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The Effect of Alloplastic graft material on the jumping gap of the Immediate Implants

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Abstract

circum-implant distances remaining between the implant perimeter and socket walls are of serious challenge facing the immediate implantation nowadays, the aim of this study was to fill this jumping gaps with alloplastic graft that is membraneless and noticed the effect on the stability and osseointegration of the implants. The study was performed on 14 cases, divided into the study group (with alloplastic graft) and the control group, and noticed the effect on the jumping gaps. The results showed that the material was of significance and that was according to the measurements of the implant stability with p value(< 0.0001), proping pocket depth with p value(0.4044)and the modified sulcus bleeding index with p value(0.0023). it can be concluded that the graft material had positively affect osseointegration and stability of immediately placed implants.

Keywords: implant stability, implant osseointegration, Alloplastic graft material, jumping gaps

Introduction.

Treatment time is reduced when the implants are placed right away. It prevents the requirements for an open flap surgery and the potential necessity for hard and soft tissue grafting.^A . In order to achieve easier andfaster surgical treatment times, various loading and placement techniques have been developed.^B. More than 30 years ago, in 1976, Schulte and Heimke were the first to report the immediate implantation of a dental implant in an extraction socket .^A Experiments have been conducted to determine the optimal outcomes for osseointegration.^C In an early investigation, Akimoto *et al* ^D conducted an initial study to examine the effects of dogs' jumping space size. After flap elevation, osteotomies were overprepared coronally but of the right size apically to have sufficient implant stability, creating simulated extraction sockets,This allowed for the preparation of surgical sites with coronal circumferential gaps that were 0.5 mm, 1 mm, and 1.4 mm broad. All jumping distances showed clinically full bone fill after 12 weeks of site healing. Histological analysis, however, showed that fibrous connective tissue had grown to varying depths between the surface of the implant and newly created bone, with the more fibrous tissue present in the wider jumping space. Subsequent research led to the conclusion that, in order to prevent soft-tissue ingrowth, jumping gap distances greater than 1.5 to 2 mm most likely required the installation of other bone graft materials, such as allograft or xenograft bone particles coated by some kind of membrane.

Variable bone grafts have been used as a solution for that problem like autogenous, alloplastic and xenograft materials but there was not a definite acknowledgement whether any of these types is preferable. These graft materials are not without problems. The autogenous bone graft requires another surgical maneuver, and either the

alloplastic or the xenograft bone graft costs the patient more and demands membrane coverage for avoidance of the epithelialization. Therefore, a new alloplastic graft material that is easier to apply and does not demand a covering membrane will be an advantage^E. Although they may not exactly mimic the natural structure of bone, alloplastic graft substitutes are synthetic materials that include some of the chemical elements of natural bone, such as calcium and phosphate, and are known to encourage bone regeneration. Compared to allogeneic and xenogenic transplants, alloplastic bone grafts have the advantages of consistent product quality and no risk of infectious disease. The biological stability and volume preservation of alloplastic bone substitutes, which permit cell infiltration and remodeling, are their primary benefits. Depending on their compositions, manufacturing processes, mechanical characteristics, crystal structures, pore sizes, porosities, and absorption rates, synthetic bone replacements have different osteoconductive capacities ^F. Beta tricalcium phosphate graft material is an additive putty with silicate material that is alloplastic in origin and at the same time membrane less made to repair bone defects caused by surgical maneuver or traumatic injury, increase bone reproduction or support the formation of new bone tissue in the loading bearing clinical applications.it can be mixed with bone marrow, blood and other clinically known grafts. It does not contain human or animal tissue thus there is no risk of disease transmission. It is osteoinductive and osteoconductive that enables to act as a roof for the cells to allow new bone formation and at the same time it has a structure similar to the mineral found naturally in bone. The silicate additive increases the protein retention to graft and gives it bioactive characteristics. Biodegradable, with its chemical structure it is suitable for continuous regeneration cycle of healthy bone during the healing process, β tcp is absorbed over time and promotes bone formation. besides, it is sterile, biocompatible and safe. According to the traceability on the x-ray it is radiopaque, its application is easy as it is putty in consistency and do not require mix^G.

Materials and methods

Aim of the study

This study was aimed to assess the effect of an alloplastic bone graft material on jumping gaps of the immediately placed implants.

Ethical considerations

Ethical approval for this study was obtained from the Research Ethics Committee (REC) at the Faculty of Oral and Dental Medicine, Delta University for Science and Technology. Teeth extraction was for indicated reasons, regardless of the purpose of this study, e.g. teeth are non-restorable, badly destructed, with grade 3 mobility or remaining roots. An informed consent was taken voluntarily from each patient before performing the procedure. *Study setting:*

The study was conducted in the outpatient surgical dental clinic at the Department of Oral and Maxillofacial Surgery, Faculty of Oral and Dental Medicine, Delta University for Science and Technology. The study included 14 different teeth from CBCT scans of 14 patients. the teeth in the scans should have intact buccal plates. The implants were applied in the sockets immediately post extraction and some were submitted to alloplastic graft filling the jumping gap (study group) and the others were not (control group) ,to fulfill the definite results relating the study. an informed consent was taken voluntarily from each case to perform the procedure. *Patients:*

Inclusion criteria: Patients included were in the age range of 18 - 65 years with no gender predilection.

They were required to be medically free, non-smokers and voluntarily seeking for implant placement.

Exclusion criteria: Patients excluded were younger than 18 years or older than 65 years. Smokers and medically complicated patients suffering from diabetes mellitus, uncontrolled hypertension or any other medical condition that affects the healing process of the bone and soft tissue like periodontitis was excluded.

Surgical procedure:

Extraction of teeth was done first using an atraumatic technique and preservation of the socket bony walls and soft tissue was of high priority then the implants were installed into sockets after being prepared with the surgical drills under copious saline irrigation, the jumping distance related to the implant was filled using the alloplastic graft material that needs no membrane (beta tricalcium phosphate with silicate) and this only went for seven patients in group I [study group]. Implant placement in the other seven patients in group II [control group] was graftless. After implantation, primary closure of the wound was done. After three months of implantation, patients had their fixed crowns on.



Figure (1): showing implant in place before alloplastic graft addittion.



Figure (2): showing implant in place after alloplastic graft addittion



Figure (3): showing the beta tricalcium phosphate with silicate and its consistency

Evaluation:

i) Clinical measures of implant stability:

- a) Implant stability quotients (ISQ) is a scale that ranges from 1 to 100 and was used to assess the implant stability. Four readings were taken at (Tx), (T0), (T1) and (T2). ISQ measurements were obtained immediately using (osstell) after implant placement (Tx), after the loading of the prosthesis (T0), after 6 months of the operation (T1), and after one year of the operation (T2). ISQ scales >70 indicated a high level of stability, scales between 60 and 69 meant medium stability and scales <60 meant low stability^H.
- b) Modified sulcus bleeding index (MSBI): clinical signs and symptoms of inflammation of peri-implant mucosa were evaluated after one month of the implant placement (T1) and after two months of the implant placement (T2) at four sites around each implant (labial, palatal, mesial and distal). The MSBI score ranges from 0 to 3, where score 0 = no bleeding when a periodontal probe is passed along the gingival margin adjacent to the implant; score 1= isolated bleeding spots visible; score 2 = bleeding forms a confluent red line on margins; and score 3 = heavy or profuse bleeding¹.
- c) Probing pocket depth (PPD): a graded probe was used to measure the distance between the base of the pocket and the gingival margin and this was measured after two months of the implant placement (T1) and six months postoperative (T2). The probe was introduced parallel to the implant base.^J



Figure (4): showing (osstell) for measuring the implant stability.

ii) Radiographic assessment of implant osseointegration:

The evaluation of the stability and osseointegration of the implant was made using cone beam computed tomography (CBCT) and panoramic x-ray as follows:

- a) Every patient was subjected to a preoperative CBCT and also a year later for noticing the osseointegration of the surrounding bone.
- b) During the follow-up period panoramic x-ray was also applied to notice the bone integration with the implants and the formation of bone trabeculae.
- c) Patients' recall was at 3 months, six months, and 1 year to judge the success of implant.^K

Results:

statistical analysis and interpretation: SPSS software, version 26 (SPSS Inc., PASW statistics for Windows version 26), was used to analyze the data. Chicago, Illinois: SPSS Inc. Numbers and percentages were used to describe the qualitative data. The Shapiro-Wilk test was used to test for normality, and the mean± standard deviation was used to describe quantitative data that was normally distributed. The results' significance was assessed at the 0.05 level. When necessary, the Chi-Square test was employed to compare qualitative data before and after treatment, the Stewart Maxwell Marginal Homogenity test was employed. For non-normally distributed data, two independent groups were compared using the student t test. Two paired readings of distributed data were compared using the paired t test. Paired t test was used to compare 2 paired readings distributed data a two-way ANOVA test, with R2 estimated.To compare various follow-up periods, the Repeated Measures ANOVA test was employed.

Implant stability quotients (ISQ)

Table 1 showed that mean and standard deviation of Implant stability quotients (ISQ) in time X was 78.32 \pm 5.9, Time 0 81.67 \pm 4.9, Time 1 85.1 \pm 3.7 and Time 2 was 87.3 \pm 2.6. (Fig 5). Our result showed that ISQ was significantly increased in Time 1 and 2 at compared to Time X. time 2 was significantly in Time 2 as compared to Time 0.

Implant stability quotients (ISQ)								
	T _x	T ₀	T_1	T_2	F	P value		
Mean ± SD	78.32 ± 5.9	81.67 ± 4.9	85.1± 3.7	87.3 ± 2.6	3.761	< 0.0001		

SD: Standard deviation; non-significant at 5% level. implant placement (Tx), after the loading of the prosthesis (T0), after six months of the operation (T1), and after 1 year of the surgical operation (T2).



Figure (5) : showing Implant stability quotients in different time

Modified sulcus bleeding index (MSBI)

Table 2 showed that mean and standard deviation of Modified sulcus bleeding index (MSBI) in time Time 1 1.07 ± 0.06 and Time 2 was 0.36 ± 0.05 . (Figure 6). Our result showed that MSBI was significantly decreased in Time 2 as compared to Time 1.

Table (2):	Modified	sulcus	bleeding	index	in	different tim	le.
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Modified sulcus bleeding index (MSBI)							
	T 1	T_2	F	P value			
Mean ± SD	1.07 ± 0.06	0.36 ± 0.05	1.533	0.0023			

SD: Standard deviation; non-significant at 5% level., after one month of the implant placement (T1) and after two months of the implant placement (T2)



Figure (6) : showing Modified sulcus bleeding index in different time



Figure (7) : showing clinical crowns a three months post operation



Figure (8): showing clinical restorations a six months post operation

Probing pocket depth (PPD)

Table (3) Our result showed that mean and standard deviation of **Probing pocket depth (PPD)** in time Time 1 3.25 ± 0.4 and Time 2 was 3.1 ± 0.3 . (Figure 9). Our result showed that PPD was significantly decreased in Time 2 as compared to Time 1.

Probing pocket depth (PPD)							
	T 1	T_2	F	P value			
Mean ± SD	3.25 ± 0.4	3.1 ± 0.3	2.258	0.4044			

Table (3	3):	Probing	pocket	depth	in	different	time.
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SD: Standard deviation; non-significant at 5% level., the implant placement (T1) and six months postoperative (T2).



Figure (9): Probing pocket depth in different time



Figure (10) : showing the measurement of the probing depth a six months post operation



Figure (11) : showing probing depth a nine months post operation



Figure (12): showing the variance in bone radioopacity before and a year after implantation

Discussion:

It is important to note that the grafting procedure improves the primary stability of immediate implants, as evidenced by the ISQ being below 65. This is consistent with the findings of the study by Doddarayapete N. Umashankar on the effectiveness of calcium phosphosilicate as graft material in bony defects, which measured bone density. The test group had higher mean values of bone density in the immediate, fourth, and sixth months after surgery, respectively, compared to 102.9 preoperation with a p-value of $<0.001^{(T)}$.

Grafting the jumping distances with bone substitutes was advantageous due to the effect of increasing the primary stability of implants, ALthough *Santos et al*, ^(S) estimated recent animal and human studies of bone substitutes used for jumping spaces defects in post-extraction implants, the effect of the graft procedure on implant primary stability has not been further studied. They came to the conclusion that while implant placement in newly extracted sockets is a dependable way to shorten treatment times, a biomaterial must be used to improve osseointegration outcomes and increase bone-implant contact..

According to our findings, Time 2's Modified Sulcus Bleeding Index (MSBI) mean and standard deviation were significantly lower than Time 1's. This showed that our score was 1 (isolated bleeding spots visible). The peri-implant tissue is more inflamed when the plaque and sulcular bleeding scores are higher. Müller, F., et al. found similar outcomes with titanium-zirconium and small-diameter titanium grade IV implants in edentulous mandibles. Following 60 months, there were no discernible variations in mPI or mSBI between the patients in the TiZr and Ti Grade IV groups (p = 0.23 and 0.77, respectively).Most of the patients showed an mPI score 0 or 1 and the same results were observed for the MSBI when implants were subjected to delayed loading^{L M}

Due to the possibility of false positive or negative results, pocket probing depth is a variable that does not always indicate treatment outcome. However, a crucial component of periodontal examination is the estimation of clinical probing depth. ^N, and is very important because deeper pockets and increased inflammation are signs of worsening periodontitis. Additional attachment loss is more likely to occur in areas with PPD ≥ 6 mm. Because many healthy sites cover changes in sites with disease progression, using patient means to calculate can be deceptive. ^O. In order to reduce the effect of masking, PPDs can be grouped according to different thresholds.

According to our findings, PPD was significantly lower in Time (2) than in Time (1). This is consistent with other research by Echeverría, J.J., A. Echeverría, and R.G.J.P. (Adherence to supportive periodontal treatment) that demonstrated that following periodontal maintenance leads to less plaque and bleeding on probing, which may slow or stop the progression of the disease. Lastly, patient compliance was regarded as a disease-modifying factor that positively affects tooth survival based on multiple retrospective studies ^{P Q}. These results agree with those of **Abrahamsson, I., et al**., (Early bone formation adjacent to rough and turned endosseous implant surfaces)

^R. However, all pointed out that an increase in PPD is not necessarily equivalent to attachment loss.

Conclusion:

According to the aforementioned research findings, the alloplastic graft had a positive impact on the stability and osseointegration of implants that were placed right away when compared to the control group. This was demonstrated by the increase in implant stability quotients (ISQ) and the decrease in the Modified Sulcus Bleeding Index (MSBI) and Probing Pocket Depth (PPD)

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