Print ISSN: 2321-6379
Online ISSN: 2321-595X

Original Article

A Clinical and Radiographic Comparative Evaluation of Self-healing Extraction Socket versus Use of Autogenous Dentin and Demineralized Freeze-Dried Bone Allograft for Socket Preservation Following Tooth Extraction

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Abstract

Introduction: Preservation of alveolar dimensions after tooth extraction is crucial to achieve optimal esthetic and functional prosthodontic results. With the increasingly frequent use of dental implants to replace non-restorable teeth, preservation of the existing alveolus is essential to maintain adequate bone volume for placement and stabilization of the implants. The aim of the study was to clinically and radiographically compare and evaluate autogenous dentin as bone graft with demineralized freeze-dried bone allograft (DFDBA) and extraction socket left alone for healing.

Materials and Methods: Ethical clearance was obtained for the study. A written informed consent was taken from all the participants. A total of 45 randomly selected adult patients were divided into three groups: (1) Extraction socket with graft material placement: Autogenous dentin (natural tooth dentin) as a bone graft (15 participants). (2) Extraction socket with graft material placement: DFDBA as a bone graft (15 participants). (3) Extraction socket to be left alone for healing (15 participants). The cases were examined at 3, 6, and 9 months post-intervention. For each visit, clinical and radiographic assessment radiovisiography was done to access the bone tissue healing. The mean buccolingual bone ridge width and height were compared both clinically and radiographically. The data collected were subjected to statistical analysis using SPSS 22.0. ANOVA and paired *t*-test were carried out for comparing the mean bone buccolingually on the radiograph. All $P < 0.05$ were considered to be statistically significant.

Results: The mean buccolingual ridge width measured by Vernier caliper for the I group was 7.13 ± 0.91, for II group, it was 6.20 ± 0.86, and for the III group was 5.33 ± 0.61. The difference between the groups was statistically significant at 9 months. The mean height of the bone measured by radiograph showed that for I group, it was 6.33 ± 0.88, for II group, it was 6.13 ± 0.83, and for the III group, it was 5.33 ± 0.61. The difference in the mean outcome was significant between I and III as well as II and III groups.

Conclusion: The results of the grafted sites showed statistically significant difference compared to non-grafted sites. The alveolar ridge preservation shows reduction in buccolingual shrinkage. The present investigation shows that augmenting the extraction socket with biomaterials may have the possibility to limit the buccolingual and coronal apical shrinkage.

Key words: Autogenous dentin, Healing, Socket preservation

Access this article online

www.ijss-sn.com

Month of Submission : 03-2020
Month of Peer Review : 04-2020
Month of Acceptance : 05-2020
Month of Publishing : 05-2020

INTRODUCTION

A regularly performed procedure in the dental set up is tooth extraction. Lack of preventive measures causes compromised health of not only the tooth but also the alveolar bone. After tooth extraction, the remaining socket heals from the apex toward the crest.[1] When no additives

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are placed into the socket at the time of the extraction, the soft-tissue infiltration at the crest often results in facial and crestal bone loss.[2] Dimensional changes after tooth extraction often result in bone resorption that complicates placement of implants or traditional prosthesis.[3] With the increasingly frequent use of dental implants to replace non-restorable teeth, preservation of the existing alveolus is essential to maintain adequate bone volume for placement and stabilization of the implants.[4] Therefore, preserving the alveolar dimension of the socket after extraction aids in successful accomplishment of dental implants. Socket preservation is a surgical procedure, in which graft material or a scaffold is placed in a fresh extraction socket to preserve the alveolar ridge for a future prosthesis.[5,6] There are many techniques, like using autogenous, allogeneic, xenograft, and alloplast graft materials, to guide and assist specialized cellular components of the periodontium to participate in the regenerative process to preserve bone width and height of the alveolus.[7] At present, all extracted teeth are generally considered clinical waste and, therefore, are simply discarded.[8] Recently, however, several studies have reported that extracted teeth from patients, which undergo a process of cleaning, grinding, demineralization, and sterilization, can be a very effective graft to fill alveolar bone defects in the same patient.[9,10] This study aims to evaluate the efficacy of autogenous dentin graft material in achieving good bone fill, which is essential for preservation of alveolar ridge dimensions.

MATERIALS AND METHODS

Ethical clearance was obtained before the start of the study. Forty-five adult patients, free of any known systemic illness (such as diabetes mellitus, hypertension, or on drugs like steroids) who agreed to participate in the study, were randomly selected from a private clinic for the study. The study is a pilot study, to check the feasibility of the method; hence, no statistical assessment of sample size was done. The selected patients were divided into three different groups as follows:

- Extraction socket with graft material placement: Autogenous dentin (natural tooth dentin) as a bone graft
- Extraction socket with graft material placement: Demineralized freeze-dried bone allograft (DFDBA) as a bone graft
- Extraction socket to be left alone for healing.

A baseline assessment of the clinical width of the alveolar ridge before extraction was done and recorded with the help of a Vernier caliper. The height was recorded using radiovisiography (RVG). After intervention, the same assessment was done after 3 months, 6 months, and 9 months. Difference in the clinical parameters between the all the four groups pre- and postoperatively, at baseline, at 15 days, 3 months, 6 months, and 9 months, was calculated using SPSS 22.0 (IBM Analytics, New York, U.S.A). Data were compared by applying ANOVA and *t*-test. All $P < 0.05$ were considered to be statistically significant.

RESULTS

Table 1 shows the clinical comparison of mean ridge with at the baseline.

The mean ridge width of Group I at baseline was 9.06 ± 0.79. At 3 months, it was 5.53 ± 0.63 and at 6 months, it was 7.00 ± 0.84. The difference between the measurements was significant after 6 months as compared to 3 months and baseline ($P < 0.001$). At 9th month, it was 7.13 ± 0.91, this was higher than the measurements at 6 months but not significant ($P = 0.164$). In Group II, the mean difference at 9 months (5.33 ± 0.61) was significantly higher than at 6 months (5.33 ± 0.61) and 3 months (4.86 ± 0.91). Table 2 shows the mean mesiodistal width comparison measured using the RVG.

The mean bone width of Group A at baseline was 9.06 ± 0.79. At 3 months it was 5.53 ± 0.63. No difference was seen between baseline and 3 months ($P < 0.792$). At 6 months it was 6.80 ± 0.77. This was not significantly different than the score at 3 months ($P = 0.207$). At 9 months, the mean ridge width was 6.93 ± 0.91, significant higher than 6 months ($P = 0.020$). The mean bone width of Group B at baseline was 9.13 ± 1.06. At 3 months it was 4.66 ± 0.48. No difference was seen between baseline and 3 months ($P < 0.871$). At 6 months it was 5.73 ± 0.79. This was not significantly higher than at 3 months ($P = 0.664$). At 9 months, the mean ridge width was 6.13 ± 0.83, significant higher than 6 months ($P = 0.020$). The mean bone width of Group C at baseline was 9.80 ± 0.94. At 3 months it was 4.86 ± 0.91. No difference was seen between baseline and 3 months ($P = 0.440$). At 6 months it was 5.33 ± 0.61. This was significantly higher than the mean bone width at 3 months ($P = 0.021$). At 9 months, the mean ridge with did not change. Table 3 shows the mean bone height measured with RVG.

The mean bone height of Group A at baseline was 9.06 ± 0.79. At 3 months it was 3.73 ± 1.09. The difference was statistically significant ($P < 0.001$). At 6 months it was 6.46 ± 0.51. This was significantly lower than the score at baseline ($P < 0.001$). At 9 months, the mean ridge width was 6.93 ± 0.91. No significant difference was seen when compared to 6 months ($P = 0.201$). The mean bone height of Group B at baseline was 9.20 ± 1.06. At 3 months it was

Table 1: Comparison of mean ridge width (buccolingual) in millimeter (mm) among the three groups (measured with Vernier caliper)

Measurement	Ridge width			*P*-value		
	Group A	Group B	Group C	Group A versus Group B	Group A versus Group C	Group B versus Group C
	Mean±SD	Mean±SD	Mean±SD			
Baseline	9.06±0.79	9.13±1.06	9.80±0.94	-	-	-
3 months	5.53±0.63	4.80±0.67	4.86±0.91	0.029	0.051	0.968
6 months	7.00±0.84	5.86±0.91	5.33±0.61	0.001	<0.001	0.176
9 months	7.13±0.91	6.20±0.86	5.33±0.61	0.008	<0.001	0.015

SD: Standard deviation

Table 2: Comparison of mean bone width (mesiodistal) in millimeters (mm) among the three groups (measured using RVG with grid)

Measurement (mm)	Bone width			*P*-value		
	Group A	Group B	Group C	Group A versus Group B	Group A versus Group C	Group B versus Group C
	Mean±SD	Mean±SD	Mean±SD			
Baseline	9.06±0.79	9.13±1.06	9.80±0.94	-	-	-
3 months	5.53±0.63	4.66±0.48	4.86±0.91	0.004	0.034	0.718
6 months	6.80±0.77	5.73±0.79	5.33±0.61	0.001	<0.001	0.305
9 months	6.93±0.88	6.13±0.83	5.33±0.61	0.021	<0.001	0.021

SD: Standard deviation, RVG: Radiovisiography

Table 3: Comparison of mean bone height in millimeters (mm) among the three groups (measured using RVG with grid)

Measurement (mm)	Bone height			*P*-value		
	Group A	Group B	Group C	Group A versus Group B	Group A versus Group C	Group B versus Group C
	Mean±SD	Mean±SD	Mean±SD			
Baseline	9.06±0.79	9.20±1.26	9.80±0.77	-	-	-
3 months	3.73±1.09	4.60±0.91	4.33±0.61	0.030	0.172	0.697
6 months	6.46±0.51	5.60±0.98	4.60±0.82	0.014	<0.001	0.004
9 months	6.53±0.63	5.66±0.97	4.93±0.96	0.025	<0.001	0.067

SD: Standard deviation, RVG: Radiovisiography

4.60 ± 0.91. There was a statistically significant difference seen between baseline and 3 months score ($P < 0.001$). At 6 months it was 5.60 ± 0.98. This was significantly higher than at 3 months ($P = 0.001$). At 9 months, the mean bone height was 5.66 ± 0.97. There was no significant difference between the scores at 9 months and 6 months ($P = 0.334$). The mean bone height of Group C at baseline was 9.80 ± 0.77. At 3 months it was 4.33 ± 0.61. Statistically significant difference was seen between baseline and 3 months ($P < 0.001$). At 6 months it was 4.60 ± 0.82. This was not significantly higher than the mean bone height at 3 months ($P = 0.104$). At 9 months, the mean bone height was 4.93 ± 0.96. No significant difference was seen between 9 months and 6 months score.

DISCUSSION

The primary aim of this study was to assess whether the use of a ridge preservation technique significantly minimizes alveolar ridge resorption following tooth extraction on the basis of radiographic and clinical parameters. It is well documented that avulsed teeth that are implanted back into their sockets undergo firm reattachment to bone, which is formed directly on root dentin or cementum, leading to ankylosis.[11] An ankylosed root is continuously resorbed and replaced by bone, eventually resorbing the entire root, while the alveolar process is preserved during this period and later.[12-15] In the present study, the use of autogenous dentin as bone graft for socket preservation showed significant results ($P = 0.029$), this is also in agreement with another study that reported favorable wound healing with minimal complications and good bone support for the implants.[16] No implant was lost after 12 months of function following prosthetic rehabilitation. Another study[17] supported the present study of the use of autogenous dentin as bone graft in immediate extraction sockets for the ridge preservation, in this study, the patient was followed up till 2 years after grafting of the extraction sites. A study reported that FDBA as a bone graft material results in socket preservation

resulted about a 1 mm gain of ridge height, while extraction alone had a loss of about 1 mm in ridge height similar to our findings.[18] In the present study, the control group depicted bone loss buccolingually and coronoapically, statistically significant bone loss compared to the autogenous dentin group. This is also in agreement with another study,[19] which reported that after 180 days of healing, the healed ridge is a non-load carrying tissue with obviously no demand for mineralized tissue. In the present investigation, mucoperiosteal flap was not raised for tooth extraction. By elevating the periosteum, the blood supply of the exposed bone surface will be compromised, leading to osteoclastic activity and bone resorption. A recent study proved that connective tissue membrane could preserve socket width, amount of keratinized tissue, and the gingival level more effectively than DFDBA alone.[20] Another study conducted in 36 single-rooted extraction sockets with DFDBA alone (control) and DFDBA along with platelet-rich fibrin (PRF) (test group) concluding that PRF could be used as an adjunct along with DFDBA for socket preservation.[20,21] Two more studies reported that Wilderman[22] Moghaddas *et al.*[22,23] concluded that radiographs with a grid aids in increasing the accuracy of the linear measurements for the treatment planning which also helped in recording the bone fill at intervals of 3 months, 6 months, and 9 months, thus supporting the current study of use of dental grids as one of the way of standardizing the study. However, the findings from the present study show that it might be reasonable to use autogenous dentin as a bone graft for ridge preservation followed by DFDBA. These grafts have the potential to limit shrinkage occurring after tooth extraction.[24-26] Yet, the biologic process after tooth extraction cannot be altered. Hence, further longitudinal studies are required to evaluate the amount of bone loss after socket preservation and also evaluating histologically, the quality of bone formed with a surgical reentry at the time of implant placement.

CONCLUSION

It Can Be Concluded by the Present Study

The results of the grafted sites showed statistically significant difference compared to non-grafted sites. The present investigation shows that augmenting the extraction socket with biomaterials may have the possibility to limit the buccolingual and coronal apical shrinkage. Over the long term, complications such as loss of function and inadequate bone for the placement of dental implants can be prevented.

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How to cite this article: Jadhav ND, Vivekananda L, Kokane S. A Clinical and Radiographic Comparative Evaluation of Self-healing Extraction Socket versus Use of Autogenous Dentin and Demineralized Freeze-Dried Bone Allograft for Socket Preservation Following Tooth Extraction. Int J Sci Stud 2020;8(2):50-54.

Source of Support: Nil, **Conflicts of Interest:** None declared.