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RESEARCH ARTICLE

EFFECT OF DENTAL IMPLANTS SURFACE TREATMENT ON MARGINAL BONE HIGHT

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Abstract

Statement of problem: Marginal bone changes around implant supported complete dentures is one of the most significant factor that affect the clinical success of dental implants which depends mainly on osteointegration and surface treatment.

Purpose. This study aimed to assess the change in marginal bone height of two different surface treated implants retaining and supporting complete overdenture.

Materials and Methods.50-60 yearsoldcompletelyedentulous patients wereselectedandand rehabilitatedwithmaxillarycomplete dentures and mandibularoverdenturesretained by twoball and socket dental implants. The implants surface treatmentsusedwereacidetch andresorbable blast media (RBM). Marginal boneheight changes wereassessed at denture insertion, after six- and twelve-monthusingconebeamcomputedtomography (CBCT). Date wascollected and Student's t-test wasperformed.

Results. The change of marginal bone of the acid etched and RPM implants throughout the follow up periods showed no significant statistical difference among the two type of implants at time of loading, after the 6th and 12th month.

Conclusions. Acid etchedandRBM dental implants supporting and retaining complete mandibular overdentures showed significant success rates regarding the marginal bone changes during the follow up period.

Clinical Implications: Guided implant placementgranting more accurate and predictable implant position while reducing the patient fear and anxiety. The marginal bone level changes were within the reported range of the literature of both acid etched and RBM dental Implants.

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Introduction:-

Although, complete dentures have been the first line of treatment of edentulous patients for longer than a century. Currently, evidence-based dentistry and systematic reviews proved that two implant retainedmandibular overdentures are superior to conventional dentures.[1] Patients rehabilitated with implant-retained or supported overdentures lost less than 0.2mm of bone in the first year and only 0.6mm over 5 years. On the other hand, bone resorption under complete dentures were reported to reach 4mm in the first year and 5.2mm after 5 years.[2]

The critical factors for implant success are biocompatibility and osteointegration.The compatibility of implant material with the surrounding tissuesdepends on its physical, chemical, and mechanical properties.This biocompatibility is evaluated by the degree of osseointegrationof implant with the surrounding marginalbone. [3-5]Researchers have focused on modifications of the implant surface to increase the success rateby altering its roughness, surface topography, morphology, and chemical composition.[6]The bone-implant interface quality is directlyinfluenced by surface roughness of the implant. As it enhances migration of osteogenic cells and its retention on the implant surface. Thus, it provides strong and quick bone formation with a great stability during the healingperiod and decreasing the loading implant time. [4,7]Recently, severaldental implant systems with different surface roughness have been introduced.[6]Among these systems are the resorbable blast media (RBM) and acid etching surface treatments. The RBM comprisesof a biocompatible material such as calcium phosphateto provide greater bone-to-implant contact. Also, it is characterized by ahydrophilic surface that draws blood and cells to its surface quickly, which initiates rapid bone development on the implantsurface.[2,8]While the acid-etchingsurface technique depends on immersing the metallic implant into an acidic solution (HCl or HF) to produce micro pit sized from 0.5-2 μm toincrease thesurface roughness.[9,10]Such techniqueprovided homogeneous surface roughness, which improvedthe cells adhesion, and subsequentlyquickosteointegration.[6]Many imaging systems have been used as preoperative diagnostic tool for implant instalment as well as to assess osteointegration. Among these systemsis cone beam computed tomography (CBCT).[11]It is an advanced radiographic system that provides an accurate estimation of the implant site regarding bonequantity(hight and with) and quality.i.e., radio-density and architecture of the trabecular bone.[12]Hence, this research aimed toassess the marginal bone height variations around acid etched and RBM surface treated dental implants retaining mandibular overdenture using CBCT.

Materials and Method:-

Sample Size

Sample size calculated depending on an earlier study[13]as a reference. According to this study, the response of the matched pairs was normally distributed with standard deviation 0.09. If the estimated difference in the mean response of the matched pairs was 0.1, minimally the study needed 8subjectsto be able to reject the null hypothesis with probability (power) 0.8. The Type I error probability associated with this test of this null hypothesis is 0.05. Total sample size increased to 10 subjects to compensate 15 % drop out.

Method:-

Ten completely edentulous patients (50-60 years) were selected from the outpatient clinic of ProsthodonticsDepartment.The study was designed and approved by the Medical Research Ethical committee (MREC Approval No: 16007) which is in accordance with Helsinki Declaration of 1975. All patients were informed about the practical steps of this study and signed a written approval consent.Also, it wasrecorded in the Clinical Trials.gov PRS with ID: NCT04800406.

The inclusion criteriawere patients free from any systemic illnessesthat might affect bone metabolism, healthy and firm mucosa covering the residual alveolar ridge with adequate bone height and width, Angel's class Iskeletal classification, and sufficient inter-arch space. While theexclusion criteria werepatients with parafunction habits and smokers. All patients participating in this study were rehabilitated with maxillary complete dentures and mandibular overdenturesretained by two ball and socket dental implants. The implants used areacid etch and RBM implants. The acid etched implant (One Q tapered dental Implant fixtures - Dentis) was inserted on the right side while the RBM implant (S-clean tapered dental Implant fixtures - Dentis) was insertedon the left side of the same patient. Marginal bone height changes were assessed at denture insertion and after the sixth and twelfth month using CBCT. Maxillary and mandibular complete dentures were fabricated from heat cured acrylic resin following the conventional procedures. The mandibular denture was used as radiographic stent.Radiographic evaluations were accomplished using Cone beam computed tomography (CBCT)(CAT 17-19, Imaging Sciences International, Hatfield, PA).A software program (Bluesky Bio) was used for accurate determination of implants sites,

size,andfabrication of surgical guides. Implants were virtually located at the canine regions bilaterally with diameter of 3.7mm and 12mm in length. Surgicalguides were inserted into the patient's mouth and stabilized by fixation screws. Osteotomy [Fig 1] was performed using three sequential drills sized 2.2, 2.8 and finally 3.7mm(3DDX, twist drills, America). Thenimplants were inserted with its top flushed with bone surfacevia a depth controlling implant driver. After that, the surgical guide was removed and covering screws were inserted [Fig 2].An antibiotic regimen was prescribed for the patientsin addition to analgesics. Also, the patients were instructed not to wear their dentures for the next 48 hours and to rinse with an antiseptic mouthwash(Chlorhexidine, KahiraPharma and Chem. Ind. Co. 2-3 times/day) starting from the second day of osteotomy. After hree-month, patients were recalledexposingthe implants and attach ball abutments (4.5mm in diameter and 2mm height, Dentis). Female sockets were attached to mandibular dentures by direct pick-up using cold-cure acrylic resin (Acrostone Dental Company). Marginal bone changes around implants were assessed at base line (loading day), 6 and 12 months using CBCT. Linear bone measurement at mesial, distal, buccal, and lingual was performed using software (AnatomageInvivoDental, Version 5.3.1) with flat panel detector supplied by the CBC).

Fig. [1]:- Surgical guide in patient's mouth and osteotomy making.

Fig. [2]:- Implants after insertion.

Stastical Analysis

Data was analyzed by Microsoft Excel 2010 and Statistical Package for Social Science (SPSS) Ver. 20. First, the data was divided into two groups Acid etched and RBM implants. Student's t-test was applied to test the significance between the two groups at different time intervals (0, 6, and 12 months) after denture insertion. A probability value of ($P \leq 0.05$) was considered statistically significant.

Results:-

The amount of Marginal bone alterations around dental implants were assessed at base line (loading day), 6 and 12 months using CBCT.

Regarding the marginal bone changes around the acid etched and RPM implants, there were an increase in the amount bone resorption from base line, 6 months, and 12 months. The total amount of marginal bone resorption in both types of implants were statistically significant as shown in table [1]. When comparing the amount of marginal bone resorption between the acid etched and RBM implants, there were no statistically significant differences between each type of implants at time of loading, 6 month and 12 month as shown in table [1].

Table [1]:- Marginal bone height changes around Acid etched and RPM implants.

Surface treatment	Base line		6 months		12 months		P-value
	Mean	SD	Mean	SD	Mean	SD	
Acid etched	9.38 ^{A}	1.26	9.03 ^{B}	1.30	8.46 ^{C}	0.71	0.006*
RBM	8.96 ^{A}	1.37	8.65 ^{B}	1.43	8.11 ^{C}	1.33	0.004*

SD:standard deviation, *: Significant at $P \leq 0.05$, Different superscripts in the same row are statistically significantly different

While the marginal bone height resorption throughout the follow up period was assessed around the acid etched and RBM implants from (base line-6-month, 6 month-12 month and from base line -12month) showed no statistically significant differencesas shown in table [2]and when comparing the amount of marginal bone heigh changes between the two types of implants, no statistically significant difference was found.

Table [2]:- The marginal bone height changes around the acid etched and RPM implants through the follow up period.

Time	Acid etched		RBM		P-value
	Mean	SD	Mean	SD	
Base line – 6 m	0.35	0.29	0.31	0.23	0.878
6 m – 12 m	0.57	0.73	0.54	0.51	0.574
Base line – 12 m	0.92	0.76	0.85	0.59	0.574

SD: standard deviation, *: Significant at $P \leq 0.05$

Discussion:-

Several studies stated that implant overdentures provide patients with superior outcomes than do conventional dentures, regarding satisfaction, chewing ability and quality of life.

Two implants supported mandibular overdenture have been considered as the first line of treatment of edentulous mandible since, thesuccessful long-term outcome of this treatment option has been documented in a follow-up of many studies to be 96% ofsurvival rate after 20 years. [4,5,14]In this research each patient received two dental implants in the interforamineal area. The implant on the right side was acid etched while the other one was RBM. This split mouth technique was used to reduce human variables and to standardize the patient factor.[15]Besides to eliminate any factors or habits that might adversely affect the results of this study. Thedigitalized surgical guides together with the flapless implantology helped to insert the planned dental implants in the same positions as those of the virtual treatment plan, granting more accurate and predictable implant positionwhilereducing the patient fear and anxiety.[16]This technique also provides surgical procedurewith reduced time, post-operative pain, swelling and discomfort.[17]The results of this research agreed with Saturnino et al in 2014[18], and Lazzara R, Porter S in 2006.[19]Where it showed a decrease in the marginal bone height throughout the follow up period of the acid etched and RBM dental implants, but this loss was insignificantbetween the two different types of dental implants. This could be attributed to adaptation of the crestal bone to the stress of theocclusal load, which initiate resorption of the crestal bone. At the end of the research (after 12 months) the marginal bone height loss was less than 1mm of both acid etched and RBM dental implants.Although, the acid etched dental implant exhibited more peri-implant bone loss compared to RBM, but this difference was statistically insignificant. This may be attributed to advantages of

using dental implants with special surface treatment that enhance osseointegration together with the use of new technologies in implant insertion such as computer guided implant placement method and flapless technique. [20,21]This results were agreed with other studies,Naert et al[22], found that after nine-year of longitudinal study the bone loss was 0.7 mm during the first year and anaverage annual bone loss was 0.05 mm during the study period. Furthermore, Payne et al[23]stated that the loss of bone height at the crest after one year was 0.35 mm and was reduced to 0.09 mm after two years. While Nickenig et al[24]reported that after six and twelve months of functional loading the mean marginal bone loss was 0.8 mm and 1.1 mm respectively.

Conclusion:-

1. Acid etched dental implants showed additional marginal bone resorption than RBM, but this was not significant.
2. The amount of marginal bone resorption around the acid etched and RBM implants at the end of the follow up period was consistent withthe criteria of implant success.

Recommendiations:-

-A larger sample size and longer follow up duration are recommended.
- Patients satisfaction and patient's oral heath quality of life evaluation are recommended.

Authors'contributions

All authors made substantial contributions to conception and design of the research. All authors, participated in the study design, practical work, scientific writing, and revising of the manuscript.

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Conflicts of interest:

The authors have declared no conflicts of interest.

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