Radiographic Evaluation of The Crestal Bone around Two Different Implant Designs in Implant Supported Mandibular partial Overdentures.

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Abstract: The present study will be conducted on fourteen partially edentulous patients selected from the outpatient clinic of the Prosthetic Department, of Faculty of Oral and Dental Medicine, Cairo University.

Material and methods: Patients are divided into two groups; each group received one implant in the distal extension area with a locator attachment.

Group I; received implant with conventional design (Non –plate form switching) and group II; received implant with plate form switching design and then followed by an implant supported mandibular partial over denture. Radiographic evaluation using direct digital radiography (Digora system).The cases will be followed up at denture insertion, 3months, 6 months and 12months intervals after partial over denture insertion.

Results: A statistically significant difference between the two implant designs was reported for all the follow up periods with Platform switched group (Group II) showing less values of bone loss compared to Non-platform switched group (Group I).

Conclusion: the current study concluded that platform switching is capable of reducing the amount of crestal bone loss. The use of implants with a modified platform (platform switching) improved preservation of the crestal bone and led to controlled biological space reposition.

Introduction:

Problems of distal extension base partial dentures are mainly due to the absence of posterior abutments and the difference in support between the periodontal ligament of the abutment tooth and the mucoperiosteum covering the edentulous ridge.[1]

One treatment option for such a clinical situations was suggested to solve the problem of unilateral distal extension cases, is the use of osseointegrate dental implants, thus converting the distal extension base removable partial denture from a tooth-tissue supported prosthesis with its problems into a tooth-implant supported one[2,3].

The platform switching (PLS) concept is based on the use of an abutment smaller than the implant neck; this type of connection moves the perimeter of IAJ to the center of implant axis. It is likely that moving the IAJ inward brings out bacteria more internally and, therefore, away from the bone crest; this would explain the limitation in bone resorption [4-8].

Chang et al. compared the implant–bone interface stresses around PLS and matching implant, using 3D finite element analysis, they confirmed that the PLS technique reduces the stress concentration in the area of compact bone and shifted it to the area of cancellous bone. Whereas for *Pessoa et al;* concluded that there is no significant biomechanical advantage to the design rationale of reducing the abutment diameter to move the implant–abutment gap area away from the implant–bone interface. [9-11]

However, some studies showed that peri-implant bone resorption is also dependent on the fixture diameter. In fact, it has been demonstrated using finite element analysis that increasing implants diameter results in reduction in stress at the peri-implant crestal bone. [12-14]

Moreover; *Cacilda Cunha Ferraz et al.* stated that the platform switching concept was able to reduce the stress and strain concentration for cortical bone compared with the regular platform. However, the switching platform showed higher stress for trabecular bone. The implant with micro-threads showed higher stress concentration for cortical bone in comparison with the smooth implant, and lower stress concentration for trabecular bone. [15]

The Locator attachment system (Zest Anchors) is an attachment system for implants. This attachment is self-aligning and has dual retention (inner and outer retention). Its design features the benefits of the minimal height requirement (3.7 mm) and greater cross-section for strength. Locator attachments are supplied in different colors; each has a different retention value (white, pink and blue). The white attachment has standard retention, the pink has light retention, and the blue has extra light retention. Additional features are the extended range attachments, which can be used to correct implant angulation up to 20◦.[(16)].

Huysmans et al. 1997 reported that recently different devices have been developed based on a storage phosphor system for intra-oral radiography. A new system for intra-oral radiography "Digora" uses these imaging plates with a storage phosphor coating. [(17)]

Material and Methods:

Fourteen partially edentulous cases were selected from the Outpatient Clinic of the Prosthodontic Department, Faculty of Oral and Dental Medicine, Cairo University with good oral hygiene and free from any systemic diseases that affect ossteo integration or bone resorption around the implant. Oral and general examinations were carried out accompanied by laboratory investigations including blood picture, blood sugar level.

Preoperative panoramic radiograph[1] (1:1) "to exclude patient with remaining roots or abnormal pathological condition". If the panoramic radiograph was found satisfactory a diagnostic Cone Beam Computed Tomography (CBCT) images using i-CAT[2] was done to evaluate bone volume (width) at the proposed implant site.

The selected cases were randomly divided into two equal groups; *Group I* of patients received a tooth-implant supported removable partial over-denture, after placement of Non-Platform Switching implant and a locator abutment. While patients of *Group II* received a tooth-implant supported removable partial over-denture, after placement of a Platform Switching Implant and a locator abutment.

A waxed-up partial denture was duplicated into clear acrylic resin to be utilized as surgical stent, to locate the exact position of the implant and to allow easy exposure of the implant in second stage surgery (figure 1).

[1] Orthopantomograph OT 100, Instrumentation Imaging, GE Corporation-Finland.

[2] I-CAT, Imaging Sciences international Company, Hatfield, PA, USA.

Fig. 1: surgical stent

All Patients 24 hours before surgery should be under an umbrella of broad spectrum antibiotic* and analgesics non-steroidal anti-inflammatory **those were taken every 12hours after surgery for 5 days.

For Group I: (non-platform switch implant design), after completion of the osteotomy sites, bone tapping is done using engine driven bone tap at a speed 22 RPM and torque of 35N/cm. Bone tapping is done to the full depth till the level of the laser mark one to the top line (II) on the countersink drill.

*Augmentin 1g- Beecham MUP.

** Ibuprofen, Knoll, Ludwigshafen, Germany.

While for GroupII :(platform switch implant design) after completion of osteotomy sites, platform was done using counter sink drill at a speed of 1000 RPM and a torque of 30-45 N/cm. The actual diameter of the countersink drill is 0.1mm larger than the fixture platform. So that the top level of fixture needs to be located 0.5mm below the marginal crestal bone level, moreover the drilling depth of the countersink was done.

For Group I :(non-plat form switching implant design) the implants were threaded till the smooth part of the implant flushes with the bone , while for Group II :(

platform switch implant design) the implant was threaded until the implant top flushes with the alveolar bone surface

After three month from implant insertion, each patient was recalled and the following procedures were carried-out:

For Group II; fixture position was detected with the help of the surgical stent; a diagnostic probe was inserted through the hole of the surgical stent to make a bleeding point on the mucosa covering the proposed implant site.

Then the second stage surgery was done using surgical punch to expose the implant covering screw, while for the second group the smooth part of the implant is already exposed in the oral cavity.

Then the covering screw was unthreaded, then the healing abutment was threaded into the implant and tightened well using hex screw driver and the patient was given 1 week as a healing period.

The healing abutments were removed after verification of Ossteointegration; the field was properly cleaned using sterile saline solution.

The mucosal thickness was assessed using graduated periodontal probe so that the locator abutment with a proper collar height was chosen, and then the abutment was threaded into the implant, tightened and then partial denture construction was done (figure 2).

Fig. 2: locator abutment in place.

First the nylon ring was inserted on the locator to block the under cuts in the locator and prevent the acrylic resin from entering this areas during pickup procedure, Then the metal housing was inserted on the locator above the nylon ring

The place for the locator was marked on the partial denture and then widened so that the metal housing fits smoothly and the partial denture can be inserted and removed without any interference with the metal housing.

Mix of chair side hard relining material * was done then when the resin reach due stage, priming with the acrylic monomer to the prepared part in the partial denture then start packing the acrylic, place in the patient mouth and the patient was asked to close in centric occlusion firmly until polymerization had taken place.

After setting of the acrylic resin, excess material was removed and then finishing and polishing were done.

Digital radiographs were used for the assessment of crestal bone level, peri-implant bone quality and bone surrounding implant apices. The radiographs were compared with base line radiographs. The marginal bone level was assessed at mesial and distal side of fixture on the radiographs. The height of the alveolar bone on mesial and distal sides of the implant was measured as follow: Average bone height = (Mesial bone height + Distal bone height)/2 (figure 3).

* Reline Hard: Surrey precision dental. Southampton, Hampshire, UK.

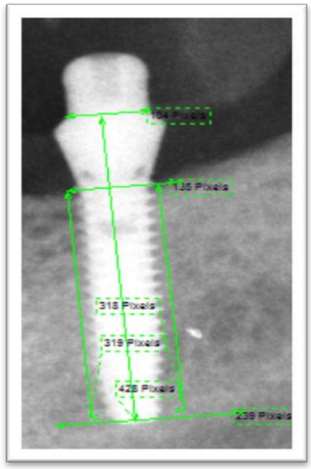

Figure 3: method of measurement of bone height.

Results:

The effect of implant designs on the marginal bone loss: In the **Non-platform, switched group (Group I)** the percentage change in the mean values of the MBL was 11.71% from loading till 3 months, 15.46 % from 3 months till 6 months, 11.18 % from 6 months till 12 months and 43.40 % from loading till 12 months. While the MBL change was 1.59 % from loading till 3 months, 23.62% from 3 months till 6 months, 12.32 % from 6 months till 12 months and 41.04% from loading till 12 months in **Platform switched group (Group II)**.The results of analysis of variance for the effect of time on Marginal bone loss (MBL) reveled a statistically significant difference between the MBL for the different follow up periods for in the **Non-platform switched group (Group I)** (H = 8.983 with P= 0.030).

The results of t-test for the effect of implant designs on the Marginal bone Loss (MBL) is shown in table (1). A statistically significant difference between the two implant designs was reported for all the follow up periods with Platform switched group (Group II) showing less values of bone loss compared to Non-platform switched group (Group I)

	Non-platform switched group (Group I)		**Platform switched group (Group II)**		**Diff**	**t**	**p**
	Mean	SD	Mean	SD			
At Loading	2.067	0.44	1.513	0.4	0.553	4.494	<0.001*
After 3 months	2.309	0.513	1.537	0.432	0.772	3.635	0.002*
After 6 months	2.666	0.553	1.9	0.347	0.766	3.829	0.001*
After 12 months	2.964	0.651	2.134	0.355	0.830	3.697	0.002*

SD = Standard deviation; Diff: difference; t-value: t-test; $P \le 0.05$ *is considered significant.*

Table (1): t-test for the effect of implant designs on the marginal bone loss (MBL).

The effect of implant designs on the Bone density*:* The results of t-test for the effect of implant designs on the bone density are shown in table (2). No statistically significant difference between the two implant designs expect at 6months and 12 months after loading (t= 2.088, 1.974 and P=0.041, 0.044 respectively).

	Non-platform switched group (Group I)		**Platform switched group (Group II)**		**Diff**	**t**	**p**
	Mean	SD	Mean	SD			
At Loading	145.403	13.483	147.542	10.553	2.139	0.688	0.494
After 3 months	188.305	14.41	197.567	35.664	9.263	1.206	0.233
After 6 months	219.021	19.989	232.218	26.279	13.196	2.088	0.041*
After 12 months	239.287	18.26	243.464	14.821	4.177	1.974	0.044*

SD = Standard deviation; Diff: difference; t-value: t-test; $P \le 0.05$ *is considered significant.*

Table (2): t-test for the effect of implant designs on the Bone density (BD).

Discussion:

All the patients that were included in this study should had a period of at least six months from the time of the last extraction or any intra-oral surgery before the

beginning of the study to make sure of the proper healing. [18]

The mandibular arch was selected for implant placement to help in solving some problems such as retention, stability and support of the superstructure. [19]

Proper patients' selection is very important for success of dental implant. Patients should be free from any systemic diseases (cardiac disease, diabetes mellitus, and debilitating diseases) that may affect the rate of bone resorption, gingival health, healing processes and the prognosis of implant-overdenture.[20]

Also; patient with insufficient bone volume, Cases with abnormal ridge relations, or Parafunctional activities as bruxism in which the magnitude of force is increased, and the direction of the occlusal forces are more horizontal than axial to the implants. Angles' class I jaw relationship patients were selected to avoid abnormal forces which are exerted on the expected implant site, thus extra load on the implant can lead to bone loss, and higher rates of implant failure. Abnormal tongue size and/or position, high labial frenum or tongue-tie require prosthetic and surgical treatment, all such cases were excluded. [21, 22]

In the implant selection, the implant designs are having sharp edged and high density threads to allow fast and successful ossteointegration. Maximized depth of the octagon design in the non-platform implants to enable easy adaptation verification for dual abutment application. [23]

Direct digital radiography (DDR) was used in this study to ensure accurate recording of bone height and density changes around fixtures as digital image analysis has the sensitivity to detect minute changes of the bone density; it has also several advantages such as immediate image display with elimination of film processing, dose reduction and computer-aided image processing facilities. Radiographic evaluation was carried out using paralleling technique with periapical film holder and individually constructed radiographic template (acrylic bite block) for each patients, to eliminate the divergence of the x-rays and avoid the possibility of magnification, unsharpness or superimposition over other structures, as well as, facilitate fixing the target to film distance to obtain repeatable radiographs. [24]

All of the investigated cases in this study showed changes radiographically during the whole follow up period, these changes could be logically explained as they could be considered as a biological response to the insertion of mandibular implant supported over denture. The clinical outcome of the present study demonstrated some differences in the outcome between platform and conventional implants designs in the Kennedy class II cases after 12 months follow up.

The reasons for the reduced bone loss observed in platform-switched implants in the present study can only be speculated upon. The horizontal inward re-positioning of the implant–abutment interface has been suggested to overcome some of the problems associated with two-piece implants. Platform switching may increase the distance between the abutment-associated inflammatory cell infiltrate and the marginal bone level, and thereby decrease its bone-resorptive effect. Also, there might be a reduction in the amount of marginal bone loss necessary to expose a minimum amount of implant surface to which the soft tissue can attach. [24]

Another reason for reduced bone loss in the present study that plate-form switching implants with micro-threads in the marginal portion were used. The possible influence on such a design on the marginal bone loss the marginal bone level was located at a more coronal position at implants when compared with conventional implants design with smooth collar in the marginal portion, and suggested that the possible positive effects may be related to the osseous healing events after implant placement rather than bone preservation during function [25-27].

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