10.21608/ADJC.2023.215508.1331 Advanced Dental Journal
Volume 6 (2024) | Issue 1| Pages 104-110

Original Article

Assessment of Marginal Bone Loss of Early Loaded Nano Coated Hydroxyapatite Implants in Posterior Maxilla

Ola Abdelsamad Amen[1], Ingy Mohamed Shehata[1], Heba M. Kamel[2], Nader Nabil Elbokle[12]
[1]Oral and Maxillofacial surgery department, Faculty of Dentistry, MSA university
[2]Oral and Maxillofacial surgery department, Faculty of Dentistry, Cairo university

Email:olaamen793@gmail.com

Submitted: 4-6-2023
Accepted: 13-8-2023

Abstract

Aim: The aim of the study was to access marginal bone loss after early loading of nano coated hydroxyapatite implants in posterior maxilla.
Methodology: This study was conducted on nine patients with at least a missing one maxillary posterior tooth. Ten Nano-coated hydroxyapatite implants (ETIII NH implant by Hiossen) were inserted in nine patients, and then marginal bone height was measured at 4 weeks (H0) which was the time of implant loading, and 4 month (H1) post-operatively by CBCT. Cone-beam computed tomography (CBCT) was performed in all patients before starting the treatment to determine wither the patient is eligible for implant placement or not. 9 implants healed well except for one implant that failed due to infection.
Results: There was no effect on implant's marginal bone, the difference between marginal bone level at H0 and H1 was non-significant, (P value 0.45).
Conclusion: Nano-coated hydroxyapatite implants maintained marginal bone height at 4 months (No bone loss).

Keywords: Dental Implants, Implant stability, Implants surface treatment, Implants surface coating

Introduction

In the restoration of totally and partially edentulous arches, dental implants are currently one of the most popular treatment modalities. With a primary focus on the maintenance of the alveolar bone and aesthetics as well as longevity of the prosthesis as a major concern, therapy with implants promised with considerably better results as compared to treatment with traditional denture. Through a process called osseointegration, dental titanium implants have the capacity to become anchored to the alveolar bone. The process of osseointegration is greatly influenced by a number of variables, for example the implant's surface topography and length. The titanium dental implant's osseointegration can be improved in a variety of ways by altering the surface of the titanium dental implant. Different surface treatments or modifications, including physical, chemical, and mechanical ones, can be done in titanium dental implants. (Sehrawat et al., 2021)

Dental implants surface coating techniques contribute to important positive effects on implant's stability and osseointegration. One common method of surface treatment is blasting, which can quickly roughen an implant's surface but falls short when it comes to critical factors including bone implant contact, removal torque values, tissue response, and biocompatibility. On the other hand, the ion implantation method is useful for hardening the titanium's surface but is not appropriate for dental implants. (Jemat et al., 2015)

Up till now, ceramic coatings (calcium phosphate (CaP), Hydroxyapatite (HAP), and Titanium oxide (TiO2) still remain the most popular bioceramic materials in the surface treatments area. Nevertheless, HAP is recognized as the best choice in bioceramics compared to TiO2. (He et al., 2009)

Numerous studies have been conducted on coatings made of CaP, such as HAP. The literature has reported a variety of methods, each of which causes a distinctive reaction in the bone. These methods include plasma spraying, electrochemical deposition, biomimetic deposition, and nanospray deposition. Nanoscale alteration of implant surfaces was proven by studies to enhance the biomimicry of dental implants due to the interaction of extracellular matrix proteins, growth factors, and many osteogenic potential cells at this scale. It's interesting to note that the possibility of improving osseointegration has been studied by applying nanostructured CaP to implant surfaces. It has been noted that electro-polished surfaces with nanometer-sized HAP coatings can increase bone-to-implant contact by about 300% compared to surfaces without coatings.(Bryington et al., 2013)

To date only few clinical studies have attempted to test the early loading of Nano-coated Hydroxyapatite implants in posterior maxilla and their effect on marginal bone loss. Therefore, the objective of this study is to demonstrate the ability of nano-coated hydroxyapatite implants to achieve minimal marginal bone loss.

Materials and Methods

This study was conducted on a total of nine patients who had at least one missing maxillary posterior tooth seeking restoration. A total of ten implants were inserted.

1.Inclusion criteria:

- Patients with missing upper posterior teeth and seeking implant placement.
- Patients who have adequate bone height and width that allows implant placement, the available bone height (ranging from 8-18mm).
- Patients free from any condition that may compromise the final outcome of the dental implantation procedure (ex: bruxism, previous radiation).
- Patients with no previous attempt of implant placement to restore these missing teeth.

2. Exclusion criteria:

- Patients with systemic diseases that may hinder the normal healing process, for example Diabetes mellitus, Peripheral vascular disease and peripheral vascular disease.
- Patients with intra-bony lesions or infections that may retard the healing.

3. Surgical approach:

- Scrubbing and draping were performed in the usual fashion for intraoral surgeries.
- Infiltration local anesthesia (Articaine HCL 4% with epinephrine 1/100000) [1] was injected intraorally on the site of implant placement.
- A paracrestal incision was made at the edentulous area extending one tooth mesial and distal to the edentulous area using Bard Parker blade #15.
- A full thickness mucoperiosteal flap was raised using mucoperiosteal elevator to expose the alveolar bone.
- Sequential drilling under copious irrigation was done till the desired implant size.
- All implants used for this study were bone level ETIII NH implant with open thread and tapered body implant by Hiossen[2].
- Implant was placed according to the manufacturer's instructions.
- Closure of the mucoperiosteal flap with absorbable suture[3].

4. Post-operative care:

- Post-operative instructions:

Applying a gauze pack: A gauze pack was applied on top of the incision site and the patient was asked to bite on It for at least one hour.

- Post-operative medications:

Patients were prescribed:

1. Antibiotics: Amoxicillin 875mg and Clavulonic acid4125mg tablets every 12 hours for 5 days post-surgically.

[1] Art Pharma® Iodine and Potassium Iodide qualityproducts

[2] Hiossen® ,OSSTEM IMPLANT, CO., LTD

[3] Isuture Isorb: AlDawlia ICO, Asyut, Egypt.

[4] Augmentin 1gm. tablets, Smithkline Beecham

2. Analgesic: Diclofenac Potassium[5] 50mg analgesic tablets three times daily for 3-5 days post-surgically.

- Mouth rinsing with Chlorhexidine[6] 3 times daily starting one day postoperatively.

5.Follow up & Evaluation:

First visit after 1week for suture removal and healing assessment.

Implant exposure was done after 4 weeks through a paracrestal incision at the implant site, then a healing abutment was put after stability measurements were taken until the delivery of the final restoration.

- **Assessment of the marginal bone height:**

Marginal bone loss was measured 4 weeks (H0), and 3 months after loading (H1) post-operatively by CBCT.

1. Readings were obtained by drawing vertical line in the mid of implant which is the long axis line of implant, then drawing horizontal line tangent to the apex of implant which makes right angle with the long axis line.
2. Two vertical lines parallel to long axis line were drawn at each side (buccal and lingual), lines were drawn from the implant apex till the crest of bone surrounding the implant on each side.
3. 4 readings were taken for each implant, 2 reading on the coronal cut of the CBCT on the mid-buccal and mid-palatal surfaces of the implant, and 2 readings on the sagittal cut of the CBCT on the mesial and distal aspects of the implant, then the mean of the 4 readings was calculated.
4. Readings at 4 weeks were taken, then a second reading was taken at 3 months after implant loading, and then differences in marginal bone level were calculated between the two readings.

Results

In this study a total of 10 implants were inserted in 9 patients that had at least a missing one maxillary posterior tooth and were selected from the Out Patient Clinic of Oral and Maxillofacial Surgery Department, Faculty of Oral and Dental Medicine, Cairo University.

The selected patients were 7 females and 3 males. Their age ranged from 22-57 years with mean of 38.3 years (7±5). The total implants placed were 10 implants.

Assessment of marginal bone loss:

Marginal bone height was measured 4 weeks (H0), and 4 month (H1) post-operatively by CBCT.

Because the readings were two variables for the same subject Paired T-test was used to compare the mean baseline marginal bone level (H0) to the mean marginal bone level after 4 months (H1). There was non-significant difference, P value 0.45, the mean of the baseline marginal bone level was 7.07(SD = 0.77), and the mean marginal bone level after 4 month was 8.02 (SD = 1.18), the difference was 15.53 (SD =4.72) (CI -1.25 to 1.98). (Table 1)

Patient satisfaction:

Patients' satisfaction survey was done for the process, the results of overall patient's satisfaction showed that 91% of patients were very satisfied and 63% of patients were satisfied. (Figure 1) shows the statistical data regarding patients' satisfaction rate.

Table 1: Table showing Inferential statistic for marginal bone loss

H0 Mean (SD)	H1 mean (SD)	95% CI of difference		P value
		Lower limit	Upper limit	
7.07 (0.77)	8.02 (1.18)	-1.25	1.98	0.45

Pharmaceuticals Co., Brentford, England

[5] Cataflam 50mg. tablets, Novartis Pharma AG, Basle, Switzerland

[6] Oraldene; Chlorhexidine hydrochloride 125mg in each 100 ml solution. EDCO, Egypt

Figure (1): Bar chart showing patients' satisfaction rates.

Case #6, implant for upper right 5, implant size 4.5*10:

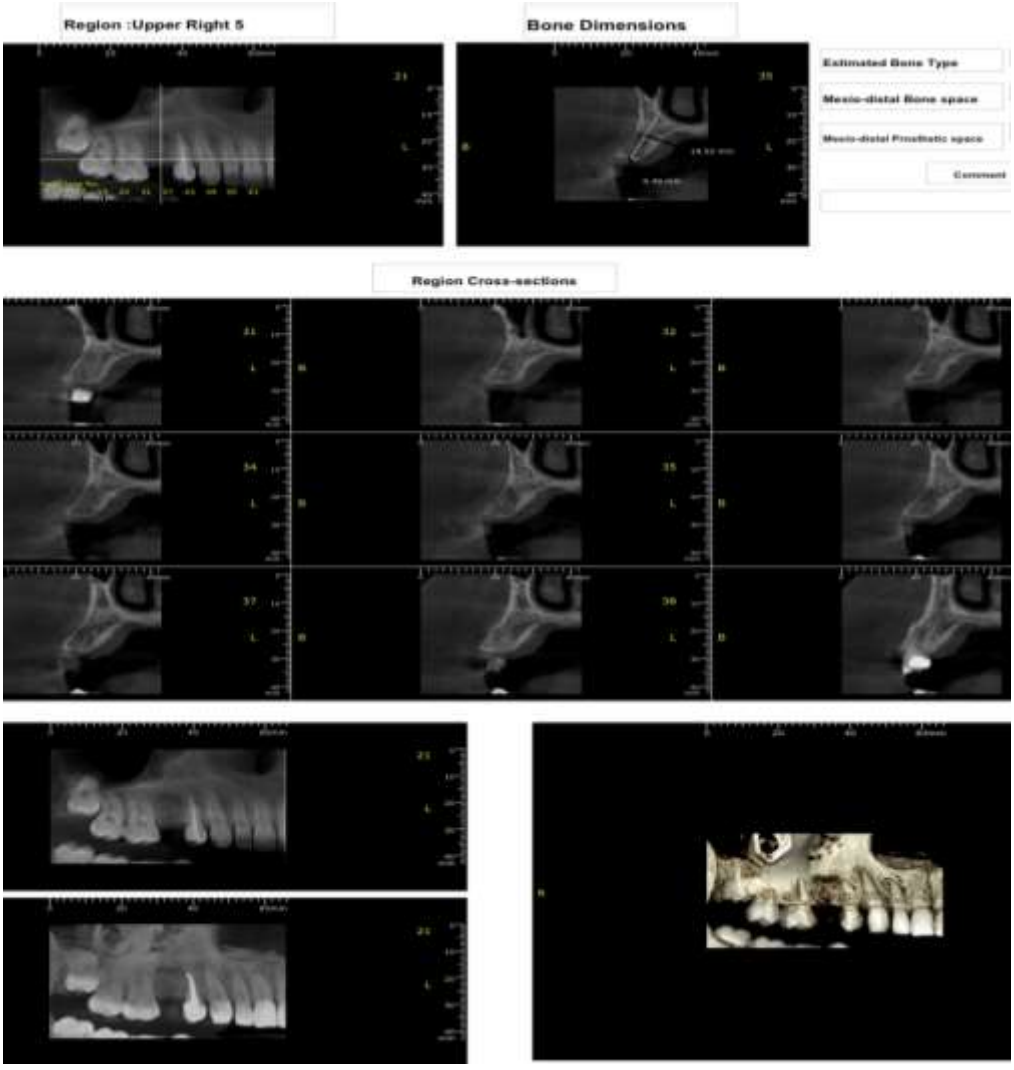

Figure (2): Photograph showing bone height and width using CBCT.

Figure (3): Clinical photograph showing ETIII NH implant.

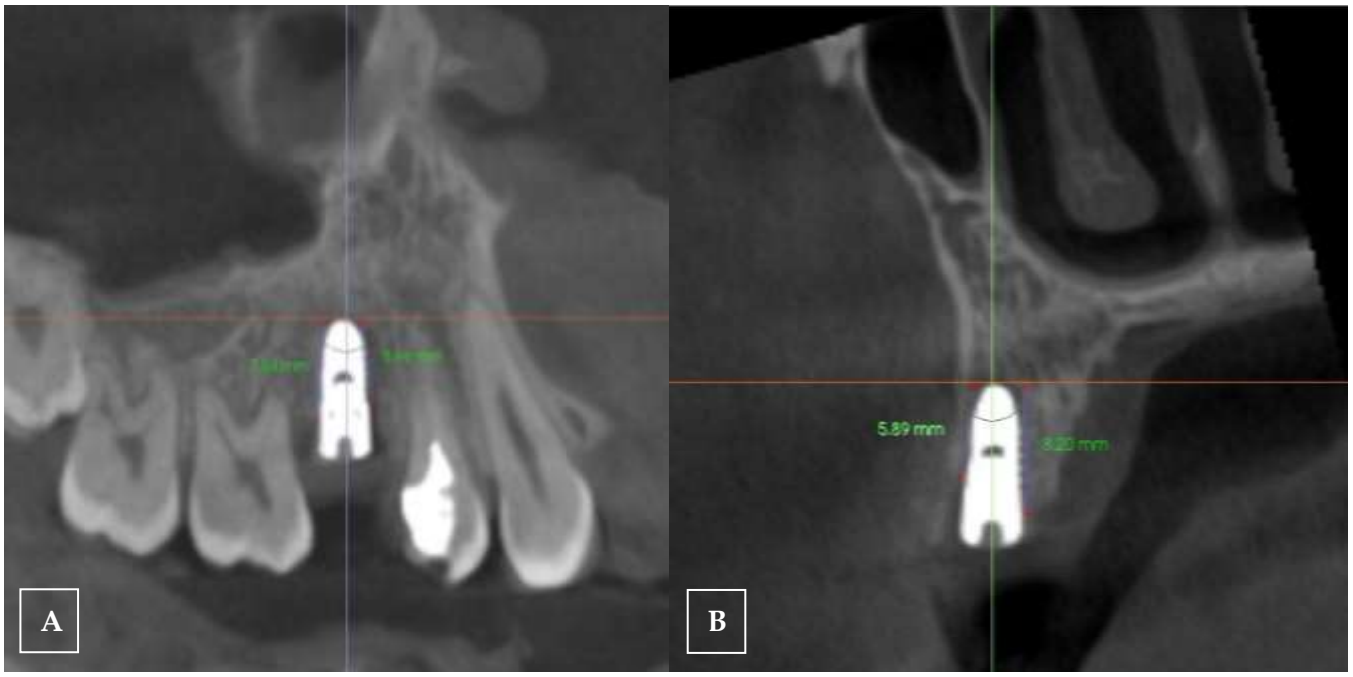

Figure (4): Photograph showing marginal bone height measurement using CBCT, A: Sagittal cut, B: Coronal cut.

Discussion

The Primary outcome in the recent research was marginal bone loss which was measured by CBCT at 4 weeks and 4 months post implant insertion, the use of CBCT in measuring marginal bone loss was supported by Goodarzi Pour et al. who stated that CBCT had a high sensitivity, specificity, positive predictive value, and negative predictive value for detecting different levels of marginal bone loss around all surfaces of the implant.(Goodarzi Pour et al., 2015)

Hydroxyapatite Nano-coating of the Hiossen ET III has been suggested as implant surface modification to encourage bone healing and osseointegration. Nanoparticle HA coatings significantly increase cell adhesion according to a systematic review by Qadir and colleagues, but they may also have a cytotoxic effect that slows the growth of the cells attached to the coating's surface areas. Van Oirschot and colleagues discovered that HA-coated Ti

had a better osseointegrating effect than shot blasting and acid etching (grit-blasted/acid-etched implants) at 4 weeks in a trial using goats. (López-valverde et al., 2020)

The results of Alabed Mela et al. clinical study also coincided with the results of our study, they evaluated the outcomes of 12 early-loaded implants in the posterior maxilla after 1 month of loading and found that the nanohydroxyapatite coating had a positive impact. They also found that the success rate achieved was 100% after 1year post-loading and that the results had been encouraging in terms of stronger and more favorable bone regeneration, better Osseointegration, higher/better quality bone production, and improved secondary implant stability of implants, which coincides with our results. (Alabed Mela et al., 2022)

The results of our study in the measurement of marginal bone loss around the implants were similar to the results of a Prospective randomized clinical trial by Kim et al. on hydrophilic tapered implant surface at maxillary posterior area between 2 groups, one of which was loaded after 6 weeks and the other was loaded after 12 weeks that evaluated marginal bone loss around the implant and found it to be within normal rate (less than 1mm after 1 year postoperatively) for all implants except for one implant in the study. The study also concluded that if bone quality is carefully taken into consideration in the event of early loading, a healing period of 6 weeks can result in clinical outcomes that are equivalent to those of a healing period of 12 week in cases of hydrophilic tapered implants, which supports early loading at 6 weeks for such implants.(Kim et al., 2016)

The results of this study were also in accordance with Ganeles et al. who assessed the survival rates and bone-level changes with immediately and early loaded Straumann implants with the SLActive hydrophilic surface in a 3-year randomized-controlled trial. The average changes in bone level were not clinically significant on average, and was best compared to the typical bone resorption reported in conventional implant loading, however they used the Straumann implants with the hydrophilic SLActive surface and also found it to be safe and predictable when used in immediate and early loading protocols (after 28-34 days). Survival rates resembled those of conventional or delayed loading even in low-quality bone. (Ganeles et al., 2008)

On the other hand, Nicolau et al. conducted a 10 years clinical follow-up study on the SLActive hydrophilic surface and found that posterior maxilla or mandibular implants with the SLActive surface the crestal bone alterations around the implant surface were within acceptable success criteria (0.2 mm each year and 1.5 mm in the first year), which coincides with our results. They also found that SLActive implants exhibit successful long-term outcomes in immediate and early loading protocols (28 to 34 days).(Nicolau et al., 2019)

Conclusion

Within the context of this study, the following conclusions can be listed:

1. Nano-coated hydroxyapatite implants maintained marginal bone height at 4 months (No bone loss).
2. Evaluation of marginal bone loss after 1 year of follow up.

References

Alabed Mela, O., Abdel- Monem Tawfik, M., Mohamed Ahmed Said Ahmed, W., & El Din Hassan Abdel-Rahman, F. (2022). EFFICACY OF NANO-HYDROXYAPATITE COATING ON OSSEOINTEGRATION OF EARLY LOADED DENTAL IMPLANTS. *International Journal of Advanced Research*, *10*(01), 564–575. https://doi.org/10.21474/IJAR01/14075

Bryington, M. S., Hayashi, M., Kozai, Y., Vandeweghe, S., Andersson, M., Wennerberg, A., & Jimbo, R. (2013). The influence of nano hydroxyapatite coating on osseointegration after extended healing periods. *Dental Materials*, *29*(5), 514–520. https://doi.org/10.1016/j.dental.2013.02.004

Ganeles, J., Zöllner, A., Jackowski, J., ten Bruggenkate, C., Beagle, J., & Guerra, F. (2008). Immediate and early loading of Straumann implants with a chemically modified surface (SLActive) in the posterior mandible and maxilla: 1-year results from a prospective multicenter study. *Clinical Oral Implants Research*, *19*(11), 1119–1128. https://doi.org/10.1111/j.1600-

0501.2008.01626.x

Goodarzi Pour, D., Romoozi, E., & Soleimani Shayesteh, Y. (2015). Accuracy of Cone Beam Computed Tomography for Detection of Bone Loss. *Journal of Dentistry (Tehran, Iran)*, *12*(7), 513–523.

He, F. M., Yang, G. L., Li, Y. N., Wang, X. X., & Zhao, S. F. (2009). Early bone response to sandblasted, dual acid-etched and H2O2/HCl treated titanium implants: an experimental study in the rabbit. *International Journal of Oral and Maxillofacial Surgery*, *38*(6), 677–681. https://doi.org/10.1016/J.IJOM.2009.03.716

Jemat, A., Ghazali, M. J., Razali, M., & Otsuka, Y. (2015). Surface Modifications and Their Effects on Titanium Dental Implants. *BioMed Research International*, *2015*, 1–11. https://doi.org/10.1155/2015/791725

Kim, S.-B., Yun, P.-Y., Kim, S.-Y., Yi, Y.-J., Kim, J.-Y., & Kim, Y.-K. (2016). Prospective randomized clinical trial of hydrophilic tapered implant placement at maxillary posterior area: 6 weeks and 12 weeks loading. *The Journal of Advanced Prosthodontics*, *8*(5), 396. https://doi.org/10.4047/jap.2016.8.5.396

López-valverde, N., Flores-fraile, J., Ramírez, J. M., de Sousa, B. M., Herrero-hernández, S., & López-valverde, A. (2020). Bioactive surfaces vs. Conventional surfaces in titanium dental implants: A comparative systematic review. In *Journal of Clinical Medicine* (Vol. 9, Issue 7, pp. 1–28). MDPI. https://doi.org/10.3390/jcm9072047

Nicolau, P., Guerra, F., Reis, R., Krafft, T., Benz, K., & Jackowski, J. (2019). 10-year outcomes with immediate and early loaded implants with a chemically modified SLA surface. *Quintessence Int*, *50*, 114–124. https://doi.org/10.3290/j.qi.a41664

Sehrawat, M., Sheoran, L., Bharathesh, S., Ravi, N., Nayak, L., & Bora, D. (2021). A literature review on different types of surface treatment in implants. *IP Annals of Prosthodontics and Restorative Dentistry*, *7*(2), 64–67. https://doi.org/10.18231/j.aprd.2021.013