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IMMEDIATE IMPLANT PLACEMENT WITH CARBONATED NANOHYDROXY APATITE

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ABSTRACT

Immediate implant considered the ideal solution in cases of loss of an individual tooth or teeth, to preserve the esthetic as well as to prevent ridge resorption. Uses of immediate implant in esthetic zone faced some problems as narrow ridge and labial bone dehiscence so, uses of nanohydroxy appetite bone substitute considered good choice to solve these problems especially during implant installation. These article presents to patients obtains the immediate implant with nanohydroxy appetite bone substitute around the implant and showing good results with decrease of osteointegration period. By x-ray evaluation, there is significant decrease in crestal bone loss as well as good healing period. Also, by clinical evaluation shows good aesthetics with predominant natural appearance.

This study aims to evaluate effect of immediate implant installation (frontier GMI) with carbonated nanohydroxy apatite bone substitutes for preservation of alveolar bone. So, this study is planned to assess efficacy of carbonated nanohydroxy apatite bone substitutes for preservation of alveolar bone and to assess the changes in the soft tissue profile after immediate dental implant placement with carbonated nanohydroxy apatite bone substitutes. For this purpose;ten implants were placed in ten patients each one receives one implant. The patients were 6 males and 4 females ranged in ages from 25 to 40 years. All the implants were placed in maxilla. Observations were made postoperatively at time of implant placement then after 1 month, 3 months and 6 months follow up periods for pain, crestal bone loss, stability, papillae height and mean probing depth.

Descriptive statistics of pain score results as function of investigation time was found that the pain score at baseline recorded the worst mean value (3.7) with minimum value (2) and maximum value (6), after 1 month the mean of pain score was (5) with minimum value (3) and maximum value (7), after 3 months the mean of pain score was (6.5) with minimum value (5) and a maximum value (8) while after 6 months the mean of pain score recorded the best mean value (8) with minimum value (7) and maximum value (9).Pair-wise Tukey's post-hoc test showed non-significant ($p>0.05$) difference between (baseline and 1 month), (1 month and 3 months) and (3months and 6 months).

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INTRODUCTION

Immediate implant placement, defined as the placement of dental implant immediately into fresh extraction socket after tooth extraction, has been considered a predictable and acceptable procedure.[1] In addition, with immediate implant placement there is minimal use of surgical drills because the socket is already found except for slight increase of the socket length in an attempt to improve primary stability.[2]

Dental implant treatment has revolutionized oral rehabilitation in partially and fully edentulous patients. When the concept of osseointegration was introduced in 1977 by **Brånemark** [3] in relation to titanium endosseous implants, it became possible to achieve high success rates in association with this treatment modality, and multiple investigations have demonstrated an excellent long-term prognosis [4] .

Initially, dental implants were mainly used for anchorage of a removable full prosthesis in totally edentulous jaws [5], but later on, also partially edentulous patients were treated successfully with either removable dentures or fixed bridges [6].

The indication for implant treatment has been gradually extended, and today an implant-retained single-crown is a well-established option for replacement of a missing tooth [7].

Osseointegration or osteointegration refers to a direct bone-metal interface without interposition of non-bone tissue. This concept has been described by Branemark, as consisting of a highly differentiated tissue making "a direct structural and functional connection between ordered, living bone and the surface of a load-carrying implant".[8]

Osseointegration was first observed by Beaton, and Davenport in 1940 [9,10] , were the first researchers to implant titanium in an animal and remarked how it had the tendency to fuse with bone. They reported that due to the elemental nature of the titanium, its strength and its hardness had great potential to be used as future prosthesis material

Nano-hydroxyapatite

Although numerous studies attempted to shorten dental implant osseointegration time and to increase the osseointegration quality utilizing different methods as autognous bone graft and low intensity pulsed ultrasounds but the use of nanohydroxy apatite crystals is conceders the best choice To better mimic the mineral component and the microstructure of natural bone, novel nano-hydroxyapatite (NHAP)/ polymer composite scaffolds with high porosity and well-controlled pore architectures were prepared using thermally induced phase separation (TIPS) techniques [II] .

The introduction of HAP greatly increased the mechanical properties and improved the protein adsorption capacity. In a dioxane/water mixture solvent system, NHAP-incorporated poly (l-lactic acid) (PLLA) scaffolds developed a fibrous morphology which in turn increased the protein adsorption three fold over non fibrous scaffolds. The results suggest that the newly developed NHAP/polymer composite scaffolds may serve as an excellent 3D substrate for cell attachment and migration in bone tissue engineering. [12]

PATIENTS AND METHODS

The present study was performed on ten patients with teeth indicated for extraction in aesthetic zone were selected from those who attended the outpatient clinics of Oral and Maxillofacial Surgery Department, Faculty of dental medicine AL-Azhar University in Cairo (Boys)

Preoperative preparation:

All patients were prepared for surgery by the same protocol follow:

1) Clinical evaluation:

Intraoral and extra oral examinations were carried; hard and soft tissue structures were evaluated as to both quality and quantity.

2) study cast:

Will be performed to make a bite registration for every patient throughout the study period.

3) Radiographic evaluation:

- Periapical x-ray and Panoramic x-ray will be performed before extraction to detect bone level, and presence of any pathological lesions implant site.
- Cone Beam Computed tomography **Fig (3)**

Bone Grafting:

A buccal dehiscence defect at the most coronal aspect of the implant exposing a few threads of the implant was noted. After decorticating the labial bone with hand instruments, (the Nano hydroxyapatite bone graft/ NHAP) mixed with blood from the recipient site was placed covering the dehiscence.

Socket preparation

Clinical depth assessment done by depth gauge or periodontal probe to get sure about the radiographic measurement.

Preparation of the socket by single drill was 2.8 mm in diameter and the pilot hole was only drilled to half or less of the implant length to be used, depending on bone quality.

Fig. (1) Preoperative Photograph of tooth to be extracted

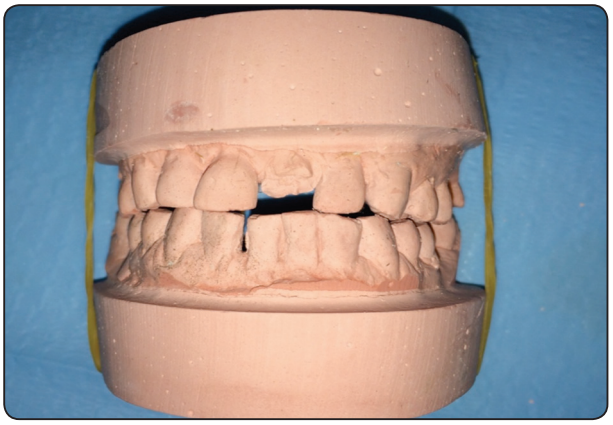

Fig. (2) Preoperative Study cast of case 1

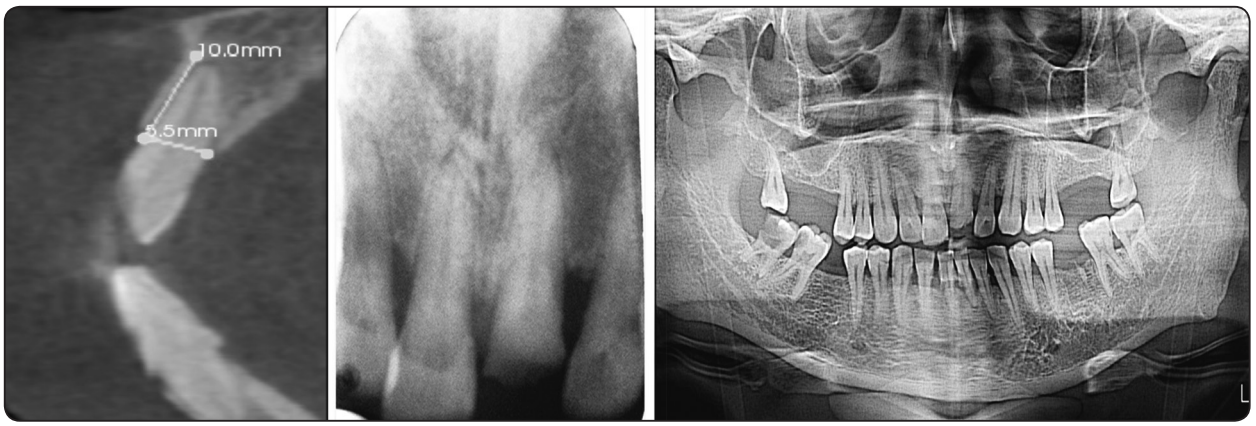

Fig. (3) preoperative periapical x-ray , panoramic x-ray and cone beam computed tomography for case 1

Fig. (4) Nanohydroxy apatite bone substitutes

Drilling has been extended 2-3 mm apically beyond the apex of the root or to base of the socket to gain primary stability for the implant from the apical bone.

The drilling should be deviated bodily toward the palatal side along the drill to preserve the buccal plate of bone and to meet the prosthetic requirements.

The motion of the drilling was in up and down motion to avoid necrosis of the bone from the heat generation.

Implant Installation:

After the socket has been prepared and ready to receive the implant, the packet of implant has been opened by assistant and placed on the bracket table on sterile gauze. The implant has been picked up by implant mountain kit which was attached to finger driver by operator hand.

A 3.75 mm implant diameter with length 13 mm was initiated into the site and placed first with titanium finger driver and then with a winged driver according to the manufactures protocol.

The finger driver has been replaced by wrench ratchet was used only for the final few turns when resistance increased which exert more force to seat the implant in place to full length

Periapical:

Peri-implant marginal bone levels were measured by standardized intraoral periapical radiographs at baseline, 1, 3 and 6 months after the operation. Reference points for the liner measurements were the most coronal margin of the implant collar in relation to the most coronal point of bone to implant contact .

Statistical Methods

Data were collected in a master sheet, coded, entered and analyzed using EPI-INFO**.** Data were presented as Mean ± Standard deviation for quantitative variables & number and percentage for qualitative variables.

Fig. (5) Implant installation in the prepared socket

Fig (6) Nano hydroxyapatite bone graft/ NHAP cover the implant

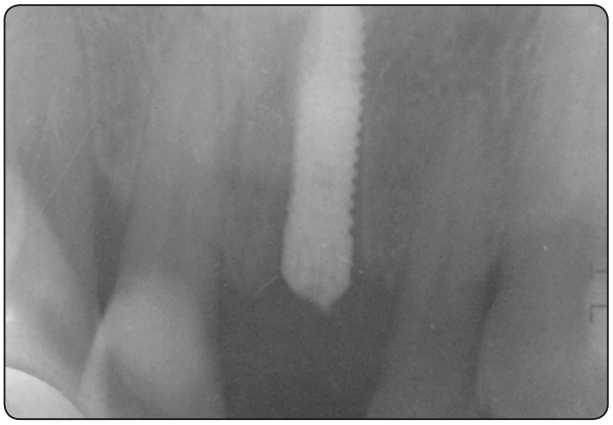

Fig. (7): Postoperative photograph after 3 months.

Fig. (8): Postoperative photograph after 3 months.

1) Descriptive statistics

❖ *Arithmetic mean:* as an average describing the central tendency of observations.

Mean

Where: $\sum X$ = sum of individual data, n = number of individuals $\left(\bar{X}\right) = \frac{\sum X}{n}$

❖ *Standard deviation:* as a measure of the dispersion of the results around the mean.

Standard deviation (SD = $\sqrt{\frac{\sum\left(\bar{X} - X\right)^2}{n-1}}$

2) Analytical analysis:

Data analysis was performed in several steps. Initially, descriptive statistics for each case results. One way ANOVA followed by pair-wise Tukey post-hoc tests were performed to detect significance between preparation cases. Statistical analysis was performed using Graph-pad prism-4 statistics software for windows. P values < 0.01 are considered to be statistically Highly Significant in all tests.

❖ *Chi-square c^2 test:*

It is a test for significance for the difference between more than two proportions i.e., to assess whether the observed frequency (O) of an event departs significantly from that expected (E) on the basis of the null hypothesis. It can be calculated from the following equation:

$$\frac{\sum(O-E)^2}{E}$$

Where: O = observed value.

E = expected value.

Expected value was calculated as follows:

$$E = \frac{(\text{row total})(\text{column total})}{\text{Grand total}}$$

Level of significance:

For all above mentioned tests done, the threshold of significance was fixed as 5% level student t-test (t) and the probability (*P* value):

- P value of > 0.05 indicates non-significant results.
- P value of < 0.05 indicates significant results.
- P value of < 0.01 indicates highly significant results.
- P value of < 0.001 indicates very highly significant results.

Final results were collected and tabulated and then comparison with correlation with each other was performed.

RESULTS

The present study was done to evaluate the immediate placement of implant into freshly extracted tooth socket with carbonated nanohydroxy apatite bone substitute in esthetic zone.

Ten implants were placed in ten patients each one receives one implant. The patients were 6 males and 4 females ranged in ages from 25 to 40 years. All the implants were placed in maxilla. Observations were made postoperatively at time of implant placement then after 1 month, 3 months and 6 months follow up periods for pain, crestal bone loss, stability, papillae height and mean probing depth.

Crystal bone loss

TABLE (1) Descriptive Statistics for crystal bone loss results as a function of investigation time

	No.	Mean	SD	SE	95% Confidence Interval for Mean		Range	
					Lower Bound	Upper Bound	Min	Max
Base Line	10	0.000^{A}	0.000	0.000	0.000	0.000	0.00	0.00
After 1 month	10	0.331^{B}	0.152	0.048	0.222	0.439	0.10	0.51
After 3 months	10	0.417^{B}	0.151	0.048	0.309	0.525	0.17	0.66
After 6 months	10	0.457^{B}	0.137	0.043	0.359	0.555	0.27	0.70

Implant stability

TABLE (2) Descriptive Statistics for implant stability results as a function of investigation time

	No.	Mean	SD	SE	95% Confidence Interval for Mean		Range	
					Lower Bound	Upper Bound	Min	Max
Base Line	10	23.271^{A}	5.463	1.728	19.363	27.179	16.26	30.84
After 1 month	10	11.708^{B}	3.068	0.970	9.513	13.903	6.59	15.51
After 3 months	10	2.987^{C}	1.565	0.495	1.868	4.107	0.68	5.22
After 6 months	10	-2.000^{D}	0.817	0.259	-2.585	-1.415	-3.19	-0.91

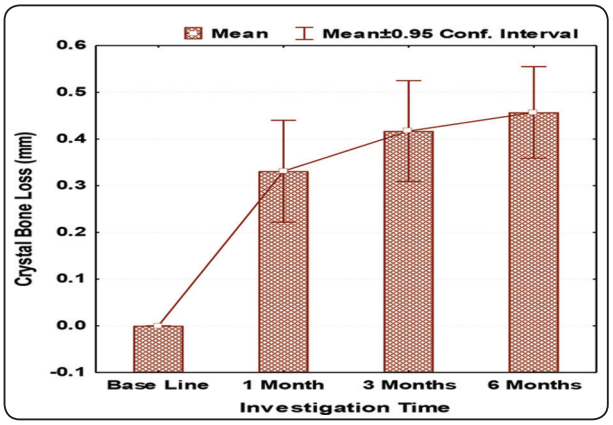

Fig. (9): Column chart with trend line showing crystal bone loss mean values at different investigation time.

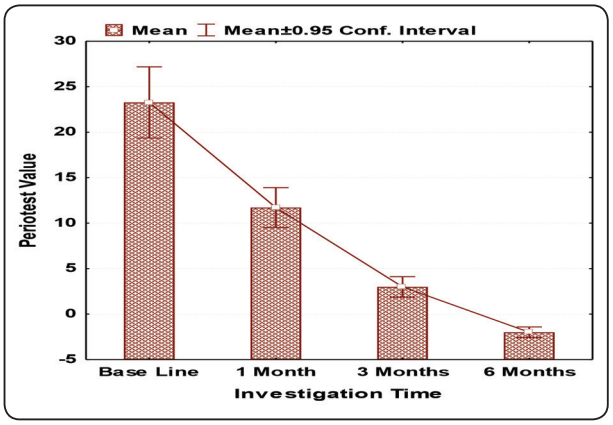

Fig. (10): Column chart with trend line showing implant stability mean values at different investigation time.

DISCUSSION

Hydroxyapatite is the main constituent of the dental tissues representing in enamel and dentine the 95wt% and 75wt%, respectively [13].

The primary determinant of dissolution rate is the solubility of hydroxyapatite (HA) which is related to pH, and the presence of salivary pellicle also appears to be important [14].

Frequent application of a high concentration of topical fluoride may be of some benefit in preventing further demineralization and increasing the abrasion resistance of erosive lesions [15].

In vitro studies have shown that synthetic carbonated hydroxyapatite dissolution inhibition is a logarithmic function of the fluoride concentration in solution [15].

Hydroxyapatite has been widely subjected to experiment as bone filler and prosthetic coating due to its biocompatibility and osteoconductivity, representing an elective material covering a wide range of applications for bone substitution and interface [16].

Nano-hydroxyapatite (n-HAp) is considered one of the most biocompatible and bioactive materials, and has gained wide acceptance in medicine and dentistry in recent years [17]. Whilst former attempts to use hydroxyapatites clinically did not succeed, synthesis of nano-scaled zinc carbonate hydroxyapatite (ZnCO3/n-HAp) yielded a significant progress, and showed considerable affinity to the enamel surface [13]. Nano-sized particles have similarity to the apatite crystals of tooth enamel in morphology and crystal structure [18].

CONCLUSION

Based on the result of this study we concluded that:

1. Nanohydroxy apatite gives a good result as a graft material with immediate implant specially in cases of buccal bone dehesnice
2. Nanohydroxy apatite composite gives a suitable scaffold for bone healing while maintain high porosity, suitable microarchiticture and minimize the crestal bone loss

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