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Machined Versus Rough-Surfaced Collar Implants Retaining Mandibular Overdenture in Controlled Type II Diabetes Mellitus Patients

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Abstract

Objectives: This research was carried out to radiographically evaluate the effect of different implant collar surfaces (machined and rough collar) on the supporting structures of implant retained mandibular over denture in controlled type II diabetes mellitus patients using CBCT.

Materials and methods: It is a cross-over randomized clinical trial where 20 implants were placed in 10 completely edentulous patients. All patients were informed that they would be a part in this study and agreed to share and follow the instructions given to them in the form of signed consent. Each patient received both types of implants. The two implants have the same diameter, length, and surface configuration except for the collar design, one implant has a machined collar (group I) while the other has a roughened collar (group II). Patients had controlled type II diabetes mellitus with glycosylated hemoglobin level ≤7. Follow-up CBCT Scans were taken at 0, 6 and 12 months after loading to evaluate marginal bone changes in the two groups over a follow-up period of one year. The acquired data were then tabulated and statistically analyzed.

Results: The results of this study showed a statistically significant difference in marginal bone changes. Six months from loading the mean marginal bone loss was 0.706 and 0.476 for group I and group II, respectively. Twelve months from loading the mean marginal bone loss of 1.368 and 0.882 for group I and group II, respectively.

Conclusion: Within the limitations of the results obtained from the study we could conclude that: Rough surfaced collar implants showed more favorable results than machined collar implants in maintaining the supporting structures of implant retained mandibular over denture in controlled type II diabetes mellitus patients. Meanwhile both types of implants provide a reliable treatment option for treating edentulous mandible over the one-year observation period.

Keywords: overdenture, implant, diabetes mellitus, machined collar.

Running title: Machined vs rough implants in diabetics.

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Introduction:

Implant retained over-dentures provide a treatment option that could overcome many of the limitations of conventional complete dentures. Mandibular implant retained over denture is considered by many authors as the treatment of choice in patients who are not satisfied with conventional complete dentures. Improved retention, stability, decrease in the alveolar bone resorption and increase in patient's satisfaction are all advantages of using implant retained over-denture.[1,2]

Diabetes mellitus is a metabolic disorder in which high blood sugar levels occurs over a prolonged period which when left untreated can cause many complications.[3]

For so long, Dental implants for diabetic patients have been avoided because of the increased susceptibility to infection, compromised wound healing, and microvascular changes. But most clinical investigations and studies found that good glycemic control gives successful results comparable to the results of non-diabetic patients.[4]

The crest module is the portion that retains the prosthetic component in a two-piece implant system. It also represents "the transition zone from the implant body design to the transosteal region of the implant at the crest of the ridge".[5]

The crest module surface is either smooth/machined or roughened surface. The crest module is called a cervical collar when its smooth and polished. Controversy exists around the effectiveness of these configurations and their influence on the marginal bone loss.[5]

A smooth collar is claimed to reduce plaque accumulation and bacterial invasion, but it may transmit increased shear forces to the bone causing crestal bone loss which also could occur due to stress shielding due to the difference in modulus of elasticity between bone and implant, other studies shows that better mechanical link between bone and an implant is provided by roughened surface and decrease marginal bone loss is achieved.[6]

So, this study was conducted to answer the question if different implant collar roughness can affect bone height changes around implant retained mandibular overdenture especially in conjunction with type II diabetes mellitus patients or not.

Materials and Methods:

Patient selection:

10 completely edentulous patients with the last tooth extraction done at least 6 months before implant placement were selected. Patients' ages ranged from 45 to 65 years old. with sufficient inter-arch space between the maxillary and mandibular residual ridges ≥ 13 mm. Patients had controlled type II diabetes mellitus with glycosylated hemoglobin level ≤7. Patients were medically free form any other disease that could interfere with implant placement. Heavy smokers, alcoholics, patients with para functional habits or TMJ disorders were all excluded from this study.

Patient approval:

Detailed information about the surgical and prosthetic steps was explained to all the patients, Also the risks and the benefits of implant placement were informed to all patients. All patients were informed that they would be a part in this study and agreed to share and follow the instructions given to them in the form of signed consent. In case of implant treatment failure, the patients would receive a new well- fitting denture and they were informed with that.

Patient examination:

Patients were examined for any extra oral facial abnormalities, swellings, tumors, and temporomandibular joint disorders. The residual ridge, oral mucosa, and tongue were inspected.

Complete denture construction:
Primary impressions were made using alginate (Cavex Holland BV-Netherlands). Secondary impressions were made by green stick compound and ZnO/Eugenol paste (Hiflex - Pervest DenPro – India, S.S.White – England). Jaw relation record was taken with occlusion rims. After mounting the teeth were arranged according to the lingualized concept of occlusion. The denture was tried in the patient's mouth and then it was delivered.
Implant placement:
Two implants with the same width and height only different in the collar surface texture were selected (V-Plus, V-Hybrid - Vitronex - Italy) (figure 1).

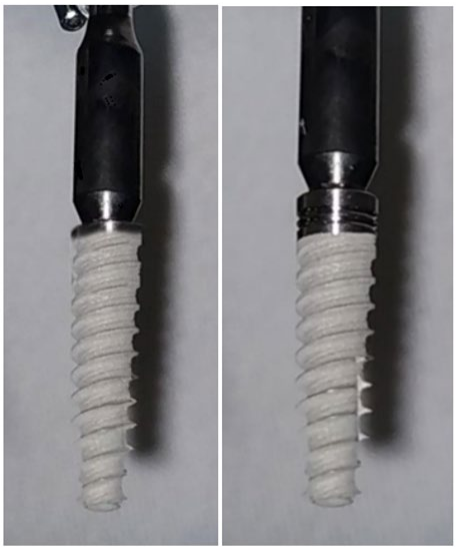

Figure 1 Implant with machined collar on the right and implant with rough collar on the left

The surgical site was irrigated with normal saline, and the elevated flap was replaced and adjusted to its former position. Simple interrupted sutures were made using 4-0 prolene suture with a 3/8 triangular cross-sectional needle (Egyprolene – TAISIER-MED – Egypt). Patients were not allowed to wear the mandibular denture during the first two weeks after the surgery. The sutures were removed 7 days after surgery. The fitting surfaces of mandibular dentures were adjusted by selective grinding at the implant locations and were relined opposing to implant sites with soft liner after another week. The implants were left submerged for 3 months after which, stage-two surgery was started.
Implant exposure and loading:
A small crestal incision was made allowing access to the cover screw. The implant cover screw was removed, and a healing abutment of suitable dimensions was placed. The fitting surface of the mandibular denture was relieved by an abrasive stone opposite to the implants' sites to accommodate for the healing abutments and tried in the patient's mouth until the denture was properly seated. After 10 days the healing abutments were removed, and the ball abutments were placed and screwed with a torque of 20 Ncm. The O-Ring attachment enclosed in the metal housing was placed over the ball abutment. The undercut below the metal housing was blocked using elastomeric light cured gingival barrier (DENU-dam – HDI – Korea). The fitting surface of the denture was relieved using acrylic burs opposing to the position of the two implants. The denture was tried in the patient's mouth to ensure complete seating and occlusion with the maxillary denture was checked. The hard

pick-up (Quick Up – Voco – Germany) material adhesive was applied on the fitting surface of the denture. The fitting surface of the denture was filled with the hard pick-up material and the denture was then inserted in patient's mouth. The patient was instructed to close in centric for about 5 minutes. The denture was then removed, and the excess material was trimmed. Instructions on denture and oral hygiene was given to the patients.

Radiographic evaluation:

Follow-up CBCT Scans were taken at 0, 6 and 12 months after loading. CBCT scans were acquired using the i-CAT next generation with standardized settings for all scans "Field of view 6cm x 18cm, voxel size of 0.2 mm; effective dose of 99 uSv, 10 mA, 120 kVp, 14-bits grey scale and 26.9s exposure time". After image acquisition, DICOM files were view using Planmeca Romexis Viewer. The implants were placed at the intersection of the sagittal, coronal, and axial planes where the implant's long axis was made perpendicular to the axial plane and parallel to the sagittal and coronal planes.

In the axial cuts screen, the coronal plane was adjusted to pass through the mesial and the distal surfaces of the implant to be investigated. Mesial and distal bone loss was measured in the coronal view screen. (Figure 2)

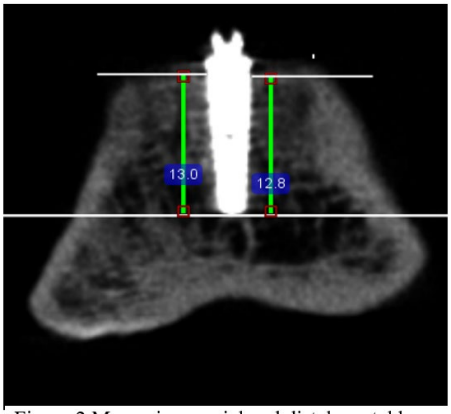

Figure 2 Measuring mesial and distal crestal bone level in the coronal view.

Results:

To compare between mean amount of marginal bone loss in the two studied groups during the follow-up intervals, unpaired t test was performed, and the results are shown in (figure 3).

six months after implant loading, the mean amount of the detected peri-implant bone loss was (0.706) mm and (0.476) mm for group I and group II, respectively. The difference between the two groups was found to be highly statistically significant $p>0.05$.

From six to twelve months the mean marginal bone loss was found to be (0.662) mm and (0.406) mm for group I and group II, respectively. The difference between the two groups was found to be highly statistically significant $p<0.05$.

Twelve months after implant loading, the mean amount of the detected peri-implant bone loss was (1.368) mm and (0.882) mm for group I and group II, respectively. The difference between the two groups was found to be highly statistically significant $p>0.05$.

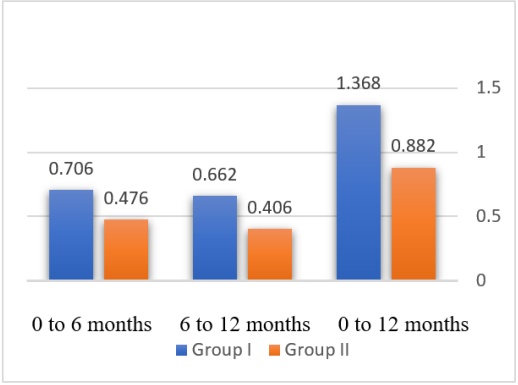

Figure 3 Mean values (mm) of marginal bone loss in studied groups during follow-up period.

Discussion:

Patient's blood glucose level was carefully monitored through the follow-up period. The patients were instructed to commit to oral hypoglycaemic drugs regimen prescribed by their physicians and to regularly check their random blood glucose level at home, Glycosylated

hemoglobin level test was done every 3 months.[7,8]

Patients have been totally edentulous for at least 6 months before implant placement in order to avoid the period of bone remodeling which occurs after tooth extraction.[9]

A specified age was selected range to neutralize the effect of age related changes on bone resorption. [10]

Flap design included full thickness crestal incision and two vertical buccal releasing incisions. Flap reflection buccally was made to the level of mucogingival junction to allow for visualization of the labial plate of bone with slight lingual flap reflection specially in the midline to avoid injuring the vessels entering the lingual foramen.[11]

The osteotomy was made using a low speed handpiece at 2500 rpm with profuse sterile saline irrigation to reduce the amount of heat generation with the drill only contacting the bone for less than 5 of every 10 seconds in a pumping action this would keep the temperature as low as possible to avoid cell injury and affecting implant osseointegration.[12]

The implants were submerged for three months to allow for optimum osseointegration. The denture was not used within the first two weeks. Then the denture was relieved over the implants and lined with soft liner to avoid any micromovement during the healing period.[13]

The second stage surgery was done 3 months after implant insertion. Healing abutments were placed to allow for soft tissue healing. The fitting surface of the denture was relieved to accommodate for the healing abutments using abrasive stones and acrylic burs on a straight handpiece.[13,14]

In this study, in order to neutralize all the factors that would interfere with the results, the two implants to be compared were placed in the same patient in the left and right canine regions. On the right side each patient received an implant with a machined collar and on the left side an implant with a rough collar. Both implants had the exact same surface geometry and treatment except in the 2 mm collar design.

Patients that participated in this study achieved successful osseointegration of both groups of dental implants through regular clinical examinations and follow-up radiographs, as well as patient satisfaction as regards to function, retention, and esthetics of their appliances. This could be attributed to proper selection of cases, adequate implant planning and selection of proper implant length and width in proportion to the height of the residual alveolar ridge, proper implant installation and angulation, and following the proper oral hygiene measures.[15]

At the end of 12 months follow-up period, the marginal bone height changes for the two studied groups within the acceptable range of implant success.[16] As researches stated that Implants suffer from some degrees of bone loss after implant installation and loading. An early marginal bone negative change of 1.5mm occurs during the healing period and the first year on function at the crest of the implants, followed by an annual loss of 0.2mm thereafter.[17,18]

This may be due to surgical trauma, establishing of the biologic width, lack of passivity in the superstructures, micro gaps present at implant- abutment interface, occlusal overloading, and implant neck configuration are among the possible etiologic causes.[19–22]

The results of this study coincided with the acceptable range of healthy nondiabetic patients in the 12-month follow-up period. This could be attributed to the good glycemic control that was maintained all over the follow-up period.

Research data about diabetic patients and development of peri-implant diseases is controversial and the actual effect of diabetes mellitus or hyperglycemia on peri-implant structures and implant failure is still uncertain.[23–25] Turkyilmaz's [26] showed no evidence of decreased clinical success one year after implant placement, defined by negative bleeding on probing, no pathological probing depth, and a negative marginal bone change of 0.3 ± 0.1 mm in a population of type II diabetic patients.

Alam-Eldein et al. [27] studied the effect of hyperglycemia control on implant retained mandibular overdentures over 3 years and found that glycemic control seems to have an effect on the survival of implants supporting mandibular complete overdentures in type II diabetic patients as it affects the crestal bone loss, probing depth around implants and affect implant stability.

The results of this study showed a statistically significant difference in marginal bone changes between the two groups in the 6 months and 12 months follow-up periods. Six months from loading the mean marginal bone loss was 0.706 ± 0.058 and 0.476 ± 0.034 for group I and group II, respectively. Twelve months from loading the mean marginal bone loss of 1.368 ± 0.109 and 0.882 ± 0.075 for group I and group II, respectively. This increase in the amount of bone loss in group I (machined collar) could be caused by the high stress concentration in the area of crestal bone around the machined neck of dental implants and the unfavorable stress distribution at the coronal portion of the implants. [28–30]

The results of this study is also agreed by Kang et al. [31] who revealed that the rough-surface dental implants significantly enhanced bone-implant interface and lowered the rate of marginal bone loss compared with smooth surface implants. Moreover, the presence of micro thread at the neck area increased interlocking of the implant and the marginal bone, thus reducing the marginal bone loss.[31,32]

A systematic review by Koodaryan et al. [33] included twelve articles with a total of 492 machined, 319 rough-surfaced, and 352 rough-surfaced micro threaded neck implants concluded that marginal bone changes were decreased around rough-surfaced micro threaded neck implants compared with polished and rough-surfaced neck implants.

Conclusion:

Within the limitations of the results obtained from the study we could conclude that: Rough surfaced collar implants showed more favourable results than machined collar implants in maintaining the supporting structures of implant retained mandibular over denture in controlled type II diabetes mellitus patients. Meanwhile both types of implants provide a reliable treatment option for treating edentulous mandible over the one-year observation period

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