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*RESEARCH ARTICLE*

# RADIOGRAPHIC EVALUATION OF CRESTAL BONE LOSS FOR BAR RETAINEDIMPLANT OVERDENTURE SUPPORTED BY FOUR IMPLANTS VERSUS ALL ON 4 SCREW RETAINED PROSTHESIS

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## Abstract

To compare in-vivo conventional 4 parallelimplant placement and bar attachment with cantilever supporting complete overdenture with All-on four configuration supporting fixed screw-retained denture in the term of crestal bone loss around implants

**Materials and methods:**Twelve male patients with good health and firm mucosa were selected to participate in this study. Each patient received four implants in the canine and second premolar areas of the mandible. The patients were randomly classified according to posterior implants angulation into two equal groups,Group(A) received four parallel implants in the canine and second premolar areas, bar-clip attachment with cantilever retaining complete overdenture while Group(B) recievedTwo anterior parallel implants in the canine region and two posteriorly 30° tilted implants in the second premolar area supporting fixed screw retained prosthesis. Crestal bone loss around implants was measured for each patient by using cone beam computed tomography (CBCT) and evaluation made at T6 and T12

**Results:**Therewassignificantdifference during comparing Marginal bone loss at 6 months with that of 12 months at mesial, distal, buccal and palatal bone for Group (A)(P=0.01, 0.025, 0.0001 and 0.007 respectively) and Group (B) (P=0.03, 0.028, 0.007 and 0.001 respectively). Comparing the two groups, there was no statistical difference at 6 months or 12 months.

**Conclusion:** Despite the limitations in this study, it can be denoted than both treatment options provide the same values of marginal bone loss Only the patient desire is still the contributing factor for choosing the type of restoration, if the patient desire fixed prosthesis with reduced extensions then treatment option used for group(B) (fixed detachable prosthesis screwed to four implants with the posterior implants tilted 30° posteriorly) however when access for oral hygiene measures is more important with patients that can't maintain hygiene with fixed prosthesis, then the selection of group (A) will be more appropriate.



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## Introduction:-

For several years it was known to use implant for supporting complete overdenture to treat completely edentulous patients that used complete dentures with limited retention and stability, the use of implants has improved the stability, retention and support of removable prosthesis also improved the neuro-muscular adaptation and thus improving function[1].

There is a wide variety of implant overdenture attachments, these attachments are either splinted as bar attachment or solitary attachments as ball, telescopic, locator and magnetic attachments[2].

A mandibular implant-supported overdenture with four implants and a bar has been shown to produce the highest quality of life scores. At the same time, it has been noted that patient satisfaction is not dependent on the number of implants or the attachment type[3].More implants may make the attachment system more rigid, producing more stability and retention.

Sometimes it's impossible to place dental implants such as in cases with sever resorption of the alveolar ridge without some sophisticated procedures as nerve transpositioning of maxillary sinus lifting or either bone grafting in the posterior areas of the maxillary and mandibular arches in such cases there is a solution introduced by tilting the posterior implants backward thus giving possibility of using longer implants providing better anchorage, decreasing the cantilever arm and increasing the anteroposterior spread[4].

Implant overdentures are indicated in patients with advanced bone loss as it offers artificial replacement to lost dental tissues and supporting bone and is also considered a cost-effective treatment modality that implant supporting fixed prosthesis[5]. However, many patients don't prefer restoration with removable prosthesis and desire fixed rather than removable one [10,11]. and though selecting the appropriate treatment plan would increase the quality and the satisfaction level of patients.

Combining tilted and straight implants for supporting fixed prostheses can be considered a viable treatment modality because of the high survival rate.16 However, the stability of peri-implant tissue and, especially, the marginal bone level for these tilted implants has not been extensively studied. Unfavorable loading direction could cause more marginal bone loss around these implants. In vitro studies have suggested accentuated stresses around implant necks that were nonaxially placed.[6,7] In addition, it is not known if angled implants are associated with a higher incidence of biomechanical complications. For that reason, the primary aim of this study is to compare bar retained overdenture with distal cantilever versus fixed screw retained prosthesis over implants placed according to all on 4 concept regarding crestal bone loss around implants evaluated with CBCT.

Radiographs are valuable diagnostic tools as an adjunct to the clinical examination. Two-dimensional (2D) periapical and panoramic radiographs are routinely used for assessing bone levels. In 2D imaging, evaluation of bone craters, lamina dura and periodontal bone level is limited by projection geometry and superimpositions of adjacent anatomical structures. These limitations of 2D radiographs can be eliminated by three-dimensional (3D) imaging techniques such as computed tomography[8]. Cone beam computed tomography generates 3D volumetric images and is commonly used in dentistry. All CBCT units provide axial, coronal and sagital multi-planar reconstructed images without magnification. Also, panoramic images without distortion and magnification can be generated with curved planar reformation; CBCT displays 3D images that are necessary for the diagnosis of intra-bony defects[9]

## Materials And Methods:-

A number of twelve patients with healthy mucosa and good oral and general health were included in the study and collected from the prosthodontic department in faculty of dentistry mansoura university and are characterized by that all patients have acceptable amount to be sufficient for placing dental implants either in height and width related to mandibular arch and verified by CBCT imaging, a minimum of 1 year after the time of last extraction, no old denture experience and of class I Angles classification, and a good interarch space. any patient experiencing smoking alcoholism radiation in the head and neck region, with any TMJ disorders was excluded

**Presurgical and surgical phases:**

Each patient received a complete denture and left to use for one month then a CBCT was made for the sake of construction of a computer guided stereo lithographic surgical stent.

All patients were classified into 2 groups according to the angulation of implants placed within bone into:

**- Group A:** Four parallel implants were planned in the edentulous mandible Two Implants in the canine regions and Two implants in the second premolar region by the aid of implant software.
**- Group B:** Four implants were planned in the edentulous mandible Two axial Implants in the canine regions and Two implants in the second premolar region with intended 30° posterior tilt by the aid of implant software**Fig(1)**.

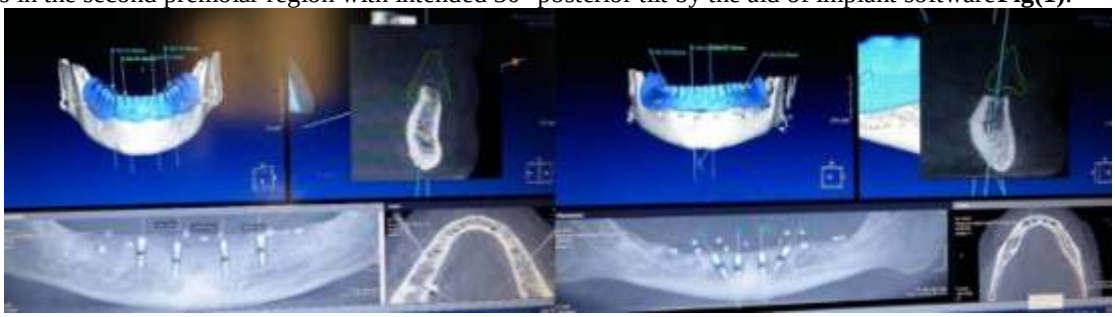

**Fig (1) Group (A) receiving 4 parallel implants while Group (B) receiving 4 implants according to All on 4 configuration**

A computer guided surgical stent that is supported upon mucosa was used during surgery that help in placing implants in the exact positions and angulations planned.

All patients received local anaesthesia and four tapered internal dental implants were placed in the canine and second premolar regions by the aid of mucosal supported stereolithographic surgical stent according to the intended planned positions and angulations**(Fig 2)**.

**Fig 2:-** Surgical procedure for guided implant placement.

**Prosthetic phase:**
After three months of osseo-integration period exposure of implants were done, cover screws were removed then straight multiunit abutments were placed in group (A) and anterior implants in group(B) whereas angled multiunit abutments (30°) were placed on posterior implants in group (B)**Fig (3)**. Then direct transfer open tray impression technique was made for every patient to transfer the exact position of dental implants using long multiunit transfer copings in tray with opening corresponding to implant sites, splinting of transfer copings with ligaturewire and composite resin then impression using rubberbase impression material, multiunit implant analogues were attached to the transfer copings, finally pouring of the impression was done after injection of tissue mimic material around analogues**Fig(4)**.

**Fig 3:-** Multiunit abutments were attached to 4 implants after ooseointegration period.

**Fig 4:-** Direct implant transfer impression.

Regarding the type of final prosthesis **Group (A)** will receive bar attachment connecting 4 implants with cantilever of length 10 mm distally, complete overdenture will be retained via 3 yellow plastic clips.

While in **Group (B)** the bar will be incorporated within the final prosthesis with perforations corresponding to implants sites that will aid in fixation.

**Bar construction:**

Four plastic multiunit abutments were screwed to the multiunit analogues on the master cast and screwed into position with abutment screws. quadrilateral 3 bars (multi-purpose bar)with distal cantilever of length 13 mm with clip attachment was fabricated and luted to plastic abutments with duralay resin while in **group (B)** bar with cantilever of length 7 mm was

fabricated with dimensions ( height 2mm and width 2mm) to be incorporated in denture base. At least 1mm clearance space should be left between the bars and the ridge to facilitate tissue cleansing under the bars.

Bars after construction (Casting,finishing and polishing) were tried inside patients' mouth then a new mandibular denture was constructed for each patient as follows:

For **Group (A)**Pick up of three yellow plastic clips was done for three bar assembly, block out under bar was done using wax then direct pickup was done using self cure acrylic resin while patient biting in centric relation.

For**Group (B)**Final prosthesis was designed with no flanges and bar was incorporated inside final prosthesis with perforations corresponding to implant sites that will aid in fixation **(Fig 5)**

**Fig 5:-** Bar-clip attachment for group (A) and screw retained prosthesis for group (B).

**Marginal bone loss evaluation:**
Radiographic evaluation was done by using Cone Beam CT (CBCT) immediately, 6 months and 12 months postoperative. OnDemand3D program was used for image reconstruction and analysis.

For the calculation of marginal bone loss (MBL), the implant was used as a reference by adjusting the cross-sectional and panoramic long axis in the centre of the implant and bisecting it (showing the buccolingual and mesiodistaldimensions).

**Cross-sectional view ofCBCT:**
A line was drawn just parallel to the implant, starting at the crest of the buccal plate of bone and ending at the apical level of the implant; height was recorded in millimeters immediately, 6 months and 12 months postoperative. The same process was repeated from the palataldirection.

**Panoramic view ofCBCT:**
The panoramic view was utilized to calculate the mesial and distal bone heights in millimeters immediately, 6 months and 12 months postoperative.

## Results:-

**Table 1:-** Showing no statistical difference regarding to marginal bone loss between two groups after 6 months of follow up:

| Marginal bone loss at 6 month | Groups | | | | P |
|---|---|---|---|---|---|
| | Overdenture group | | All on 4group | | |
| | Mean | ±SD | Mean | ±SD | |
| Mesial | 0.78 | 0.50 | 0.77 | 0.48 | 0.95 |
| Distal | 0.59 | 0.44 | 0.79 | 0.67 | 0.5 |
| Buccal | 0.35 | 0.23 | 0.37 | 0.19 | 0.9 |
| Palatal | 0.73 | 0.45 | 0.57 | 0.32 | 0.46 |

**SD:Standarddeviation P:Probability P: Significancewhen<0.05**

**Table 2:-** Showing no statistical difference regarding to marginal bone loss between two groups after 12 months of follow up:

| Marginal bone loss at 12 months | Groups | | | | P |
|---|---|---|---|---|---|
| | Overdenture group | | All on 4group | | |
| | Mean | ±SD | Mean | ±SD | |
| Mesial | 1.04 | 0.47 | 1.09 | 0.44 | 0.85 |
| Distal | 1.37 | 1.00 | 1.20 | 0.94 | 0.74 |
| Buccal | 0.60 | 0.23 | 0.65 | 0.21 | 0.68 |
| Palatal | 0.98 | 0.55 | 0.84 | 0.33 | 0.59 |

**SD:Standarddeviation P:Probability P: Significancewhen<0.05**

**For Group (A)** At 6 months, the mean of MBL were 0.78±0.5 mm mesially, 0.59±0.44 mm distally, 0.35±0.23 mm buccally and 0.73±0.45 mm palatally.

At12months,themeanofMBLwere1.04±0.47mmmesially, 1.37±1 mm distally, 0.60±0.23 mm buccally and 0.98±0.55mmpalatally.

Mesial,distal,buccalandpalatal,thereweresignificantdifference during comparing MBL at 6 months with that of 12 months,(P=0.01, 0.025, 0.0001 and 0.007 respectively).

**For Group (B)** At 6 months, the mean of MBL were 0.77±0.48 mm mesially, 0.79±0.67 mm distally, 0.37±0.19 mm buccally and 0.57±0.32 mm palatally.

At 12 months, the mean of MBL were 1.09±0.44 mm mesially, 1.2±0.94 mm distally, 0.65±0.21 mm buccally and 0.84±0.33 mm palatally.

Mesial, distal, buccal and palatal, there were significant difference during comparing MBL at 6 months with that of 12 months, (P=0.03, 0.028, 0.007 and 0.001 respectively).

Comparing the two groups, there was no statistical difference at 6 months or 12 months.

## Discussion:-

In this study, calculations of bone loss were done by measuring the bone height 6 months and 12 months after insertion of final prosthesisfor each implant surface in both groups, from the bottom to the top of the implant (which was used as a reference), in order to measure the amount (in millimetres) and percentage of resorption for each surface and to compare them with those of the other group[10].

CBCT was used for evaluation of marginal bone loss in this study as evidence shows that compared to conventional radiography or 2D digital techniques, CBCT enables the clinician to visualize structures in thin sections without superimposition of anatomical structures and also enables more accurate evaluation of bony changes due to periodontal diseases.[11,12]

Studies comparing the use of 3D volumetric images and 2D images in detection of artificial bone defects have shown that CBCT has a sensitivity of 80–100% in the detection of bone defects; while intraoral radiographs provide a sensitivity of 63–67%. When compared with periapical and panoramic images, CBCT has also shown an absence of distortion and overlapping and the dimensions it presents are compatible with the actual size [13].

There was no significant difference in marginal bone loss around tilted and vertical implants of both groups, perhaps for the following reasons: (1) the length of the implants used was long and (2) the splinting effect. To engage more bone to maximize implant stability, most included studies utilized implants with a length of at least 10 and up to 20 mm. With increasing implant length, more effective stress distributions for cancellous bone were found[14]. Another finite element study[15] suggested that longer implants distributed stress better, resulting in reduced gap distances between bone and implant. A prospective study[16] did report that long implants (14 to 16 mm) had significantly less marginal bone loss than average length (12 mm) implants at 1-year postloading. The comparable marginal bone loss for tilted implants could have been partially due to their long length.

A more probable method to reduce stress around the neck of a tilted implant is splinting and reduction of the cantilever length rather than increasing the implant length.[17,18] In all cases included in the present review, tilted implants were splinted into a fixed prosthesis, either for a partial or full arch. The reduction of the cantilever span by tilted implants and the rigidity of the prostheses could have helped to reduce stress. Some recent three-dimensional finite element studies[19,20]suggested that tilted implants could benefit stress distribution by reducing cantilever length and, therefore, may be a viable option. These computersimulation studies could have partially explained the favorable marginal bone level around tilted implants

## Conclusion:-

Despite the limitations in this study, it can be denoted than both treatment options provide the same values of marginal bone loss

Only the patient desire is still the contributing factor for choosing the type of restoration, if the patient desire fixed prosthesis with reduced extensions then treatment option used for group II (fixed detachable prosthesis screwed to four implants with the posterior implants tilted 30° posteriorly) however when access for oral hygiene measures is more important with patients that can't maintain hygiene with fixed prosthesis, then the selection of group II will be more appropriate

## Recommendations:-

Further extensive study with additional number of patients and more investigation methods is recommended for comparingbetween the two treatment modalities and comparing them with others

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