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Original Article

Clinical and biometrical evaluation of socket preservation using demineralized freeze-dried bone allograft with and without the palatal connective tissue as a biologic membrane

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ABSTRACT

Background: Alveolar ridge preservation following tooth extraction has the ability to maintain the ridge dimensions and allow the implant placement in an ideal position fulfilling both functional and aesthetic results. The aim of this study was to evaluate the efficacy of the palatal connective tissue as a biological membrane for socket preservation with demineralized freeze-dried bone allograft (DFDBA).

Materials and Methods: Twelve extraction sites were treated with DFDBA with (case group) and without (control group) using autogenous palatal connective tissue membrane before placement of implants. Alveolar width and height, amount of keratinized tissue, and gingival level were measured at pre-determined points using a surgical stent at two times, the time of socket preservation surgery and 4 months later during implantation. The significance level was set at 0.05.

Results: In both groups a decrease in all socket dimensions was found. The average decrease in socket width, height, keratinized tissue, and gingival level in case group was 1.16, 0.72, 3.58, and 1.27 mm, and in control group was 2.08, 0.86, 4.52, and 1.58 mm respectively. Statistical analysis showed that decrease in socket width ($P = 0.012$), keratinized tissue ($P \leq 0.001$), and gingival level ($P = 0.031$) in case group was significantly lower than that of the control group. Results showed no meaningful difference in socket height changes when compared with case and control groups ($P = 0.148$).

Conclusion: Under the limits of this study, connective tissue membrane could preserve socket width, amount of keratinized tissue, and the gingival level more effectively than DFDBA alone.

Key Words: Connective tissue, dental implant, membrane, tooth socket

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INTRODUCTION

Alveolar ridge resorption has long been considered as an unavoidable consequence of tooth extraction. In the long term, prosthodontic complications, loss of function, and inadequate bone for the placement of dental implants may result.[1] In anterior ridges, partially edentulous patients loss of teeth results in 91% of ridge deformities.[2] Post-extraction bone loss is accelerated in the first 6 months followed by a gradual modeling and remodeling of the remaining bone, with as much as 40% of the alveolar height and 60% of alveolar width lost in the first 6 months.[1]

Hence, preservation of alveolar ridge volume followed by tooth extraction, facilitates subsequent placement of dental implants and leads to an improved esthetic and functional prosthodontic result.[3] Different methods represent socket preservation techniques with their advantages and disadvantages. Several studies

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have used grafting bone substitute materials for ridge preservation,[4-14] and different barrier membranes have been used for socket preservation at the time of tooth extraction such as polytetrafluoroethylene (ePTFE), bio-absorbable membrane, cellular dermal matrix, and acellular dermal matrix allograft (ADMA).[15-18] Nowadays, many investigations have used platelet-rich fibrin matrix (PRFM) for ridge preservation, which demonstrated that PRFM alone may be the best graft for ridge preservation procedures.[19] Yet there has not been any study to evaluate the use of palatal connective tissue as a biologic membrane for socket preservation. There have been several studies illustrating the use of palatal connective tissue as a biologic membrane for treatment of vertical bony defects which all indicate effectiveness of this method.[20-24]

The purpose of this study was clinical and biometrical evaluation of socket preservation using demineralized freeze-dried bone allograft (DFDBA) with and without the palatal connective tissue as a biologic membrane to measure width and height changes of socket and alterations in coronal level of gingiva and mucogingival junction (MGJ) position.

MATERIALS AND METHODS

This was a randomized controlled clinical blind study. A total of 12 maxillary single root teeth in eight patients (four men and four women) referring to the Department of Periodontology, Shahid Beheshti University of Medical Science, Tehran, Iran were randomly selected and then divided into two groups. Patient's age ranged from 22 to 58 years. All subjects gave written informed consent to the survey procedures and were well informed of the nature of the study. Exclusion criteria included: Presence of systemic disease (diabetes, chemotherapy, immunosuppressive disease, disease with bony manifestations); history of allergic reaction to any materials used in this study; smoking; using the drugs that interfere with bone repair; and pregnancy and breast feeding. An alginate impression was prepared from each subject (before tooth extraction) and an acrylic stent was made including at least one tooth distally and mesially to the objective tooth. The distance between the margin of stent to the Cemento-enamel junction and margin of a restoration was measured, which was considered as a reliable reference point for further measurements. Before any intervention, first SL (The distance between the margin of stent and coronal level of gingiva in 3 points: Mesiobuccal, midbuccal and distobuccal) and SMG (The distance between the margin of stent and MGJ in 3 points: Mesiobuccal, midbuccal and distobuccal) were measured (that will be explained in the next part). Then local infiltration of lidocaine2% with epinephrine (1:80,000) was administered for hemostasis and to reduce post-operative pain. Sulcular and two vertical releasing incisions were made around the teeth that would be extracted and then full-thickness buccal and lingual flaps were reflected. The roots of the teeth were atraumatically extracted using a periotom so that socket walls were preserved. Following tooth extraction the bony walls were debrided. At this stage, the following measurements were carried out using the previous stent and a caliper (KOHLER, made in Germany). Desired indices consisted of the following:

SL: The distance between the margin of stent and coronal level of gingiva in 3 points: Mesiobuccal (SLm), midbuccal (SLmid), and distobuccal (SLd). In other words SL is the mean of SLm, SLmid, and SLd.

SMG: The distance between the margin of stent and MGJ in 3 points: Mesiobuccal (SMGm), midbuccal (SMGmid), and distobuccal (SMGd)**.** In other words SMG is the mean of SMGm, SMGmid, and SMGd.

SC: The distance between the margin of stent and the crest of socket in 3 points: Mesiobuccal (SCm), midbuccal (SCmid), and distobuccal (SCd). In other words SC is mean of SCm, SCmid, and SCd.

SD: The distance between margin of stent and socket depth.

W: Socket width at the most coronal level.

As mentioned before, from the listed indices, SL and SMG were measured before flap reflection.

Then in case group, DFDBA (Grafton, American Biohorizons Company) was mixed with the patients' blood, placed in the socket, and covered by palatal connective tissue (dissected from the palatal mucosa in the region of the canines, 1st and 2nd premolars and with the thickness of 1.5-2 mm) as a biologic membrane so that it would extend at least 3 mm beyond the socket inlet in all sides. Consecutively, an undermining split-thickness preparation of the buccal aspect was performed and a tension-free primary closure was made with simple interrupted 3-0 silk sutures [Figure 1]. In control group, the socket was

filled only with DFDBA, and other procedures were same as case group. Then subjects were administered Amoxicillin (500 mg/kg, PO, TID) for a week and Ibuprofen (400 mg, per OS) when required. An administration of 0.2% chlorhexidine solution was performed twice a day for 14 days. Follow-up appointments were after 1, 2, 4, and 8 weeks to evaluate the healing process and plaque control. The second surgery was performed 4 months after the first surgery. All indices were measured again (but SL and SMG before flap reflection) and the implant was inserted in the prepared area [Figure 2]. The data obtained were then analyzed using the SPSS (Statistical Package for the Social Sciences) software,

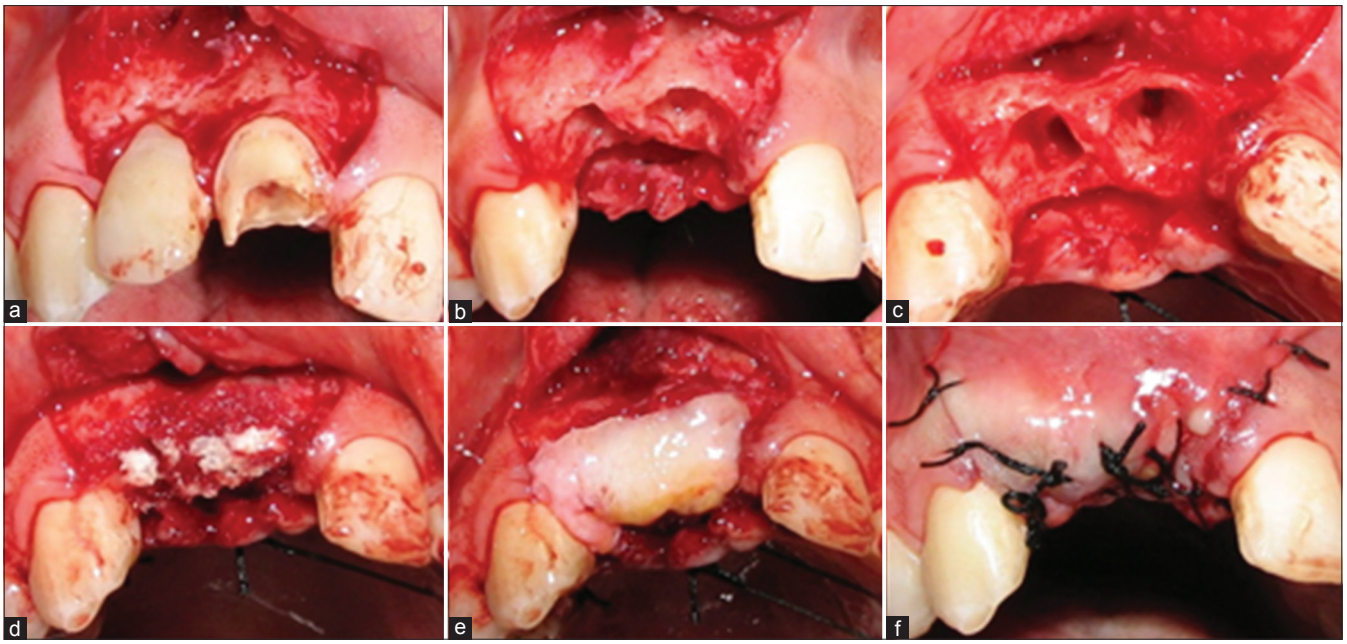

Figure 1: Different steps of socket preservation using palatal connective tissue as a biologic membrane in case group

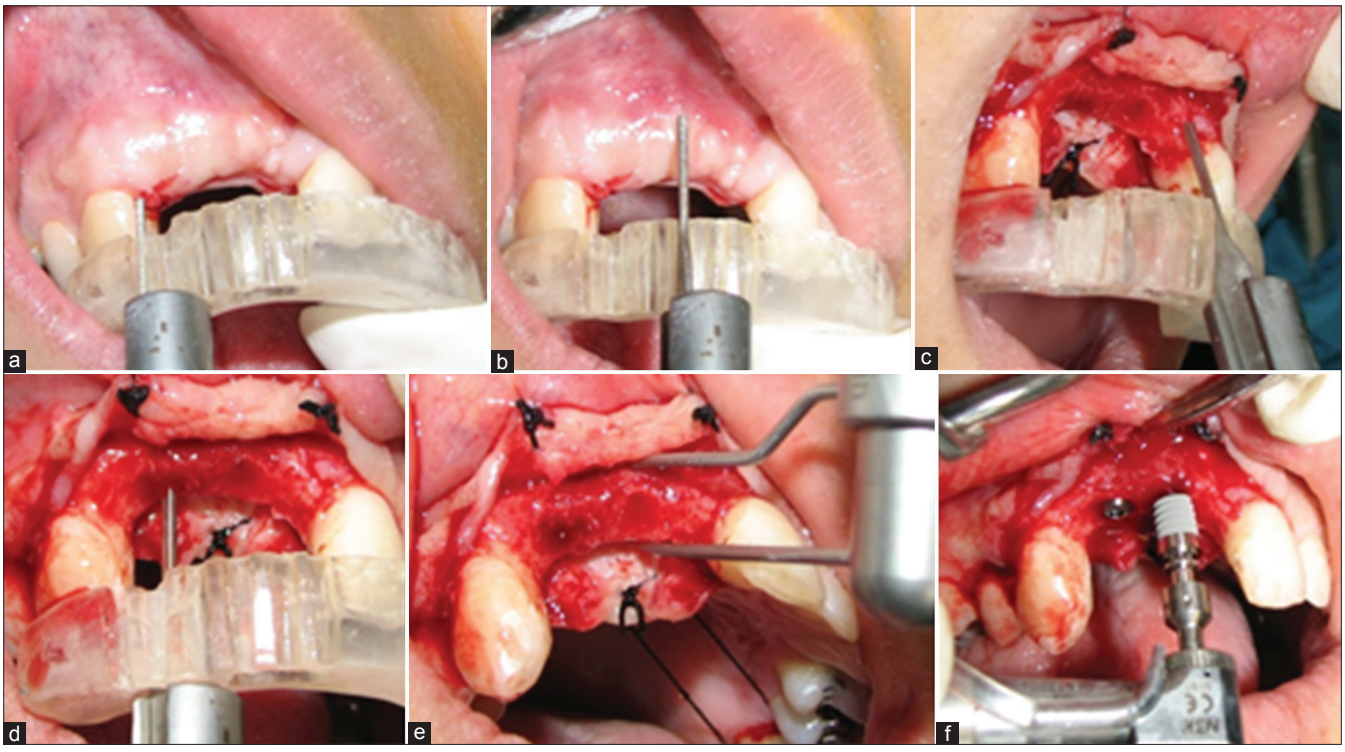

Figure 2: Different measurements in the healed socket after 4 months and then insertion of implant in case group

the Wilcoxon test to evaluate indices alterations in each group, and the Mann–Whitney test to evaluate inter-group changes. The significance level was set at 0.05.

RESULTS

The Wilcoxon test was used to evaluate the indices alterations in each group. Tables 1 and 2 indicate that intra-group differences were statistically significant after 4 months in all indices in both case and control groups ($P < 0.05$). To compare indices alterations among treatment groups, the Mann–Whitney test was used. Table 3 shows mean differences of the measured indices in case and control groups before and after socket preservation. As mentioned before, in each group the average of SLm, SLmid, and SLd were calculated and expressed as SL (the distance between the margin of stent and gingiva) and then compared with each other. This approach was also used to compare alterations in MGJ position and crest of socket between two groups, so that SMG (the distance between the margin of stent and MGJ) was in fact mean of SMGm, SMGmid, and SMGd and the distance between the margin of stent and the crest of socket was presented as SC, which was mean of SCm, SCmid, and SCd. Then these measurements were compared in case and control groups. Statistical analysis showed that decrease in socket width ($P = 0.012$), keratinized tissue ($P \leq 0.001$), and gingival level ($P = 0.031$) in case group was significantly lower than control group, but no meaningful difference in socket height changes was observed comparing case and control groups ($P = 0.148$).

DISCUSSION

This study was performed on 12 single root sockets of maxilla to unify bone healing and structure in treatment groups. Since major dimensional alterations occurred during the first 8 weeks following tooth extraction, and due to the investigations of Schropp,[3] Simon,[7] and Zubillaga,[25] in this study 4 months was considered as an appropriate time for socket healing. Nemocovsky[4] and Artzi[5] demonstrated ridge enhancement and socket preservation method, utilizing bony graft materials without membrane. The positive aspect of the present study was using DFDBA in both groups, which is an advantage in comparison with the listed literatures.

In a histologic study, Froum concluded that the

Table 1: Mean of the desired indices in case group at the first and second surgeries in mm

Group	Indices										
	SLm	SLmid	SLd	SMGm	SMGmid	SMGd	SCm	SCmid	SCd	SD	W
Case											
At the time of tooth extraction	13.41±1.53	13.83±2.31	13.41±1.71	20.66±1.60	20.83±1.77	20.91±1.62	16.25±1.99	17.50±1.78	16.33±1.96	27.50±2.30	7.25±0.27
4 months later	14.83±1.66	14.91±1.88	14.75±1.80	17.08±1.49	17.25±1.36	17.33±1.53	17.00±1.89	18.08±1.88	17.16±2.11	18.08±1.88	6.08±0.37
Mean differences	1.41±0.37	1.08±0.58	1.33±0.40	3.58±0.58	3.58±1.06	3.58±0.49	0.75±0.27	0.57±0.20	0.83±0.25	9.50±0.70	1.16±0.40
P value	0.026	0.027	0.026	0.027	0.027	0.026	0.024	0.020	0.023	0.027	0.026

Table 2: Mean of the desired indices in control group at the first and second surgeries in mm

Group	Indices										
	SLm	SLmid	SLd	SMGm	SMGmid	SMGd	SCm	SCmid	SCd	SD	W
Control											
At the time of tooth extraction	14.16±1.88	15.58±1.82	13.83±2.01	21.91±2.35	22.66±2.25	22.25±2.42	17.08±1.42	17.58±1.28	17.16±1.53	27.41±1.49	8.16±0.60
4 months later	15.66±1.86	17.08±1.53	15.50±1.87	17.50±2.48	18.58±2.17	17.41±2.37	18.08±1.31	18.33±1.36	18.00±1.41	18.33±1.21	6.08±0.66
Mean differences	1.50±0.31	1.58±0.37	1.66±0.25	4.33±0.20	4.33±0.81	4.83±0.40	1.00±0.31	0.75±0.25	0.83±0.25	8.66±0.68	2.08±0.58
P value	0.024	0.024	0.023	0.020	0.027	0.026	0.024	0.024	0.023	0.026	0.027

Table 3: Comparision of mean differences of the desired indices in case and control groups before and after socket preservation in mm

Indices	SL	SMG	SC	SD	W
Mean differences					
Case	1.27±0.46	3.58±0.71	0.72±0.25	9.50±0.70	1.16±0.40
Control	1.58±0.30	4.52±0.55	0.86±0.27	8.66±0.68	2.08±0.58
P value	0.031	<0.001	0.148	0.070	0.012

average percentage of vital bone in sockets covered with ADMA was 38% compared to 22% in sockets covered with ePTFE membrane barrier.[18] In this study palatal connective tissue was used as a biologic membrane and due to Froum's investigation, it has a relative advantage when compared with other synthetic membranes such as ePTFE.

Other benefits of this study include: Low probability of bacterial accumulation, one stage surgery (compared to using non-absorbable membranes), low risk of infection, and antigenic problems because of its autogenous nature (rather than alloderm and collagen membranes). In addition, in this study, denudation of membrane is not a problem and every suture threads can be used. There have not been any clinical controlled studies in which palatal connective tissue have rolled as a biologic membrane for socket preservation, but several studies have used this technique for treatment of angular bony defects and all have suggested that using palatal connective tissue as a biologic membrane is efficacious and clinically successful.[20-24]

In the present study, a complete preservation of socket dimensions has not been proved, which is consistent with the outcome of Zubillaga's literature.[25] In case group the socket width was preserved more than control group that was statistically significant ($P < 0.05$, average decrease of 1.16 mm vs. 2.08 mm). Four months after tooth extraction, no statistically significant differences was observed among both groups with regard to the socket height ($P > 0.05$; average decrease of percentage 72 ± 0.25 mm in case group versus percentage 86 ± 0.27 mm in control group).

MGJ was placed more coronal than before the tooth extraction due to the type of surgery, which caused release of incisions and coronal positioning of buccal flap. Mean alteration in MGJ position in case group was 3.58 ± 0.71 mm, which was significantly lower than control group (4.52 ± 0.55 mm) because of the effect of palatal connective tissue in preserving keratinized tissue ($P < 0.05$). In our study surgery procedures were similar in case and control groups (flaps were closed completely), thus in both groups decrease in keratinized gingiva was unavoidable.

It is guessed that if flap closure is not complete and palatal connective tissue becomes exposed, lower decrease in the width of keratinized gingiva would occur. More research is required in this regard. Coronal level alterations of gingiva demonstrated lower decrease in case group (the average decrease was 1.27 ± 0.46 mm) in contrast with control group [mean decrease was 1.58 ± 0.30 mm ($P < 0.05$)], emphasizing the effect of palatal connective tissue in preserving the gingival level, which is very critical in the esthetic zone.

CONCLUSION

Under the limits of this study, connective tissue membranes can preserve socket width, amount of keratinized tissue, and the gingival level more effectively than DFDBA alone. There was no significant statistical difference in the reduction of socket height between both groups, although socket dimensions never preserved completely in either surgical techniques studied.

REFERENCES

1. Bartee BK. Extraction site reconstruction for alveolar ridge preservation. Part 1: Rationale and materials selection. J Oral Implantol 2001;27:187-93.
2. Abrams H, Kopczyk RA, Kaplan AL. Incidence of anterior ridge deformities in partially edentulous patients. J Prosthet Dent 1987;57:191-4.
3. Schropp L, Wenzel A, Kostopoulos L, Karring T. Bone healing and soft tissue contour changes following single-tooth extraction: A clinical and radiographic 12-month prospective study. Int J Periodontics Restorative Dent 2003;23:313-23.
4. Nemcovsky CE, Serfaty V. Alveolar ridge preservation following extraction of maxillary anterior teeth. Report on 23 consecutive cases. J Periodontol 1996;67:390-5.
5. Artzi Z, Nemcovsky CE. The application of deproteinized bovine bone mineral for ridge preservation prior to implantation. Clinical and histological observations in a case report. J Periodontol 1998;69:1062-7.
6. Becker W, Clokie C, Sennerby L, Urist MR, Becker BE. Histologic findings after implantation and evaluation of different grafting materials and titanium micro screws into extraction sockets: Case reports. J Periodontol 1998;69:414-21.
7. Simon BI, Von Hagen S, Deasy MJ, Faldu M, Resnansky D.

Changes in alveolar bone height and width following ridge augmentation using bone graft and membranes. J Periodontol 2000;71:1774-91.
8. Jung RE, Siegenthaler DW, Hämmerle CH. Postextraction tissue management: A soft tissue punch technique. Int J Periodontics Restorative Dent 2004;24:545-53.
9. Nevins M, Camelo M, De Paoli S, Friedland B, Schenk RK, Parma-Benfenati S, *et al*. A study of the fate of the buccal wall of extraction sockets of teeth with prominent roots. Int J Periodontics Restorative Dent 2006;26:19-29.
10. Araújo M, Linder E, Wennström J, Lindhe J. The influence of Bio-Oss Collagen on healing of an extraction socket: An experimental study in the dog. Int J Periodontics Restorative Dent 2008;28:123-35.
11. Wang HL, Tsao YP. Histologic evaluation of socket augmentation with mineralized human allograft. Int J Periodontics Restorative Dent 2008;28:231-7.
12. Araújo MG, Lindhe J. Dimensional ridge alterations following tooth extraction. An experimental study in the dog. J Clin Periodontol 2005;32:212-8.
13. Landsberg CJ. Implementing socket seal surgery as a socket preservation technique for pontic site development: Surgical steps revisited - a report of two cases. J Periodontol 2008;79:945-54.
14. Seifi M, Ghoraishian SA. Determination of orthodontic tooth movement and tissue reaction following demineralized freeze-dried bone allograft grafting intervention. Dent Res J (Isfahan) 2012;9:203-8.
15. Lekovic V, Kenney EB, Weinlaender M, Han T, Klokkevold P, Nedic M, *et al*. A bone regenerative approach to alveolar ridge maintenance following tooth extraction. Report of 10 cases. J Periodontol 1997;68:563-70.
16. Kwan SK, Lekovic V, Camargo PM, Klokkevold PR, Kenney EB, Nedic M, *et al*. The use of autogenous periosteal grafts as barriers for the treatment of intrabony defects in humans. J Periodontol 1998;69:1203-9.
17. Fowler EB, Breault LG, Rebitski G. Ridge preservation utilizing an acellular dermal allograft and demineralized freeze-dried bone allograft: Part I. A report of 2 cases. J Periodontol 2000;71:1353-9.
18. Froum S, Cho SC, Elian N, Rosenberg E, Rohrer M, Tarnow D. Extraction sockets and implantation of hydroxyapatites with membrane barriers: A histologic study. Implant Dent 2004;13:153-64.
19. Simon BI, Zatcoff AL, Kong JJ, O'Connell SM. Clinical and histological comparison of extraction socket healing following the use of autologous Platelet-Rich Fibrin Matrix (PRFM) to ridge preservation procedures employing demineralized freeze dried bone allograft material and membrane. Open Dent J 2009;3:92-9.
20. Lekovic V, Kenney EB, Carranza FA, Martignoni M. The use of autogenous periosteal grafts as barriers for the treatment of Class II furcation involvements in lower molars. J Periodontol 1991;62:775-80.
21. Moghaddas H, Karimi M. The comparison of the effect of periostal pedicle flap as membrane with debridement in treatment of vertical defects of alveolar bone. Pajohande J 1998;10:127-34.
22. Moghaddas H, Ghasemi N. The comparison of the effect of palatal connective tissue as membrane with andwithout hydroxyappatite in treatment of vertical defects of alveolar bone. Beheshti Univ Dent J 1999;17:60-8.
23. Moghaddas H, Jalali A. The comparison of the effect of hydroxyappatite and palatal connective tissue as membranes with and without doxycycline local application in treatment of vertical defects of alveolar bone. Beheshti Univ Dent J 2001;19:175-84.
24. Moghaddas H, Soltani L. The comparison of the effect of palatal connective tissue and collagen as membranes with Bio-Oss in treatment of interproximal vertical defects of alveolar bone. Beheshti Univ Dent J 2004;22:510-20.
25. Zubillaga G, Von Hagen S, Simon BI, Deasy MJ. Changes in alveolar bone height and width following post-extraction ridge augmentation using a fixed bioabsorbable membrane and demineralized freeze-dried bone osteoinductive graft. J Periodontol 2003;74:965-75.

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