International Journal of Clinical Oral and Maxillofacial Surgery
2015; 1(1): 4-10
Published online June 30, 2015 (http://www.sciencepublishinggroup.com/j/ijcoms)
doi: 10.11648/j.ijcoms.20150101.12

Management of Periodontal Defect after Mandibular Third Molar Extraction

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To cite this article:

Shadia Abdel-Hameed Elsayed, Abeer Saad Gawish, Amany Khalifa. Management of Periodontal Defect after Mandibular Third Molar Extraction. *International Journal of Clinical Oral and Maxillofacial Surgery*. Vol. 1, No. 1, 2015, pp. 4-10.
doi: 10.11648/j.ijcoms.20150101.12

Abstract: Objectives: 1) to compare the regeneration with and without applying nanohydroxyapetite (nHA) bone graft and to determine if there is a clinical potential benefits of nHA in the regeneration on postextraction alveolar bone healing of distal bone defects of mandibular 2nd molar, 2) to determine whether there are differences in postoperative clinical symptoms between the two groups. Study Design: a prospective, randomized controlled and double blinded study. The hypothesis is based on the extraction of impacted third molar in both groups by the same surgeon. A total of 50 patients were included in the present study, they were divided into two equal group. Group I treated by surgical extraction of impacted third molar with nHA on the socket, while Group II treated by surgical extraction of impacted third molar alone. Assessment of postoperative clinical symptoms (pain, swelling, trismus, infection), changes in probing depth and alveolar bone height and density at the distal second molar was done in both groups. Results: The highest acceleration in alveolar bone formation on the distal aspect of the adjacent second molar was observed on graft group. There were no statistically significant differences between groups regarding the clinical symptoms pain, swelling, trismus and infection. There was a significant reduction in probing pocket depth and increase in bone height and density at the end of study period in both groups. Conclusions: According to the results of the present study, the use of nanohydroxyapetite bone graft show improvement on height and density of alveolar bone and there was a significant reduction of the probing pocket depth. The clinical symptoms seems similar with non- significant differences between groups regarding pain, swelling, trismus and infection.

Keywords: Periodontal Defect, Mandibular Third Molar Extraction, Bone Graft, Nanohydroxyapetite

1. Introduction

One of the major periodontal complications after extraction of a deeply impacted lower third molar is bony defects on the distal root adjacent to the second molar [(1)]. Rehabilitation of periodontally compromised teeth is the main concern of periodontics [(2)]. Extraction of impacted third molars are a major problem in modern dentistry and of the most frequently treatment decisions faced by the dentist [(3, 4)].

Several conflicting data have been published regarding the effects of impacted third molar extraction on the periodontal health of the adjacent second molar; some studies have shown improvement of periodontal health distal to the adjacent second molar, however; others have demonstrated loss of attachment and reduction of alveolar bone height [(5, 6)].

The therapeutic approaches attempting to achieve periodontal regeneration include the use of different grafting materials (autogenous, allogeneic, xenogeneic and alloplastic grafts)[(7, 8)].

It is assumed that the use of materials would result both in the regrowth of alveolar bone and the formation of a new cementum layer with inserted collagen fibers onto the previously periodontally involved root surface [(9)]. The mechanism of action may be either via the stimulation of osteogenesis (new bone formation from the bone-forming cells contained in the graft), osteoconduction (when the graft serves as a scaffold for bone formation from the adjacent host bone), or osteoinduction (the matrix of the bone graft contains bone-inducing substances that result in bone formation in the surrounding tissues [(10)].

An ideal scaffold is a biocompatible material that provides appropriate mechanical support [11]. Hydroxyapatite (HA) is an alloplastic material, chemically similar to the inorganic component of bone matrix that translates these properties in a valuable and optimal biocompatibility [12].

Neo-osteogenesis has been stimulated when HA is grafted beneath a healthy periosteum and well-vascularized bone, it first becomes integrated by a clot [13,14] and the phosphate ions releases into the surrounding environment.

A fundamental factor governing optimal integration of HA with bone is the dimensions of the crystals. HA particles with dimensions closer to the size of natural crystals found in vertebrate hard tissues (i.e., ranging from 1 to 10 nm), are now available [15,16] and they have been reported to mimic the extracellular matrix of bone in size and structure [17-19].

Preliminary studies showed that nano-sized ceramics could be a promising class of bone substitutes, owing to their improved osseointegration properties [20]. New synthetic products with improved biological performance have been introduced to the market [21,22].

Our hypothesis is that the nanohydroxyapetite bone-graft substitute promotes bone regeneration in mandibular bone defect after surgical extraction third molar.

Objectives

To determine the role and usefulness of the nHA in mandibular regeneration compared to non-graft.

Therefore, the aim of this study was try to the answer of following questions:

- Are there differences in the bone formation in the postextraction socket among those grafted with nHA and controls (non-grafted)?
- Are there differences in the clinical inflammatory symptoms and postoperative pain, swelling, infectious events and trismus observed among grafted and non-grafted groups?

2. Patients and Methods

2.1. Study Population

This prospective, randomized, controlled and double blinded study was conducted on 50 patients in need of surgical extraction of impacted mandibular third molar.

The participants were selected from the outpatient clinic of the department of Oral and Maxillofacial surgery, Faculty of dental medicine-Girls' branch, Al Azhar University, Cairo, Egypt for surgical removal of impacted mandibular third molar. The study was carried out between September 2013 to January 2015 G. Each patient was informed of the objectives and nature of the study includes benefits and risks, and signed the informed consent to carry out the intervention and for inclusion in the study

Inclusion criteria: To carry the present study fifty patients with impacted lower third molar tooth have been selected for this study. This study was compiled with the Helsinki Declaration and was approved by the bioethics committee involving human subjects

2.2. Eligible Patients Fulfilled the Following Criteria

2.2.1. Inclusion Criteria

•Aged between 19 to 30 years old (25.5±2.3).

•Impacted mandibular third molar with a similar anatomical position, and similar surgical difficulty..

• No allergies to medicines prescribed in the postoperative period.

2.2.2. Exclusion Criteria

• The presence of uncontrolled diabetes, immune disease, or other contraindicating systemic conditions.

• Radiation therapy/Chemotherapy in the 12 month period earlier to the proposed therapy.

•Uncontrolled periodontal disease.

• Presence of any acute local infection.

• A smoker.

• Pregnant women, children, elderly ([60 years), physically and mentally challenged, terminally and seriously ill.

• An unwillingness to commit to a long-term post therapy maintenance program

2.2.3. Study Groups

The patients were distributed randomly into two equal groups. In group I (study group) consists of 10 males and 15 females were treated with nanohydroxyapetite bone graft group. Group II (control group) consists of 11males and 14 females.

2.2.4. Clinical Parameters

-Probing pocket depth was measured using graduated William's periodontal probe at the distal of lower second molar.

-Assessment of postoperative clinical symptoms (pain, swelling, trismus, infection) was done.

2.2.5. Radiographic Evaluation

All patients were subjected to radiographic examination by panoramic film to show: Number of roots, Direction of roots, Relation of root apices to inferior dental canal, Relation of the impacted tooth to the ramus and second molar, Density of bone, Classification of impaction, Pathosis related to the impacted tooth, and Presence of more than one impacted tooth to identify the degree of surgical difficulty.

Standardized digital periapical radiographs were used to measure the level of bone height and density distal to the second molar. The exposure parameters were fixed for all patients and over the follow –up period.

Radiographic measurements were assessed as follows; bone density (BD) was assessed using the DBS-Win 1.5 software, which is a part of the recently introduced vista scan system. The mean gray value in each region of interest was calculated (256 gray levels of colors resolution) by assigning the gray value (0) to black, and the value 256 to white. To measure bone density, linear density measurements were performed by drawing three lines parallel to the lower mandibular second molar. The line extended from the apex of the alveolar crest.

Three lines were drawn at one mm apart from each other. The grey level along each line was recorded at the beginning of the line, at the middle, and at the end. The average of the three readings was calculated to obtain the mean average density (grey level) along each line. Radiographic bone height was measured from the CEJ to the alveolar bone crest (Fig. 1).

All the clinical and radiographic data were taken at base line, 3 and 6 months after the surgical removal of impacted mandibular third molar. The measurement of bone neo-formation was performed.

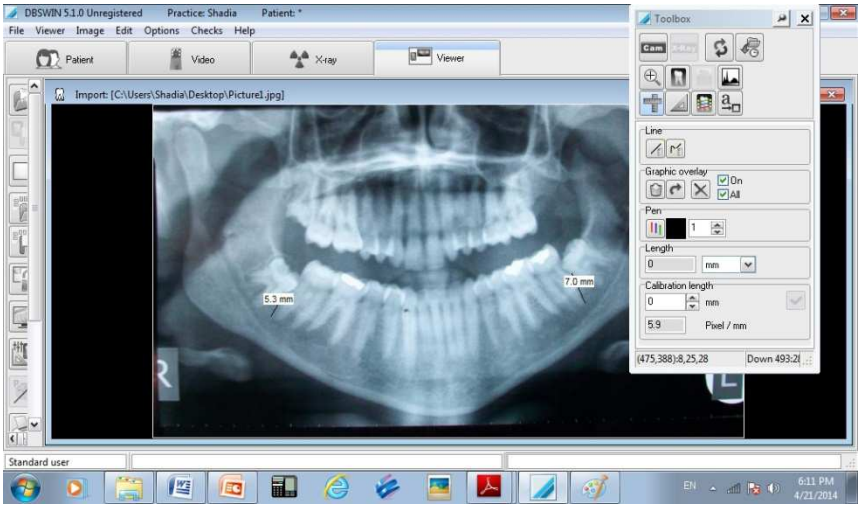

Figure 1. *Preoperative OPG of bilateral impacted lower wisdom.*

2.2.6. Randomized Procedure

All patients were randomly assigned by the study coordinator, using a coin toss, to receive one of the two treatments. They were either treated by surgical removal with nHA graft or without graft. The randomization process led to comparable mean values of all investigated clinical parameters in both groups.

2.2.7. Surgical Protocol

Extraction of the lower third molar was performed under local anesthesia by using 2% mepivacaine hydrochloride (Mepicaine 2%: by Alexandria Co. for pharmaceuticals, Egypt).local analgesic agent with 1: 20000 levonordefrin was used. The standardized pyramidal flap was performed as the incision was started just medial to the external oblique ridge at a distance of about 2cm from the distal wall of lower second molar. Then it was directed anteriorly in a diagonal direction with gingival tissues of lower second molar until it reached interdental papilla between lower first and lower second molar. Then the incision was extended down toward the mucobuccal fold at a 45 angle. By the use of mucoperiosteal elevator the flap was reflected buccally (Fig. 2and 3). Obstructing and covering bone was removed to minimize resistance and to gain access to the impacted tooth by surgical burs. Tooth division was performed according to the type of impaction. Tooth delivered by straight elevator or buccal applicator. The residual tooth follicle was excised after removal of impacted tooth. All foreign bodies, bone chips and tooth particles were removed by tissue forceps. Irrigation and suction were performed (Fig. 4). In group I, Nanohydroxyapetite bone graft (nHA) (Ostim1, Haraeus Kulzer, Hanau, Germany) was mixed with sterile saline and inserted into the socket and compressed without excessive force until the bony socket was completely filled (Fig. 5). Approximation and closure of the flap was performed by using 3-0 black silk. A sterile gauze pack was placed over the wound for 30 minutes. All surgical procedure was performed by the same surgeon who remind masked to treatment assignment. All patients were asked to stay in outpatient clinic for the immediate postoperative six hours, during which the following was done: haemostatic measures by pressure pack, intermittent cold applications and also for collection of samples. The patient was dismissed after informed him to complete the regimen of cold application for the next 12 hours. Intermittent warm intraoral saline fomentations were carried out for the next 24 hours. Clindamycin 300mg was taken orally every 8 hours for 6 days and Ibuprofen 400mg/5mg, (Kahira/Abott.) four times daily. The patients were informed to return again for removal of sutures on the seventh day post operatively.

Figure 2. *pyramidal incision .*

Figure 3. *flap reflection.*

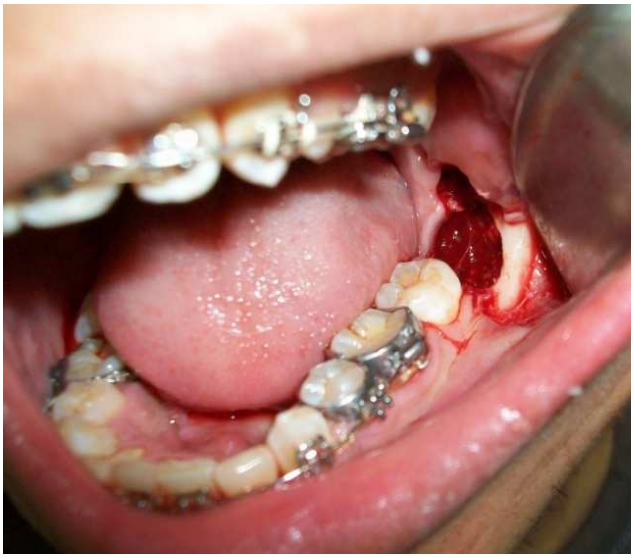

Figure 4. *bony defect after removal of wisdom.*

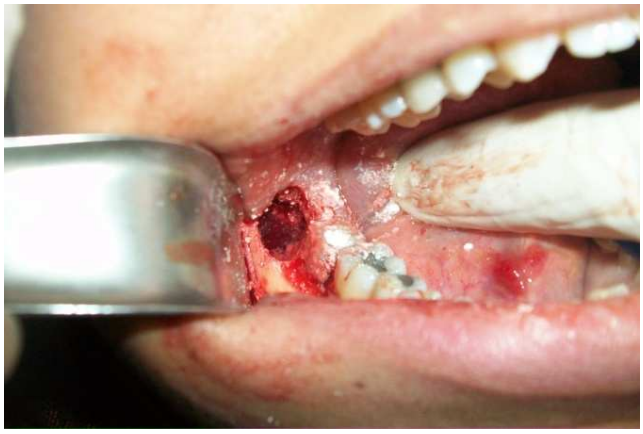

Figure 5. *socket filled with nHA bone graft.*

2.2.8. Monitoring and Variables

The studied predictor variables were age, sex of the patient, difficulty of intervention (easy, intermediate or high difficulty, assessed in terms of surgical time by an experienced surgeon).

2.2.9. Postsurgical Evaluation

Several response variables on the post-operative evolution in two ways had been assessed. A questionnaire for each patient had been completed daily throughout the first postoperative week. This questionnaire assessed pain (using two methods: an analog pain scale from 1 to 10 points, and the number of analgesics to control pain consumed on each of the first 7 postoperative days) as well as the number of days that passed until the restart of a normal diet. On the other hand, a single clinical observer performed a clinical assessment in the 7th day postoperative.

The observer assessed the inflamed side, decreased mouth opening measured in mm compared to that observed at the time of the intervention, and the occurrence of infectious events. This clinical observer was blinded for whether or not socket grafting was performed. In this appointment, the questionnaire mentioned above was collected.

2.2.10. Statistical Methods

The results of the study were tabulated by using statistical program for social science version 14 has been used for data analysis. The description of data was done in form of mean (+/-) SD. By using one way ANOVA test. P-value ≤ 0.05 was considered statistically significant. Student's t-test for paired observations was used in order to examine the statistical significance of the difference Probing pocket depth, alveolar bone height and density pre- and post-operatively on both groups.

3. Results

95% of our patients were females with age range between 19 and 22 years old. The cause of impacted eight removal was pain in 75% of cases followed by caries in 15% and orthodontic purpose in 10 % of the cases. 77% of the impaction was mesioangular and 13% was horizontal followed by 10% was vertical type.

In all cases the operative time was ranged from 20 to 40minute (45±3). Postoperative course throughout the study period was uneventful. The clinical undesirable postoperative sequelae were limited to minimal edema, limitation in mouth opening and mild pain in ten patients which was completely resolved on the seventh day postoperatively.

All extraction sockets healed uneventfully. No infections were observed during the study period. There were no hemorrhage and no damage to surrounding structures intraoperatively in both groups. No incidence of infection, paraesthesia or altered of nerve sensation, alveolar ostitis for any patient in either group postoperatively.

Table (1). *bone height at distal side of lower second molar in group I.*

	Preoperative	3month Postoperative	6month postoperative
Mean	7.04	8.20	8.28
SD	2.09	2.59	1.72
Min	4.5	5.3	6.3
Max	10.2	12.4	11
T test	Pre VS 3 months 0.036	Pre VS 6 months 0.014	3 months VS 6 months 0.852

Table (2). *bone height at distal side of lower second molar in group II.*

	Preoperative	3month postoperative	6month postoperative
Mean	9.58	9.66	9.50
SD	2.07	1.89	1.71
Min	7	7.6	7.7
Max	12	12.2	11.9
T test	Pre VS 3 months 0.675	Pre VS 6 months 0.782	3 months Vs 6 months 0.212

p value (comparison between groups) : 0.089 0.3404 0.2925

There was a significant difference in the measuring of distal side bone height of lower second molar at the 3 and 6 months' time intervals in the group I (p = 0.036, 0.014) which was higher than the group II which reveal non-significant difference at the same time intervals (p= . 0.675, 0.782). However there was a non-significant statistical difference in the measuring of distal side bone height of lower second molar at all postoperative time intervals between both groups (table 1,2) .

Table (3). *bone density at distal side of lower second molar in group I.*

	Pre	3 Months	6 Months
Mean	109.33	147.89	153.75
SD	32.69	24.63	26.78
Min	45	100	103
Max	170	176	186
T test	Pre VS 3 months 0.035	Pre VS 6 months 0.010	3 months Vs 6 months 0.590

Table (4). *bone density at distal side of lower second molar in group II.*

	Pre	3 Months	6 Months
Mean	93.91	139.91	157.70
SD	16.98	17.81	13.54
Min	62	109	135
Max	116	167	177
T test	Pre VS 3 months 0.000	Pre VS 6 months 0.000	3 months Vs 6 months 0.003

p value (comparison between groups : 0.2254 0.4294 0.7119

From the result of bone density statistics, there was a significant intragroup difference at 3, 6 time intervals in both groups although group I showed a higher bone density than group 2. However at the end of the study period the statistical analysis showed a non-significant inter group differences (table3.4), (Fig. 6).

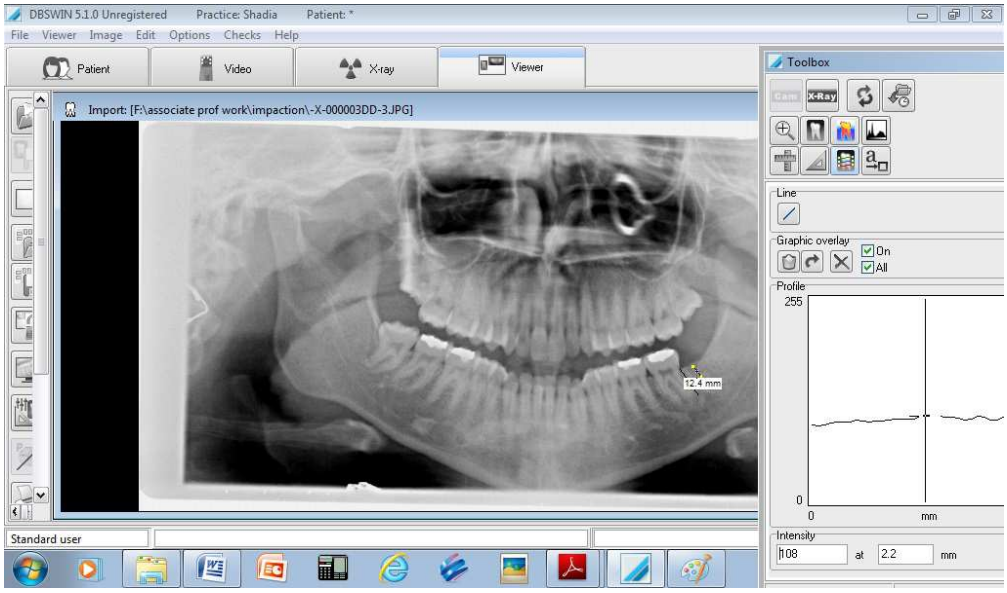

Figure 6. *Postoperative OPG bone height after the surgical removal of impacted lower wisdom in group I.*

Table (5). *probing pocket depth at distal side of lower second molar in both groups.*

	Probing depth		1month		3month		6month	
Group	I	II	I	II	I	II	I	II
Mean	7.14	7.29	5.14	6.29	3.71	4.57	2.57	3.57
SD	1.07	1.25	0.90	0.76	0.76	0.53	0.53	0.53
Min	6	5	4	5	3	4	2	3
Max	9	9	7	7	5	5	3	4

There was a significant difference in the reduction of probing pocket depth at the 3 and 6 months' time intervals in the group I which was higher than the group II which reveal non-significant reduction of probing pocket depth at the same time intervals. However there was a non-significant statistical difference in of probing pocket depth reduction at all postoperative time intervals between both groups (table. 5)

4. Discussion

The surgical removal of impacted third molar may be associated with several postoperative complications; these complications are more common in the mandible than in the maxilla; they may include bleeding, dry socket, nerve injury, delayed healing, periodontal pocketing, and infection [(23)].

Periodontal affection of distal aspect of lower 2nd molar is a common complication after surgical extraction of impacted lower 3rd molar [24,25].

Along with the increase in the incidence of third molar impaction in humans, the number of patients facing complications related to surgical removal of this impacted tooth is growing. One complication is periodontal problems [26]. The extraction of wisdom tooth could lead to significant changes in periodontal condition in distal surface of adjacent second molar tooth. This is in contrast to the results of the present study [27]. However, Eshghpour et al reported no significant difference in bone level at the distal part of second molar tooth, which is in accordance with our findings. They reported the results of a 6-month follow-up[28].

There exists conflicting results in previous reports. Peng et al compared periodontal status of second molar teeth adjacent to the extracted wisdom tooth with the other side second molar. They performed a retrospective study on 57 cases that had their teeth removed at least 5 years before the study. They observed a significant loss in attachment level and bone height in addition to the increased probing depth of experimental sides [29].

This study was a prospective study in which the periodontal parameters of adjacent second molar tooth 6 months after surgery were compared to the baseline values of the same tooth. According to this difference in study design, the results of the current study are more valid than mentioned retrospective studies [26,29].

Richardson and Dodson performed a review over the effect of removal of wisdom tooth on periodontium of adjacent second molar tooth. They only included prospective RCT studies with more than 6 months follow-up. They included eight studies and concluded that surgical extraction of impacted wisdom tooth had insignificant effect on probing depth and attachment level in distal surface of second molar tooth; the conclusion which is in accordance with the results of the current study [30].

According to the results of the current study, in the follow-up session, probing depth (PD) was higher than baseline and there was an increase in bone height and density but these changes were not statistically significant.

In the present study we didn't observe further acceleration in bone formation at 6 months, either in cases in which nHA was used nor in those cases where no graft was used; we didn't find significant differences between both treatment modalities.

Although the clinical results showed significant difference in probing depth reduction, increase bone density and height between the baseline and at the end of study period the good reaction to the graft with no signs of inflammation or infection at all with nHA make it superior than other types of traditional bone graft. However; there was a non-significant difference between two treatment modalities at the end of the study period.

From the result of the present study we can conclude that nHA bone graft give good clinical and radiographic results in managing distal bone defect of mandibular 2nd molar after impaction removal but with statistically non-significant difference with non-grafted group. So it could be recommended in special cases as deep impaction or position C and not in all ordinary cases.

Recommendations

A further investigation with long follow up period is recommended.

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