EVALUATION OF OSSEOINTEGRATION OF IMMEDIATELY PLACED AND LOADED DENTAL IMPLANTS WITH NANOCRYSTALLINE HYDROXYAPPATITE PARTICLES IN THE ESTHETIC ZONE (A RANDOMIZED CONTROLLED CLINICAL TRIAL)

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ABSTRACT

INTRODUCTION: Replacing a single tooth by the use of immediate implant can eliminate the need for preparation of a sound tooth to use it as an abutment. The drawbacks of using autogenous bone grafts have led to producing a large number of alternative bone substitute materials to fill in the jumping gap which can encourage bone formation and affect implant stability and crestal bone loss depending on different prespectives as Nanocrystalline hydroxyapatite particles and xenografts.

OBJECTIVES: The aim of this study is to evaluate clinically and radiographically the quality of osseointegration for both Nanocrystalline hydroxyapatite particles and xenograft around immediately placed and loaded dental implants in the esthetic zone by measuring implant stability and marginal bone loss.

MATERIALS AND METHODS: This study is conducted on sixteen patients diagnosed with unrestorable anterior single tooth indicated for extraction and immediate implant placement. Nanocrystalline hydroxyapatite particles was used around the implant in group A while xenograft was used in group B. Follow up was done immediately postoperative and after four and seven months.

RESULTS: Insignificant statistical difference was reported in Implant stability, and crestal bone loss during the follow up period when comparing both groups during the fourth and the seventh months follow up period.

CONCLUSION: Within the limitations of this study. Even though Nanocrystallne hydroxyapatite particles was placed in the jumping gap, it did not prevent bone loss following tooth extraction and immediate implant installation same as xenograft bone group.

KEYWORDS: Immediate implant, Nanocrstalline hydroxyapatite, Osseointegration.

RUNNING TITLE: Evaluation of the use of bone graft around immediate implants.

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INTRODUCTION

In the anterior maxillary region, implant placement is a difficult aesthetic protocol since tooth loss causes bone resorption and gingival architecture to collapse, which compromises aesthetics and leave insufficient bone for implant placement. Placement of immediate implants into a fresh extraction socket shortens the duration of the procedure, lowers the expense, maintains the aesthetics of the gingiva, and improves patient comfort (1).

After all, significant bone remodelling following extraction may be anticipated, particularly at the labial aspect, frequently leading to a weak alveolar ridge. A lack of convexity labialy and even midfacial recession could result from placing an implant right away into a brand-new extraction socket because of this (2).

In regular practise, several teeth are extracted because of periodontal disease or root fractures. Both cause significant bone loss, which further reduces the

durability of the original implant and the likelihood of osseointegration. In these situations, choosing instantaneous implant placement (IIP) in conjunction with bone augmentation operations is strongly recommended (3).

After immediate implant placement, there may still be sizable gaps between the walls of the extraction socket and the implant's border. These spaces are known as "jumping distances," and it has typically been assumed that some type of grafting is necessary to encourage bone fill (4).

Natural substitutes for bone have been produced to provide better osteogenic, osteoconductive, and osteoinductive potentials by fostering an optimum microenvironment for bone formation. Grafting materials called xenografts come from species that are not genetically linked to the host (5).

Despite the fact that bone graft and substitution materials are utilised widely over the world, there are still drawbacks to the materials that are now in use. These mostly entail the use of autografts, which is the transfer of grafting materials from one site of the body to another inside the same person, and allografts, which is the transfer of materials to be grafted between two genetically unrelated subjects (6). However, there are several downsides associated with autografts, such as the requirement for a secondary surgical visit, donor site injury and the potential for scarring. Additionally, autografts have been associated with higher surgical costs, more significant surgical risks, e.g., excessive bleeding, infection, inflammation and pain, limiting their application to relatively smaller bone defects. Thus, in large craniofacial defects, auto grafts may not represent a viable option (7).

Allograft materials can be prepared in three primary forms—fresh, frozen, or freeze-dried. Fresh and frozen allograft materials possess superior osteoinductive properties but are rarely used nowadays due to the higher risk of a host immunogenic response, limited shelf life, and increased risk of disease transmission (8).

Since 2005, Synthetic allograft, a brand-new bone substitute with a nanostructure, has been available on the market. Granules of nano bone are accessible; they are made up of 24% nanostructured silica dioxide (SiO 2) and 76% nanocrystalline hydroxyapatite (nHA). A silica gel connects the loosely packed nanocrystalline hydroxyapatite. The sol-gel method, a new approach, is used to create nanobone, with pore diameters between 10 and 20 nm and a porosity of more than 80%. Due to the pores' extensive interconnection, they have an extremely large surface area (84 m2/g) (9).

The aim of this study is to evaluate clinically and radiographically the quality of osseointegration for both Nano crystalline hydroxyapatite particles and xenograft around immediately placed and loaded dental implants in the esthetic zone by measuring implant stability and marginal bone loss.

MATERIALS AND METHODS

This was a prospective randomized controlled clinical trial with a 1:1 allocation ratio that was carried out after ethical approval from the Alexandria University Faculty of Dentistry's Research Ethics Committee.

Patients

This study included sixteen patients from the Alexandria University Teaching Hospital's out patient clinic who had badly destructed anterior teeth in need for extraction. Prior to the procedure, all patients signed an informed consent form at Alexandria University's Faculty of Dentistry's Oral and Maxillofacial Surgery Department. Patients were divided into two groups , Group A (Study group) patients were treated using an immediate implant and filled the jumping gap with nanocrystalline hudroxyapatite paricles. Group B (Control group) patients were treated using an immediate implant and filled the jumping gap with xenograft.

Inclusion criteria included adult patients between the ages of 18 and 40 who did not have a preference for either gender, those with hopeless teeth in the maxillary aesthetic area that needed extraction and immediately replaced with implants, as well as those with intact four-wall sockets for the teeth, Jumping gap between labial aspect of the implant and labial wall $\geq$ 2 mm (10).

Acute infections at surgical sites, long-term use of non-steroidal anti-inflammatory drugs, periodontal disease associated with bone loss, a history of systemic diseases that would interfere with the surgery, a known allergy to any of the study's materials, and patients with severely atrophic ridges that needed staged grafting were among the exclusion criteria.

Materials

Dentium super line Implant system (Dentinum company, Seoul, Korea).

Osstell (Osstell AB, Sweden).

Nano Bone® (Artoss inc, Deutschland).

Xenograft (Bio-Oss®, Switzerland).

Zepf-Line Periotomes(HELMUT ZEPF, Germany).

Methods

Pre-operative assessment and examinations

Clinical examination

The patients were evaluated by taking full medical and dental histories. Extra-oral and intra-oral inspection was performed to confirm the presence or absence of suppuration, discharge or swelling. Hard tissue was examined for any bony abnormalities, occlusion was also checked.

Radiographic examination

Cone-Beam Computed Tomography (CBCT) was done to evaluate the present bone and to detect any hidden bony abnormalities and make sure the four walls were intact and for expecting the length and diameter of implant.

Surgical phase

Preoperative medications

To control infection, antibiotic prophylaxis was 1 gm amoxicillin 875 mg + clavulanate 125 mg sixty minutes before operation, according to the (INFECTIOUS DISEASES SOCIETY of AMERICA) guidelines (11).

Surgical procedure

The operation was done under local anesthesia by using infiltration technique (Articaine HCL 4% with vasoconstrictors (1;200.000)).

An atraumatic protocol was followed during tooth extraction. Then a sulcular incision was done using No. 15 blade. (Figure 1A, B)

The extraction started using a periotome to detach the periodontal ligaments and clear the tissues around the root and to luxate the tooth. Then a forceps was used to deliver the tooth out of its socket using gentle extraction movements to preserve labial plate of bone. The fresh extraction socket was irrigated with saline to remove any hard or soft debris that may be present after the extraction. (Figure 2A, B)

Sequential drilling up to the final drill is done and the implants were inserted manually and by using torque wrench. The initial drill that's used when making the hole for a dental implant is called a pilot drill. This is simply a small diameter drill which, as its name implies, is used to create a hole that serves as a guide for other drills used later on,after the pilot drill is finished the second guide drill is used to continue shaping of the bone, then the final drill is inserted according to the diameter of the implant to be placed so that the final drill diameter is smaller than that of the implant to gain more primary stability (12,13), In order to gain a sufficient amount of bone on the labial site a slightly palatal positioning of the implant is necessary.

The implant was removed from its sterile package and held using the attached plastic carrier, placed into the prepared socket using fixture driver and screwed manually till resistance is met.

After that the torque wrench ratchet was attached to complete the seating of the implant into its final position to a minimum of 35Ncm up to 45Ncm (14,15), with the platform lower than the bone level by 1 - 2 mm and the apex of the implant at least 2 mm beyond the socket base to gain primary stability (16).

Insertion of grafting material after mixing it with saline and condensing it in the gab between the implant and the labial wall of the socket according to each group, for group A, The gap between the implant's facial aspect and the labial wall was measured using a millimeter periodontal probe from the implant's labial surface to the socket's labial surface and then filled with nanocrystalline hydroxyapatite particles. While for group B, the gap was filled with xenograft. (Figure 3A, B)

The implant primary stability (base line) was measured with a dedicated instrument (Osstell AB) and the customized healing abutment was finished and polished. A temporary polymethyl methacrylate crown (PMMA) was fabricated. (Figure 4A, B)

Partial soft tissue coverage was done by suturing the flap without tension using 3 - 0 prolene suture.

Postoperative phase

Instructions were given to the patients postoperatively including oral hygiene instructions and cold fomentations for 5 min. every 3 hours for the first day, then warm mouthwashes every 6 hours for the following days.

Postoperative medications

Postoperative medications including:

Antibiotic: amoxicillin/ clavulanic acid 1g; 1 capsule every 12 hours for 6 days post-operatively (Augmentin: manufactured by GlaxoSmithKline, England).

Chlorhexidine mouthwashes (Hexitol, Arab Drug Company, Cairo, ARE).

Nonsteroidal anti-inflammatory drugs: Ibuprofen 400 mg; 1 tablet every 8 hours daily after meals for 4 days (Brufen (400 mg): Abbott multinational pharmaceutical company, Cairo, ARE).

Follow up phase (immediate, after four months and after seven months)

Clinical follow up

Implant stability (17-21)

Implant stability was assessed during surgery (primary stability) and four months later using an implant stability metre (Osstell AB). The little magnet (Smartpeg®) that was immediately screwed onto the implant was exposed to magnetic pulses from this portable device. The magnet began to vibrate, and the tone was picked up by the probe and converted it into an implant stability quotient (ISQ) value. From the four sites, ISQ values (scaled 1–100) for each implant was calculated (mesial, distal, labial, and palatal sites). The final ISQ of the Implant was calculated as the mean of all measurements, rounded to the nearest whole number.

Radiological follow up

CBCT was done immediately postoperative and after four and seven months to evaluate:

Crestal Bone loss (22)

By altering the cross-sectional and long axes at the implant's centre and bisecting it, the implant was employed as a reference. A line just parallel to the

implant on the cross sectional view was drawn ,starting at the labial and palatal bone plates' crests and finishing at the implant's apical level; height was measured in millimetres immediately following surgery and at 4 and 7 months. Since bone heights for the two groups could not be compared because they vary depending on the case, the difference between the bone height at each site at the time of insertion and the bone height at each site after four and seven months was subtracted, and the mean of the two values was then calculated. (Figure 5A ,B)

Prosthetic phase

The porcelain fused metal crown was inserted at 4 months postoperatively. (Figure 6A, B).

Statistical analysis

IBM SPSS programme version 25.0 was used to record, tabulate, and statistically analyse the data (Armonk, NY: IBM Corp). Data were entered in numerical form, as suitable. The normality test Kolmogorov-Smirnov found significance in the distribution of the majority of the variables, Consequently, non-parametric statistics were chosen. Minimum, maximum, median, 95% confidence interval for the median, and 25th to 75th percentiles were used to describe the data. Using the Mann-Whitney U test, comparisons were made between two independently examined, not-normally distributed subgroups. The Wilcoxon Signed Ranks test was used to compare two related but not regularly distributed subgroups. The Friedman's test was used to compare samples that were connected to one another. Dunn-Sidak method was used for pair-wise comparison when Friedman's test was significant. The Bonferroni adjustment has been applied to the significance values for multiple tests. Beta error was permitted up to 20% during the sample size determination process with an 80% research power. A 95% significance threshold was used with an alpha level of 5%. The threshold for statistical significance was $p < .05$.

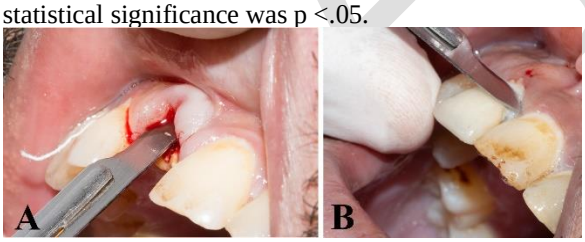

Figure (1): Incision made (A) NanoBone® group. (B) xenograft group.

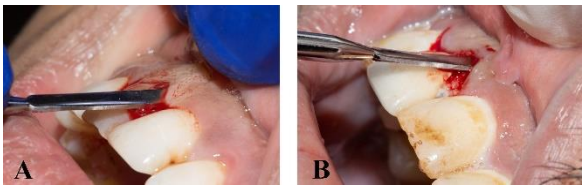

Figure (2): Using periotome to detach PDL (A) NanoBone® group. (B) xenograft group.

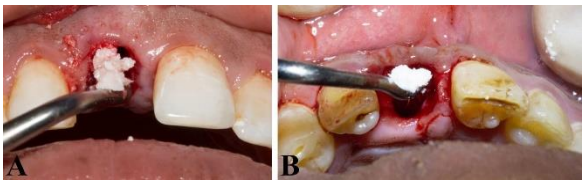

Figure (3): Bonegraft application (A) NanoBone® group. (B) xenograft group.

Figure (4): Customised healing abutment then Polymethyl methaacrylate temporary crown placement (A) NanoBone® group. (B) xenograft group.

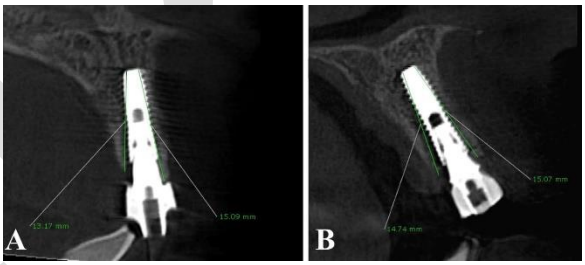

Figure (5): CBCT for bone loss measurement (A) NanoBone® group. (B) xenograft group).

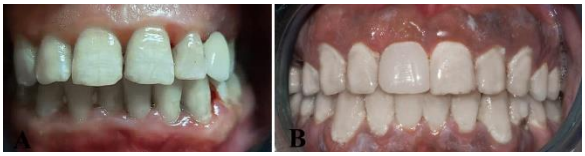

Figure (6): Final prosthesis insertion (A: NanoBone® group. (B) Bio-Oss group.

RESULTS

Biodata

The present study was conducted on sixteen patients. Sixteen implants were placed in freshly extracted maxillary anterior socket. Patients were picked from the Oral and Maxillofacial Surgery Department's outpatient clinic at Alexandria University's Faculty of Dentistry. Patients' ages ranged from 18 to 40 years old were 9 females and 7 males. All patients were followed

up for monitoring progress in implant stability and crestal bone loss, and the results were registered as regards both clinical and radiographic evaluations. Age differences between the two studied groups were not statistically significant. (p = .636) (Table 1).

Clinical Evaluation

Implant stability

Mean (ISQ) value was measured for all cases immediately postoperative (primary stability) and after 4 months.

Mean ISQ for the implant primary stability ranged from 53.50 - 59.50 with a median of 57.50 [55.38 - 58.25], 95% CI 54.50 - 58.75 in the Xenograft dental implant group, while it ranged from 54.50 - 62.50 with a median of 56.25 [55.75 - 57.75], 95% CI 55.75 - 62.50 in the Nanobone dental implant group.

Mean ISQ for the implant primary stability has no statistically significant difference between the two studied groups (p=.673) (Table2).

Mean ISQ for the implant in the fourth month ranged from 57.75 - 67.25 with a median of 61.75 [60.25 - 64.38], 95% CI 59.75 - 65.75 in the Xenograft dental implant group, while it ranged from 61.75 - 69.25 with a median of 3.75 [61.75 - 69.25], 95% CI 62.25 - 67.00 in the Nanobone dental implant group.

Mean ISQ for the implant in the fourth month has no statistically significant difference between the two studied groups (p=.093) (Table2).

Radiographic evaluation

Crestal Bone loss

Four months later, the mean post-operative crestal bone loss was 8.74 - 15.22 (mm) in group A with a with a median of 12.92 [9.22 - 14.55] (mm), 95% CI 8.83 - 14.91 (mm). While in group B Mean marginal bone loss in the fourth month ranged from 6.50 - 16.35 (mm) with a median of 12.01 [10.18 - 12.46] (mm), 95% CI 9.45 - 12.79 (mm).

In the fourth month, the mean marginal bone loss between the two studied groups is not significantly different. (*p*=.529) (Table 3).

Mean marginal bone loss in the seventh month ranged from 6.24 - 7.85 (mm) with a median of 7.48 [6.31-7.67] (mm), 95% CI 6.31-7.69 (mm) in the Xenograft dental implant group, while it ranged from 6.27-8.68 (mm) with a median of 7.53 [7.14-7.98] (mm), 95% CI 7.02-8.02 (mm) in the Nanobone dental implant group.

Mean marginal bone loss has no statistically significant difference between the two studied groups in the seventh month (p=.345) (Table 3)

In each group, repeated measure analysis showed a statistically significant change in the mean marginal bone loss among the different time of measurement (months) in the xenograft dental implant group (*p*=.001) and nanobone dental implant group (*p*=.002)

Table (1): Comparison of age (years) between both studied groups.

	Group		**Test of significance *p value***
	Xenograft (n=8)	**Nanobone (n=8)**	
Age (years)			
n	8	8	
Min. – Max.	35.00-51.00	34.00-53.00	
Median	43.50	41.50	$Z_{(MW)}$=0.473
95% CI of the median	39.00-50.00	36.00-48.00	*p*=.636 NS
25th Percentile – 75th Percentile	39.50-48.50	36.50-47.00	

NS: Statistically not significant *(p*>.05)

Table (2): Comparison of Mean ISQ for the implant in the two studied groups at different points of measurements (months).

	Group		**Test of significance *p value***
	Xenograft	**Nanobone**	
Mean ISQ for the implant (Primary stability) n Min. – Max. Median 95% CI of the median 25th Percentile – 75th Percentile	 8 53.50-59.50 57.50 54.50-58.75 55.38-58.25	 8 54.50-62.50 56.25 55.75-62.50 55.75-57.75	 $Z_{(MW)}$=0.423 *p*=.673 NS
Mean ISQ for the implant (4 Months) n Min. – Max. Median 95% CI of the median 25th Percentile – 75th Percentile	 8 57.75-67.25 61.75 59.75-65.75 60.25-64.38	 8 61.75-69.25 63.75 62.25-67.00 62.50-66.50	 $Z_{(MW)}$=1.680 *p*=.093 NS
Test of significance ***p***	$Z_{(WSR)}$=2.527 *p*=.012*	$Z_{(WSR)}$=2.521 *p*=.012*	
Mean ISQ for the implant percentage change (%) n Min. – Max. Median 95% CI of the median 25th Percentile – 75th Percentile	 8 4.37-25.70 7.53 5.19-10.50 5.36-9.92	 8 5.60-23.11 11.66 8.09-19.11 8.89-18.27	 $Z_{(MW)}$=1.680 *p*=.093 NS

*: Statistically significant (p<.05)

Table (3): Comparison of Mean Marginal Bone Loss (mm) in the two studied groups at different points of measurements (months).

	Group		**Test of significance** *p value*
	Xenograft	**Nanobone**	
Mean Marginal Bone Loss (Baseline) (mm) n Min. – Max. Median 95% CI of the median 25th Percentile – 75th Percentile	 8 7.56-17.99 12.79 11.93-14.78 11.99-14.08	 8 9.40-15.92 13.27 9.64-14.40 11.04-14.27	$Z_{(MW)}$=0.210 *p*=.834 NS
Mean Marginal Bone Loss (4 Months) (mm) n Min. – Max. Median 95% CI of the median 25th Percentile – 75th Percentile	 8 6.50-16.35 12.01 9.45-12.79 10.18-12.46	 8 8.74-15.22 12.92 8.83-14.91 9.22-14.55	$Z_{(MW)}$=0.630 *p*=.529 NS
Mean Marginal Bone Loss (7 Months) (mm) n Min. – Max. Median 95% CI of the median 25th Percentile – 75th Percentile	 8 6.24-7.85 7.48 6.31-7.69 6.31-7.67	 8 6.27-8.68 7.53 7.02-8.02 7.14-7.98	$Z_{(MW)}$=0.945 *p*=.345 NS
Test of significance ***p***	$c^2_{(Fr)(df=2)}$=14.250 *p*=001*	$c^2_{(Fr)(df=2)}$=13.000 *p*=.002*	
Mean Marginal Bone Loss percentage change (%) (4M vs Baseline) n Min. – Max. Median 95% CI of the median 25th Percentile – 75th Percentile	 8 -20.80 - 6.10 -11.23 -18.51 - -7.85 -16.30 - -8.47	 8 -33.26 - 57.91 -6.21 -32.20 - 14.02 -20.67 - 4.55	$Z_{(MW)}$=1.050 *p*=.294 NS
Mean Marginal Bone Loss percentage change (%) (7M vs Baseline) n Min. – Max. Median 95% CI of the median 25th Percentile – 75th Percentile	 8 -57.27 - -17.53 -45.49 -51.48 - -35.77 -50.66 - -36.88	 8 -54.38 - -7.66 -47.24 -49.68 - -17.54 -49.13 - -27.68	$Z_{(MW)}$=0.315 *p*=.753 NS
Mean Marginal Bone Loss percentage change (%) (7M vs 4M) n Min. – Max. Median 95% CI of the median 25th Percentile – 75th Percentile	 8 -53.00 - -4.00 -39.96 -47.35 - -18.90 -44.78 - -26.87	 8 -55.86 - -1.70 -44.52 -51.29 - -8.30 -49.54 - -13.83	$Z_{(MW)}$=0.525 *p*=.600 NS

*: Statistically significant (p<.05)

DISCUSSION

Histologically, healing of a socket following tooth extraction begins with the creation of a blood clot, continues with the woven bone filling, and ends with mature trabecular bone six months later. Due to physiological resorption of the bony ridge's outer outlines over the first month following tooth extraction, this healing/repair is not fully complete. The bucco-lingual and vertical dimensions of the post-extraction socket are both reduced by 50% in the first year (23).

Less traumatising extraction methods that include periotomes can lessen the loss of bone and associated damage. The final result of the bone remodelling phase is impossible to anticipate even if the labial bone remaining is still there at the extraction time due to high individual variability, which exacerbates the aesthetic outcome (24).

Elevating a flap is not even required in some situations. Immediate implant placement promotes the maintenance of the contour for both the bone and soft tissue and offers papillae and midfacial gingival tissues mechanical support, allowing for maximum preservation as opposed to waiting for socket healing. Additionally, because it reduces the amount of bone loss that often occurs during the rebuilding phase, it speeds up the treatment of edentulism (25).

The aim or our study is to evaluate clinically and radiographically the osseointegration of (Nano crystalline hydroxyapatite particles) around immediately placed and loaded dental implants in the esthetic zone by measuring Implant stability and Marginal bone loss.

Only by placing the implant in the bone apicaly (3 to 4 mm) is primary stability possible to acheive, and after three to four months, in the peri-implant marginal gap, spontaneous bone fill occurs. Type 1 immediate dental implants undergo intra- and extra-alveolar modelling and remodelling, which inevitably results in a vertical and horizontal decrease of the bone that is particularly noticeable in the alveolar bony walls of the face (26).

Following initial implant placement, these biological alterations suggest a higher chance of marginal mucosal recession, which could lead to non-aesthetic restorations in places where aesthetic attention should be given. Grafting materials have been suggested to fill the implant-to-bone space in order to solve the issue of the persistent peri-implant leaping gap (27).

Nano crystalline hydroxylapatite (nHA) employed as bone grafting materials synthetic alternatives addresses both the avoidable and unavoidable issues of auto graft. It is a brand-new product that has been offered for sale since 2005. Consists of a 74% unsintered, slow-resorbing nanocrystal of hydroxyapatite that is embedded in a 24% microporous gel of silica dioxide (SiO_2). It has numerous benefits, including complete bone graft remodelling, faster and safer bone growth, and great performance thanks to nanostructure (28).

An essential requirement for successful osseointegration and implant placement is implant stability. Numerous mechanical elements such as the implant design, bone augmentation, protocol of treatment, surgical technique, together with local and systemic factors, contribute to the implant and surrounding socket bone connection (29).

In agreement with our study, according to *Gotz et al.*,(30) The nanocrystalline hydroxyapatite component is responsible for osteoconductivity, while the silica gel component is assumed to stimulate connective tissue formation, osteoblast proliferation, matrix mineralization and calcification, so it combining osteoconductive and osteoinductive properties.

Implant stability is a fundamental criteria and important factors in achieving implant success and osseointegration. The connection between the implant and surrounding socket bone is generated by many mechanical factors include implant design, bone augmentation, treatment protocol, surgical procedure, along with local and systemic factors (31).

There are several methods used to measure marginal bone level changes postoperatively, with a wide range of reliability. The conventional and digital periapical xray techniques using paralleling cone technique have proven to be the accurate and the most practical method for the linear measurement of alveolar bone height with less radiation exposure in comparison to 3D imaging (32).

In group (1), the nanocrystalline hydroxyapatite graft was placed till the level of the peri-implant mucosa as recommended by *Araujo et al.* (33), and *Chu et al.* (34) to improve the level of marginal bone to implant contact and prevent soft tissue recession.

Also in accordance with our study, *Cornelini et* al.(35), and *De Angelis et al.*(36) reported that marginal bone loss around dental implants might represent a threat to implant aesthetic and longevity. Marginal bone loss that occurs after implantation may be influenced by multifactor such as infection or occlusal overloading the implants, surgical trauma, periimplantitis, biologic width, implant crest module and surgical approach. Implant stability is the main factor for the immediate placement success which used as guide for the best time for implant loading (37).

At the end of this randomized clinical trial the evaluation of the implant stability assessment in the study; there was no statistical insignificant difference in ISQ measurements after 6 months between the

"nanocrystalline hydroxyapatite" group and "xenograft bone" group.

This demonstrated the possibility of achieving osseointegration and stability of dental implants either grafted with nanocrystalline hydroxyapatite or xenograft bone graft.

These results are in agreement with *Vanden Bogaerde et al.* (38), *Villa and Rangert* (39) and *Crespi et al.* (40) They studied immediate implants placement with early loading and Autogenous bone graft in anterior/posterior mandible/ maxilla arch; the measurement of ISQ was 58 - 63 after 6 months revealing the preservation of high implant stability.

Another prospective controlled studies using immediate implants with Autogenous graft in anterior aesthetic area, reported implant stability (ISQ) with mean value of 64.5 ±6 3.9 at 6 months and no significance difference with the comparator "delayed implant" group (41,42).

In a randomized Case-Series *Vanden Bogaerde* and *Senner* (43) placed 22 immediate implants with immediate function in 11 patients, 13 of the implants were augmented with xenograft and only one implant was augmented with Nano Bone which failed after six weeks showing a constant decline in stability. Resonance frequency analysis values were measured in autogenous bone grafted implants in a bucco-palatal direction and have shown a progressive stability increase.

Regarding to radiographic assessment of the marginal bone level using digital x-ray showed that there was statistical significant reduction in marginal bone level in mesial and distal surfaces in the nanocrystalline hydroxyapatite group.

Moreover, in the xenograft group there was a significant reduction in marginal bone level for both mesial and distal surfaces compared with seventh month marginal bone level.

Baseline radiographs assessment showed peri-implant bone level was more coronal to implant shoulder as x rays were taken during first week after sub-crestal implant placement and bone grafts packing. Bone graft particles had confounded the radiograph assessor for scoring the actual marginal bone level at baseline. Ideally x-rays should be taken at implant placement before bone augmented. Meanwhile six months readings showed peri-implant bone loss; many investigators supported this finding (44).

Most of the marginal bone was lost during the first three months (0.6 ±0.4mm). In randomized clinical trials as *Chen et al.* (45) and *Sanz et al* (46) reported crestal bone height changes at 6 months follow-up; the mean vertical height change showed a loss of 1.12 mm.

Another randomized clinical trial by *Hazzaa et al.* (47) reported a mean change in vertical height with a loss of 2.57 ±0.23 mm after 6 months of immediate implants placement augmented with autogenous bone/melatonin composite graft.

While in a prospective trial by *Noelken et al.* (48) measuring marginal bone level in immediate implants with autograft in aesthetic anterior zone revealed that at 5 years follow-up the mean and standard deviation was (0.15 ±0.59, −0.05 ±0.54, 0.04 ±0.65) 1st year, 3rd year and 5th year respectively. The tenable explanation of marginal bone loss in this study and the other supported studies could be related to the phenomenon of normal bone remodeling and replacement of the bone grafts by new bone formation in the jumping gap (40).

A number of studies measured peri implant bone level changes in subjects with immediately loaded implants and compared them with conventional loading. *Danza M et al* in his randomized controlled study with 1 year follow-up showed no significant differences for marginal bone loss between immediately and conventionally loaded implants (49).

In vivo comparative study conducted by Guncu MB et al (50) showed that immediate functional loading did not negatively affect implant stability, marginal bone levels and periimplant health when compared with conventional loading of single tooth implant.

CONCLUSION

Within the limitations of this study. It may be concluded that:

Even though Nano bone graft was placed in the jumping gap, it did not prevent bone loss following tooth extraction and immediate implant installation same as xenograft bone group. Both treatment approaches were associated with implant stability with insignificant difference. Customised healing abutments plays an important role in holding the bone graft in its place while osseointegration takes place. Despite that results showed no statistical difference between Nanobone and Xenograft , Nanobone was easily applied to fill in the gap.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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