Research Article

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Grafting of Third Molar Extraction Socket with Bioactive Glass: Comparison with Control Site

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ABSTRACT

Aim: The present study was conducted with an objective to evaluate the ability of bioactive glass to enhance the rate of wound healing and to assess whether it is more predictable method of tissue regeneration in third molar extraction sockets.

Material and Method: 20 patients aged from 18-60 years of age who had similar bilaterally impacted third molars with no apparent systemic history were included. Clinical parameters included oral hygiene, eruption status, probing depth while radiographic parameters consisted of alveolar bone height and density which were assessed in 3rd and 6th postoperative month.

Results: The parameters assessed had shown an overall improvement over the postoperative follow up period but the results were statistically insignificant.

Conclusion: Individual recording suggest improved final outcome of the osseous defect distal to the second molar after extraction of the impacted third molar however a larger sample size with longer term of follow up may reinforce the findings of improved outcome.

Keywords: Bioactive glass, third molar, grafting, regeneration.

INTRODUCTION

Wisdom tooth extraction is a common procedure in Oral Surgery. The normal healing response to the procedure results in a significant loss of bone and collapse of the surrounding gingival tissue distal to second molar. In addition to normal healing, a substantial percentage of patients suffer postoperative complications.[1] A reduction of about 50% in both horizontal and vertical directions has been observed over 12 months, with two-thirds of the reduction occurring in the first 3 months. The rate and pattern of bone resorption may be altered if pathologic and traumatic processes have damaged one or more of the bony walls of the socket. In these circumstances, fibrous tissue will likely occupy part of the socket, preventing normal healing and osseous regeneration.[3] After extraction of mandibular wisdom teeth, a reported complication is development of the periodontal osseous defect on the adjacent second molar. Risk factors associated with bone loss after lower third molar extraction include age, preoperative bony defects, and resorption of the roots of the second molar.[6] Osseous defects distal to the second molar can also

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be result of the eruption pattern of the third molar.[2] As bone resorption occurs post extraction, regeneration may pose a therapeutic problem, the management is usually directed and is usually directed at periodontal maintenance of the area and the osseous defect created by surgical removal of third molar which may require augmentation[4].

Various investigators have used variety of material in grafting of third molar sockets. These include calcium phosphate (hydroxyapatite) [2], bioactive glass[2, 7, 10], demineralised bone powder [6], combination of bioactive glass with calcium phosphate membrane[7], demineralised freeze dried bone allograft [9], membranes, both resorbable and non resorbable.[11] Apart from these, Multiple sources of bone have been used to graft bony defects which include iliac crest, rib, cranial and vascularised bone grafts[6].

NOVABONE (NOVABONE Inc., USA) dental putty is a combination of osteocalciumphosphosilicate particulate and a synthetic absorbable binder which is composed of glycerine and polyethylene glycol. There have been number of studies on grafting of bioactive glass in extraction socket, but only few analyse its role in mandibular impacted third molar extraction socket. The purpose of this study is to evaluate the use of NOVABONE putty as a graft material for osseous fill as compared with non-grafted extraction site after removal of bilateral impacted mandibular third molars.

MATERIALS AND METHODS

This prospective study on 20 patients aged from 18-60 years of age was done to assess the efficacy of the bioactive glass (NOVABONE PUTTY-NOVABONE Inc. USA) in extraction socket of impacted third molars in Department of Oral and Maxillofacial Surgery, ITS Centre for Dental Studies & Research. A detailed history of all patients was taken according to the decided performa. All patients included had similar bilaterally impacted third molars who had agreed to sign an informed consent, reported unremarkable systemic history and no allergies towards the drugs to be used in the study.

Clinical parameters included oral hygiene, eruption status, and probing depth (PD). Oral hygiene was evaluated by using Oral Hygeine Index – Simplified by Greene and Vermilion in 1960 and the eruption status was assessed according to Winter's classification.

Probing depth (PD) was measured using UNC -15 probe (Fig. 1) from 'free gingival margin' to the bottom of the pocket in nearest mm. The probe tip was inserted into gingival sulcus parallel to the long axis of the tooth until slight resistance was met. The average of PD at the three different positions i.e. distobuccal, distal, distolingual surface of 2nd molar was taken preoperatively, 3rd and 6th month post operatively

Radiographic parameters included alveolar bone height (ABH) and alveolar bone density (BD). ABH which was measured using OPG of the patient in which a caliper was placed on to the crest of the alveolar bone up to the level of CEJ of the tooth. The distance was then measured on a graduated ruler and the recordings were recorded on pre operative, 3rd month and 6th month post operatively. BD was assessed using Adobe Photoshop CS3 software in which the area distal to the second molar on the OPG was localized using marquee tool and the density was assessed by Gray scale histogram[44] (Figure 3). The reading of the histogram is inversely proportional to the density of the gray in the particular localized area. OPG radiographs were taken preoperatively, 3rd and 6th post operative month in every case. Each OPG was photographed and fed in the software for evaluation of bone density of the bone near third molar on either side.

A third molar socket was then randomly assigned to receive the graft in each subject (Figure 2) while the other site did not receive any bone graft. All the patients underwent oral prophylaxis in the preoperative phase. All patients were prescribed postoperative antibiotics (Ampicillin 250 mg + Cloxacillin 250 mg and Metronidazole 400mg) and analgesics (Ibuprofen 325 mg + Paracetamol 400 mg). Patients were recalled on 3rd and 7th day postoperatively to assess the healing of the wound. Postoperative clinical evaluation included the measurement of the probing depth distal to the second molar at 3rd and 6th month post operatively using a UNC – 15 probe from CEJ to the base of the defect.

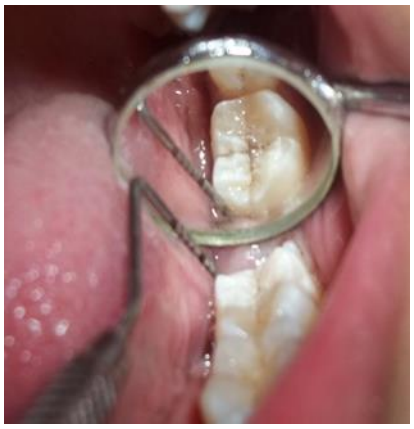

Fig 1: Measurement of probing depth using UNC – 15 probe on distolingual (DL) aspect of 2nd molar.

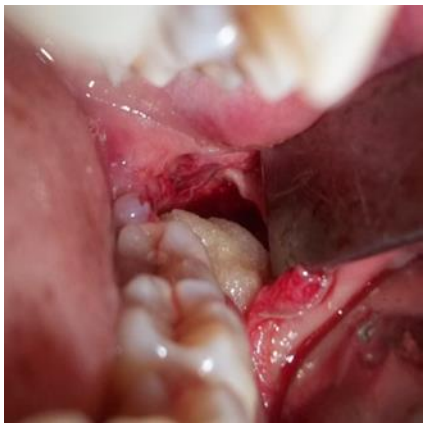

Fig 2: Graft placed in the socket.

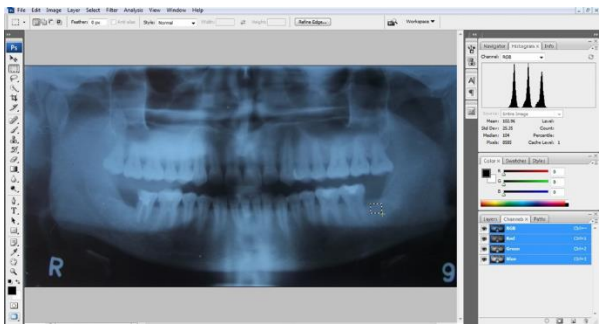

Fig 3: Assessment of bone density.

All measurements were taken by the same investigator to minimize measurement error. Clinical and radiographic pictures were taken using (KODAK C183 - 14 Mpx 32mm-96mm Optical Aspheric lens) camera with exposure time of 1/40 seconds, focal length of 6 mm and maximum aperture of 3.07.

OPG were taken from the same machine using same exposure time and potential difference for each radiograph at 3rd and 6th month post operatively to assess the alveolar bone height distal to second molar and the bone density. Each OPG was photographed using the above mentioned camera and fed in the computer software for evaluation of bone density of the extraction sockets on either side. Bone density was measured by mean gray scale histogram.

The outcome parameters were noted as changes in probing depth, alveolar bone level and bone density. The follow up was done at 3rd month, and 6th month post operatively for probing depth, alveolar bone height and bone density. Mean probing depth on preoperative measurement was 3.34±0.60 mm for control site. In the 3rd postoperative visit the mean probing depth was found to be 3.07 ± 0.59 mm showing an improvement of about 0.27 mm (8%). The same increased to 3.09 ± 0.50 mm showing worsening of 0.02 mm (0.61%) an overall improvement of 0.25 mm (7.4%).

Mean probing depth on preoperative measurement was found to be 3.34 ± 0.70 mm for grafted site. In the third postoperative month the mean probing depth was found to be 3.04 ± 0.51 mm showing improvement of about 0.3 mm (8%). The same decreased to 2.95 ± 0.58 mm showing overall improvement of 0.39 mm (11.6%). Mean difference in alveolar bone variation measured for control group was 2.60 ± 1.82 mm, which had reduced to 1.82 ± 1.10 mm at third postoperative month showing a decrease of almost 0.78 mm. The reading showed further decrease to 1.77 ± 0.99 mm showing a decrease of 0.05 mm. The overall decrease for the control group was about 0.83 mm which indicates an increase in 0.83 mm of alveolar bone height from the basal bone.

Mean alveolar bone height measured for grafted site was 3.00 ± 2.20 mm, which had reduced to 2.11 ± 1.45 mm at third postoperative month showing a decrease of almost 0.89 mm. The reading showed further decrease to 1.90 ± 1.17 mm showing a decrease of 0.21 mm. The overall decrease for the grafted site was about 1.1 mm. This indicates an increase of alveolar bone height of 1.1 mm from the basal bone. On comparison between the groups, at the end of 6th month the mean alveolar bone height was reduced by 0.83 mm in

Table 1: Assessment of Probing Depth (PD) using Independent Samples Student t-Test.

	Groups	Number	Mean± S. D.	T-value	P-value
Pre-Operative Probing Depth	Grafted site	20	3.34 ± 0.70	0.00	1.000
	Non-grafted site	20	3.34 ± 0.60		
3Months Probing Depth	Grafted site	20	3.04 ± 0.51	-0.18	0.860
	Non-grafted site	20	3.07 ± 0.59		
6Months Probing Depth	Grafted site	20	2.95 ± 0.58	-0.84	0.404
	Non-grafted site	20	3.09 ± 0.50		

Table 2: Assessment of Alveolar Bone Height (ABH) Using Independent Student t Test.

	Groups	Number	Mean ± S. D.	t-value	p-value
Pre-Operative Alveolar Bone Height	Grafted site	20	3.00 ± 2.20	0.63	0.535
	Non-grafted site	20	2.60 ± 1.82		
3Months Alveolar Bone Height	Grafted site	20	2.11 ± 1.45	0.68	0.500
	Non-grafted site	20	1.82 ± 1.10		
6Months Alveolar Bone Height	Grafted site	20	1.90 ± 1.17	0.40	0.695
	Non-grafted site	20	1.77 ± 0.99		

Table 3: Assessment of Bone Density (BD) Using Independent Student's t Test.

	Groups	Number	Mean ± S. D.	t-value	p-value
Pre-Operative Bone Density	Grafted site	20	128.82 ± 34.44	-0.35	0.727
	Non-grafted site	20	132.60± 33.60		
3Months Bone Density	Grafted site	20	127.16 ± 32.86	0.19	0.848
	Non-grafted site	20	125.22 ± 29.07		
6Months Bone Density	Grafted site	20	129.93 ± 28.13	0.31	0.757
	Non-grafted site	20	127.10 ± 29.24		

control site as compared to 1.1 mm in that of grafted site. However the p-value of 0.695 (p>0.05) was not found to be statistically significant.

The mean preoperative bone density for control site was 132.60 ± 33.60 which had reduced to 125.22 ± 29.07 at 3rd month follow-up depicted a decrease in mean density of about 7.8 (5.5%). It showed improvement in the values at the end of 6th postoperative month which was calculated to be 127.10 ± 29.24 measuring an increase of about 1.88 (1.5%). Bone density was found to be reduced at the end of 6th postoperative month and overall decrease of 5.5 (4%) when 6th postoperative month mean value was compared with mean preoperative value.

The mean preoperative bone density for grafted site was 128.82 ± 34.44 which had reduced to 127.16 ± 32.86 on the 3rd postoperative month showing a decrease in mean density of about 1.6 (1.2 %). It showed improvement in the values at the end of 6th postoperative month which was calculated to be 129.93 ± 28.13 measuring an increase of about 2.77 (2.1%). Bone density was found to be increased at the end of 6th postoperative month and overall increase of 1.11 (0.8%).

On comparison of both the groups the mean bone density had reduced in the control group by 4% while there was an increase of 0.8 % on the grafted site at the end of 6th postoperative month. The p-value of 0.757 (p> 0.05) was however not found to be statistically significant.

DISCUSSION

Novabone putty consists of Calcium Phosphosilicate (CPS) (55%), a smaller CPS particulate (14%), Polyethylene glycol (PEG) and Glycerine. CPS and its particulate counterpart are involved in formation of chemical bonds with living tissue, i.e. bioactive phase while addition of PEG helps in keeping the putty in smooth consistency and glycerine is added to keep the mass coherent. Both PEG and glycerine are water soluble and engineered to be resorbed from the site within 3-5 days. After placement of the graft an ion release mechanism is initiated in which the calcium and silica ions leach out and initiate a cascade of events responsible for signalling and recruiting undifferentiated cells to the site. The leaching out of additive and binder leaves a porous scaffold within 24-48 hours which is critical for the blood and tissue fluids movements. The smaller putty particle react with blood providing initial burst of calcium and eventually forming small nodules of calcium phosphate which mature into bone at various sites. The larger particles react and are responsible for maturation of osteocytes into osteoblasts and subsequently bone regeneration starts.

The effect of impacted third molar extraction on periodontal pocket distal to the adjacent second molar has been investigated by several authors with conflicting results. Ash et al (1962)[41], Zeigler (1975)[42] and Kugelberg (1990)[12] have reported deepening of periodontal pockets but Szmyd and Hester (1963)[46] have reported decrease in the probing depth while Wong et al (2009)[38] reported no significant changes of periodontal pocket depth.

In our study, the preoperative probing depth on grafted site was 3.34 ±0.70 mm and control site was 3.34 ± 0.60 mm which had decreased to 2.95 ± 0.58 mm and 3.09 ± 0.50 mm in the grafted and control site respectively at the end of 6th month, indicating that the decrease in probing depth is more on the grafted site which is in agreement with findings by Throndson (2002)[2]. This also is similar with findings of Lovelace(1998)[9] et al who had reported a decrease of upto 3.1 ± 0.8 mm of probing depth in bone defects grafted with bioactive glass[9]. Although, there is an overall improvement of about 0.39 mm (11%) on the grafted site as compared to 0.25 mm (7%) of the control site of the probing depth, the p-value of 0.404 ($p>0.05$) for the same is statistically insignificant.

The effect of extraction of impacted third molar on the level of alveolar bone has been studied and it was found in the literature that response of alveolar bone was quite variable. While Wong et al (2009)[38] and Grondhal and Lekholm(1973)[45] demonstrated no changes at all in the level of the supporting bone distal to second molar, Zeigler (1975)[42] and Ash et al (1962)[41] have reported increase of alveolar bone height after the extraction of impacted third molars.

In the present study the preoperative difference in mean alveolar bone height as mentioned above was 3.00 ± 2.20 mm for the grafted site while it was 2.60 ± 1.82 mm for the control site. The mean alveolar bone height had decreased subsequently and final data collected was 1.90 ± 1.17 mm for the grafted site and 1.77 ± 0.99 mm in the control site at the end of 6 months. The grafted site had reported a decrease of 1.1 mm as compared to the loss of 0.89 mm in the control sites which indicates that there was increase of alveolar bone level with respect to basal bone by 1.1 mm on the grafted site as compared to 0.89 mm increase on the control site. This finding was comparable to study by Throndson[2] in which the preoperative alveolar bone height was 2.96 ± 0.89 in the grafted site which was measured to be 2.02 ± 0.37 mm at the end of 6 month while in the control site the height was 3.79 ± 1.67 mm which reduced to 3.04 ± 1.29 in the same time period. Lovelace et al[9] had also reported resorption of alveolar bone height by almost 0.53 ± 0.64 mm in the sites grafted with bioactive glass which was found to be statistically insignificant when compared to other graft material. Munhoz et al has reported significant decrease in the difference between the CEJ and the alveolar crest, but the difference between the control and the grafted group was not found to be statistically significant. The compaction of the inorganic nature of the graft into the internal bone can be pointed as a probable cause of delay in graft resorpetion[40]. In order to overcome this shortcoming, a newer version of bioactive glass that contains nano particles has been introduced which can undergo rapid resorption[29]. On the technical aspect, during the grafting of the socket, the socket was not

overfilled with the graft but rather limited to the height of the socket present after extraction.

The mean bone density of the grafted sites in our study was found to be comparable in the postoperative period to the preoperative readings. This finding is similar to that of Munhoz[40] who reported increase in the bone density in the grafted site in initial 6 months after graft placement.

The long term benefits of grafting of alloplastic material on bone density remains to be determined. However, though the values are not statistically significant, it may indicate that NOVABONE PUTTY might provide a better socket fill and a better quality bone in regeneration. Since it is known to 'osteostimulate', the bone is not only formed over the porous scaffold but the graft itself stimulates the expression of the genes responsible for osteoblast functions and further release of ions from the glass system reinforces the forming nodules which will form the future bone[10].

Grafting distal to 2nd molar after removal of the impacted mandibular third molar has shown potential in improving the late outcome of the surgical procedure. We believe that it offers better acceptability to the treatment in context to the patients as well as the surgeons.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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