7) (P = 0.012) and in the control group (5.0 ± 0.8 vs. 4.1 ± 0.9) (P = 0.009), the reduction in both groups was statistically significant. Similarly, on comparing the CALs at various time points in the test group (6.4 ± 0.5 vs. 3.2 ± 0.6) (P = 0.012) and in the control group (6.8 ± 1.0 vs. 5.6 ± 1.2) (P = 0.018), the reduction in both groups was statistically significant.

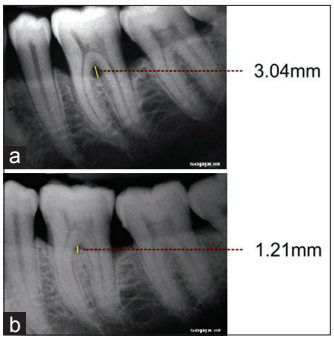

Figure 3: (a) Radiograph measurement of bone fill at baseline. (b) Radiograph measurement of bone fill at 180th day

Table 1: Comparison of mean changes in clinical parameters between test and control groups (intra-group observations)

Variable	Group	0 day	90th day	180th day	Difference	*P*
Vertical probing depth	Test	6.3±0.5	4.5±0.5	3.2±0.6	3.1±0.7	0.012
	Control	6.8±1.0	5.7±1.1	5.3±1.1	1.5±0.5	0.012
Horizontal probing depth	Test	4.7±0.7	3.5±0.7	2.5±0.7	2.2±0.6	0.012
	Control	5.0±0.8	4.5±1.1	4.1±0.9	0.9±0.3	0.009
Clinical attachment levels	Test	6.4±0.5	4.5±0.5	3.2±0.6	3.2±0.6	0.012
	Control	6.8±1.0	5.9±1.3	5.6±1.2	1.2±0.6	0.018

Inter-group comparisons

The results of the inter-group comparisons are presented in Table 2.

On comparing the mean improvements in VPDs between the test and control groups from 0 to 180 days (3.1 ± 0.7 vs. 1.5 ± 0.5), the gain in test group was higher than in the control group (P = 0.007). On comparing the mean improvements in HPDs between the test and control groups from 0 to 180 days (2.2 ± 0.6 vs. 0.9 ± 0.3), the gain in test group was higher than in the control group (P = 0.006). On comparing the mean clinical attachment gain between the test and control groups from 0 to 180 days (3.2 ± 0.6 vs. 1.2 ± 0.6), the gain in test group was higher than in the control group (P = 0.007).

Comparison of defect fills

The results of the compilation of defect fills are presented in Table 3. On comparing the amount of defect fill between the two groups, the test group (2.0 ± 0.1) exhibited greater defect fill than the control group (0.2 ± 0.1) and the result was statistically significant (P = 0.001).

DISCUSSION

Conventional surgical approaches like open flap debridement used in the treatment of furcation involvement have limited potential in regenerating the tissues destroyed by periodontal disease. Other modalities like GTR and use of bone grafts are considered more successful than the conventional methods. The World Workshop in Periodontics, 1989 suggested that combination therapy of bone grafts and barrier membranes shows more predictable results.[8] Various studies[9-13] have also shown that combination therapy shows better results.

Table 2: Comparison of mean changes in clinical parameters between test and control groups (inter-group observations)

Variable	Time points compared	Test	Control	*P*
Vertical probing depth	From 0 day to 90th day	1.8±0.6	1.1±0.3	0.035
	From 0 day to 180th day	3.1±0.7	1.5±0.5	0.007
	From 90th day to 180th day	1.3±0.5	0.4±0.5	0.007
Horizontal probing depth	From 0 day to 90th day	1.2±0.4	0.5±0.5	0.020
	From 0 day to 180th day	2.2±0.6	0.9±0.3	0.006
	From 90th day to 180th day	1.0±0.5	0.4±0.5	0.034
Clinical attachment gains	From 0 day to 90th day	1.9±0.6	0.9±0.6	0.020
	From 0 day to 180th day	3.2±0.6	1.2±0.6	0.007
	From 90th day to 180th day	1.3±0.5	0.3±0.5	0.004

Table 3: Comparison of mean defect fills in test and control groups

Variable	Time points compared	Test	Control	*P*
Defect fill	0 day	3.5±0.1	3.5±0.3	0.001
	180th day	1.5±0.1	3.3±0.1	0.064 (NS)
Comparison of mean defect fill	0-180th day	2.0±0.1	0.2±0.1	0.001

NS = Non significant

In lieu of the above, the aim of the present study was to compare the clinical and radiographic outcomes of treatment of mandibular grade II furcation using combination technique and open flap debridement alone. The study population consisted of 10 patients with chronic periodontitis, in the age group of 35-55 years, and having bilateral grade II furcation defects in mandibular molars. Only mandibular molars with grade II furcation defects were selected owing to the fact that placement of barrier membrane in the maxillary molars with furcation involvement gives no added advantages over flap debridement due to the differences in the anatomy of the furcation.[14,15]

The test group received combination therapy of anorganic bovine bone graft with resorbable GTR membrane and the control group underwent only open flap debridement. Clinical parameters like VPD and HPD of the furcation defect and CAL were recorded at the baseline, i.e. 0 day, and on the 90th day and 180th day. Radiological bone fill was recorded on 0 day and 180th day. The study was followed until the 180th day as the dimensional alteration of the periodontal tissues after periodontal therapy occurs within the first 6 months.[16,17]

The clinical and radiographic parameters were compared within and between the groups at different time points. The most reliable outcome for assessing the periodontal regeneration is human histologic investigation. However, the morbidity associated with this technique and the practical and esthetical restraints preclude this assessment of periodontal regeneration.

By 180th day, the test group showed a decrease in VPD from 6.3 ± 0.5 mm to 3.2 ± 0.6 mm, with a mean change of 3.1 ± 0.7 mm which was statistically significant and superior to other studies.[11,18,19] This gain is attributed to the combination of a GTR membrane with bone graft, which resulted in better coronal extension of the portion of the wound that healed with complete periodontal regeneration.[20] The control group showed a decrease in VPD from 6.8 ± 1.0 mm to 5.3 ± 1.1 mm, with a mean change of 1.5 ± 0.5 mm

which was statistically significant and more than the values obtained in other studies.[18,21]

Increased pre-surgical VPD was associated with a significant reduction in complete furcation closure post-surgically. Deep probing depth at the furcation site at baseline increases the likelihood for more favorable horizontal attachment gain in furcations.[22] Similarly, studies have also suggested that initial probing depth might be a useful indicator for the regenerative potential of a given site.[23]

The test group showed significant gain in mean HPD of 2.2 ± 0.6 mm which was statistically significant and similar to that reported in other studies.[18,24] The control group showed a mean change in HPD of the furcation defect of 0.9 ± 0.3 mm, which was also statistically significant and superior to other studies.[25,26] On inter-group comparison, the test group showed a statistically significant reduction at the 90th and 180th days. This reduction in depth in the test group may be attributed to the clot stabilization and space maintenance by collagen membrane,[27,28] and the osteoconductive properties of bone graft and its better integration with the bone tissue.[29]

Gain in CAL was recorded in the test group to be 3.2 ± 0.6 mm which was superior to that reported in other studies.[11,18,19] The improvement in CAL seen in the study group may represent a clinical improvement in the furcation defects based on true periodontal regeneration.[29-31] In the control group, the mean gain in CAL was only 1.2 ± 0.6 mm, which was similar to that reported in other studies.[18,25] The gain in CAL following open flap debridement alone without placement of any bone grafts and barrier membranes was due to a reparative type of healing characterized by a long junctional epithelium.[29,32]

When the CALs of the test group and the control group were compared, the test group showed a statistically significant gain in CAL at the 90th and 180th days. Three hypotheses have been suggested to justify such findings: (1) The presence of partially resorbed particles of the graft hindering probe penetration; (2) true regeneration of connective attachment due to the presence of the graft which may have created and maintained a large space underneath the membrane; and (3) true bone formation.[33] This finding is in accordance with other studies.[11,18]

Defect fill in the furcation area was assessed with standardized radiographs using direct digital radiography. Defect fill in the test group was 2.0 ± 0.1 mm and in the control group was 0.2 ± 0.1 mm. These changes were statistically significant in the test group and not significant in the control group (P = 0.064). These findings were similar to those of Tsao *et al*.[25] On inter-group comparison, the test group showed a statistically significant gain in defect fill, as compared to the control group.

The limitations of the present study are its small sample size and short follow-up, i.e. 6 months. So, future studies with larger sample sizes and longer follow-ups are suggested.

CONCLUSIONS

The results of the present study indicate that combination regenerative therapy in mandibular Class II furcation defects with bovine bone graft and resorbable GTR membrane provided additional benefits over open flap debridement alone. Combined regenerative technique resulted in significant improvement of the clinical and radiographic parameters evaluated.

REFERENCES

1. Newell DH. The diagnosis and treatment of molar furcation invasions. Dent Clin North Am 1998;42:301-37.
2. Gottlow J. Periodontal Regeneration. Proceedings of the First European Workshop in Periodontology. London: Quintessence; 1994. p. 172-92.
3. Luepke PG, Mellonig JT, Brunsvold MA. A clinical evaluation of a bioresorbable barrier with and without decalcified freeze-dried bone allograft in the treatment of molar furcations. J Clin Periodontol 1997;24:440-6.
4. Schallhorn RG, McClain PK. Combined osseous composite grafting, root conditioning, and guided tissue regeneration. Int J Periodontics Restorative Dent 1988;8:9-31.
5. Anderegg CR, Martin SJ, Gray JL, Mellonig JT, Gher ME. Clinical evaluation of the decalcified freeze- dried bone allograft with guided tissue regeneration in the treatment of molar furcation invasions. J Periodontol 1991;62:264-8.
6. Farzad M, Mohammadi M. Guided bone regeneration-Literature review. J Oral Health Oral Epidemiol 2012;1:3-18.
7. Pellegrini G, Pagni G, Rasperini G. Surgical approaches based on biological objectives: GTR versus GBR techniques. Int J Dent 2013;1:1-13.
8. American Academy of Periodontology. Proceedings of the 1989 World Workshop in Clinical Periodontics: American Academy of Periodontology; VII-V125.
9. Anderegg CR, Martin SJ, Gray JL, Mellonig JT, Gher ME. Clinical evaluation of the use of decalcified freeze-dried bone allograft with guided tissue regeneration in the treatment of molar furcation invasions. J Periodontol 1991;62:264-8.
10. Machtei EE, Schallhorn RG. Successful regeneration of mandibular Class II furcation defects: An evidence-based treatment approach. Int J Periodontics Restorative Dent 1995;15:146-67.

11. Simonpietri-C JJ, Novaes AB Jr, Batista EL Jr, Filho EJ. Guided tissue regeneration associated with bovine-derived anorganic bone in mandibular class II furcation defects. 6-month results at re-entry. J Periodontol 2000;71:904-11.
12. Lekovic V, Camargo PM, Weinlaender M, Vasilic N, Aleksic Z, Kenney EB. Effectiveness of a combination of platelet-rich plasma, bovine porous bone mineral and guided tissue regeneration in the treatment of mandibular grade II molar furcations in humans. J Clin Periodontol 2003;30:746-51.
13. Novaes AB Jr., Palioto DB, de Andrade PF, Marchesan JT. Regeneration of class II furcation defects: Determinants of increased success. Braz Dent J 2005;16:87-97.
14. Metzler DG, Seamons BC, Mellonig JT, Gher ME, Gray JL. Clinical evaluation of guided tissue regeneration in the treatment of maxillary class II molar furcation invasions. J Periodontol 1991;62:353-60.
15. Pontoriero R, Lindhe J. Guided tissue regeneration in the treatment of degree III furcation defects in maxillary molars. J Clin Periodontol 1995;22:810-2.
16. Wang HL, Burgett FG, Shyr Y, Ramfjord S. The influence of molar furcation involvement and mobility on future clinical periodontal attachment loss. J Periodontol 1994;65:25-9.
17. Pontoriero R, Lindhe J, Nyman S, Karring T, Rosenberg E, Sanavi F. Guided tissue regeneration in degree II furcation-involved mandibular molars. A clinical study. J Clin Periodontol 1998;15:247-54.
18. Houser BE, Mellonig JT, Brunsvold MA, Cochran DL, Meffert RM, Alder ME. Clinical evaluation of anorganic bovine bone xenograft with a bioabsorbable collagen barrier in the treatment of molar furcation defects. Int J Periodontics Restorative Dent 2001;21:161-9.
19. Reddy KP, Nayak DG, Uppoor AS. A clinical evaluation of anorganic bovine bone graft plus 10% collagen with or without a barrier in the treatment of class II furcation defects. J Contemp Dent Pract 2006;7:60-70.
20. Camelo M, Nevins ML, Lynch SE, Schenk RK, Simion M, Nevins M. Periodontal regeneration with an autogenous bone-Bio-Oss composite graft and a Bio-Gide membrane. Int J Periodontics Restorative Dent 2001;21:109-19.
21. Eto AL, Joly JC, Jeffcoat M, de Araújo NS, de Araújo VC, Cury PR. Use of anorganic bovine-derived hydroxyapatite matrix/cell-binding peptide (P-15) in the treatment of class II furcation defects: A clinical and radiographic study in humans. J Periodontol 2007;78:2277-83.
22. Horwitz J, Machtei EE, Reitmeir P, Holle R, Kim TS, Eickholz P. Radiographic parameters as prognostic indicators for healing of class II furcation defects. J Clin Periodontol 2004;31:105-11.
23. Machtei EE, Cho MI, Dunford R, Norderyd J, Zambon JJ, Genco RJ. Clinical, microbiological, and histological factors which influence the success of regenerative periodontal therapy. J Periodontol 1994;65:154-61.
24. Taheri M, Molla R, Radvar M, Sohrabi K, Najafi MH. An evaluation of bovine derived xenograft with and without a bioabsorbable collagen membrane in the treatment of mandibular Class II furcation defects. Aust Dent J 2009;54:220-7.
25. Tsao YP, Neiva R, Al -Shammari K, Tae J, Wang HL. Effects of a mineralized human cancellous bone allograft in regeneration of mandibular Class II furcation defects. J Periodontol 2006;77:416-25.
26. 26. Manoj H, Dilip GN, Uppoor AS. A clinical evaluation of bioactive glass particulate in the treatment of mandibular class II furcation defects. Braz J Oral Sci 2007;6:1450-56.
27. Wikesjö UM, Nilvéus RE, Selvig KA. Significance of early healing events on periodontal repair: A review. J Periodontol 1992;63:158-65.
28. Haney JM, Nilvéus RE, McMillan PJ, Wikesjö UM. Periodontal repair in dogs: Expanded polytetrafluoroethylene barrier membranes support wound stabilization and enhance bone regeneration. J Periodontol 1993;64:883-90.
29. Sculean A, Berakdar M, Chiantella GC, Donos N, Arweiler NB, Brecx M. Healing of intrabony defects following treatment with a bovine-derived xenograft and collagen membrane. A controlled clinical study. J Clin Periodontol 2003;30:73-80.
30. Camelo M, Nevins ML, Schenk RK, Simion M, Rasperini G, Lynch SE, *et al*. Clinical, radiographic, and histologic evaluation of human periodontal defects treated with Bio-Oss and Bio-Guide. Int J Periodontics Restorative Dent 1998;18:321-31.
31. Mellonig J. Human histologic evaluation of a bovine-derived xenograft in the treatment of periodontal osseous defects. Int J Periodontics Restorative Dent 2000;20:19-29.
32. Caton J, Nyman S, Zander H. Histometric evaluation of periodontal surgery. II. Connective tissue attachment levels after four regenerative procedures. J Clin Periodontol 1980;7:224-31.
33. De Leonardis D, Garg AK, Pedrazzoli V, Pecora GE. Clinical evaluation of the treatment of class II furcation involvements with bioabsorbable barriers alone or associated with demineralized freeze-dried bone allografts. J Periodontol 1999;70:8-12.

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