

## **Effect of Two Different Treatment Modalities on Pre-implant Bone Height of Implant Supported Mandibular Overdenture**

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**Aim:** This study was carried out to evaluate radiographically the effect of different treatment modalities (All on 4 Concept or 4 implant in interforaminal region) on pre-implant bone height changes of implant supported mandibular overdenture using CBCT.

**Material and methods:** Fourteen completely edentulous patients were selected according to the inclusion and exclusion criteria and divided randomly into 2 groups. Group 1: seven completely edentulous patients were rehabilitated with upper complete denture and lower implant supported hybrid prosthesis using All on 4 concept and group 2 seven completely edentulous patients were rehabilitated with upper complete denture and lower implant supported hybrid prosthesis using four straight implants in anterior intra foraminal region. Bone height changes were evaluated at 0, 6, 12 months after insertion of prosthesis. All data was collected, tabulated & statistically analyzed.

**Results:** The results of this study showed more marginal bone loss around tilted implants in All on 4 concept than straight posterior implants in the second group.

**Conclusion:** Tilted posterior implants in All on 4 concept induce more bone resorption than straight posterior one.

**Keywords:** Surgical guided surgery, all on 4 concept, Implant supported overdenture

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## Introduction

Edentulism reflects an organ deficiency generally seen in elderly people and has a deep impact on the quality of life<sup>(1)</sup>.

The implant retained overdenture has been proposed as the standard of care for the restoration of the edentulous mandibular arch<sup>(2)</sup>. The advantages of the mandibular implant retained overdenture compared to the conventional complete denture prosthesis are the improved stability, retention, function, esthetics, reduced ridge resorption, simplicity of fabrication and ability to convert an existing denture into an overdenture<sup>(3-4)</sup>.

Five organized treatment options were introduced for implant supported mandibular overdenture in completely edentulous patients. The treatment options range from primary soft tissue support and implant retention to a completely implant supported prosthesis depending on patient complaints, anatomy, desire, needed amount of retention and/or stability, and financial ability<sup>(5)</sup>.

Recently there is another treatment option that is all on 4 implant supported prosthesis. The all on 4 concept is a cost efficient graftless solution that provides the patient with a fixed full arch prosthesis on the day of surgery. It provides full arch rehabilitation with only 4 implants two axial anterior implants and two posterior implants tilted up to 45 degrees. By tilting the two posterior implant, the bone to implant contact is enhanced, providing optimized bone support even with minimum bone volume. Tilting of the posterior implant also helps to avoid vital structures and results in a better distribution of implant along the alveolar crest, which optimizes the load distribution and allows for final prosthesis with up to 12 teeth<sup>(6)</sup>.

All on 4 treatment concept can restore function, esthetics and speech. This makes it attractive and potentially life changing

treatment option for the patient. It reduces treatment complexity, the number of surgeries and the overall treatment time by tilting the posterior implant avoids the need for time consuming bone grafting procedures. Also, immediate loading can be done with a fixed provisional prosthesis shortens time to teeth.<sup>(7)</sup>

The All on 4 treatment concept is not only the least time-consuming treatment option, but it is also the least costly in comparison with conventional implant treatment method for the edentulous and soon to be edentulous jaw using two stage surgery<sup>(8)</sup>. So, this study was conducted to compare All on 4 concept & conventional implant supported prosthesis regarding bone height changes in completely edentulous mandibular arch.

## Materials and Methods

Fourteen completely edentulous patients were selected from the out-patient clinic of Prosthodontics Department, Faculty of Dentistry, Ain Shams University. Completely edentulous patients with good oral hygiene, sufficient interarch space and had no history of parafunctional habits were selected in this study. Patients with uncontrolled systemic diseases such as diabetes and heavy smokers were excluded from this study. The complete denture construction was made in conventional method and delivered to all patients. Patients were randomly assigned into two equal groups using closed envelope. **Group 1:** Seven completely edentulous patients were rehabilitated with upper complete denture and lower implant supported hybrid prosthesis using All on 4 concept.

**Group 2:** Seven completely edentulous patients were rehabilitated with upper complete denture and lower implant supported hybrid prosthesis using four straight implants in the anterior intraforaminal region.

Cone beam computed tomography (CBCT) scan was made for patients while wearing the denture with radio-opaque gutta-percha markers at the proposed implant sites. CBCT was analysed by measuring bone height and width at the proposed implant sites. Suitable implant sites and sizes matching the bone dimensions were then selected.

For group 1, four conventional interactive (J dent implant system) two piece implants screw type with 3.7 mm in diameter and 13mm in length were selected to follow all on 4 concept, 2 anterior straight implants and 2 posterior mesially tilted implants with 30 degree angulation .

For group 2, four straight implants oriented axially within the interforamin space.

Once the positions of implants were accepted, the virtual surgical guide with four holes was designed on the software. Additional three channels were added during the virtual planning for the installation of anchor pins.

The surgery was performed under local anesthesia with articaine chlorohydrate with adrenaline 1:100,000.

For group (1):

Patients of this group received four surgically guided implants according to All-on-4 concept. The surgical guide was disinfected according to the manufacture instruction. It was placed in a chemical disinfectant glutaraldehyde for 10 to 12 min. The mucosal supported surgical guide was adapted by occlusion with the opposite arch. Fixation of the guide was done using the manufacture provided surgical guide surgical kit in 2 guide universal kit cyber med to drill through 3 labial windows to place anchorage fixation pins. Fig (1)



Fig. (1): Adaptation and fixation of surgical guide by patient's occlusion and anchorage pins Surgical guide seated in place.

The drilling sequence for implant placement began with a tissue punch through each metal sleeve of the surgical guide to remove the mucosa only in the areas where the implants' osteotomy had to be done. Following the report provided with the surgical guide about the exact drill length and diameter to be used according to the virtual plan. The sequential drilling was done for each implant through the surgical guide to ensure precise implant location.

The two anterior implants were oriented axially while the two posterior implants were tilted mesial with a 30-degree angulation guided by the secured surgical guide. Each implant was inserted manually through the guide. Each implant was secured with final torque of 35–45 N/cm using torque ratchet. 30-degree multiunit abutments were placed at the posterior sites and 0-degree multiunit abutments were placed at the anterior sites, so they emerge toward the occlusal surface of the denture. Fig. (2).



Fig. (2): Multiunit abutments in place

### For group (2):

**Patients of this group received four surgically guided implants oriented axially in the interforamin space without angulation.**

Patients of this group received four surgically guided implant oriented axially in interforminal region and the steps of surgery were the same as group 1.

The sequential drilling was done for each implant through the surgical guide to ensure precise implant location. Fig (3)



Fig. (3): Implant site Drilling through surgical guide.

The four implants were oriented axially within the intraforamin space without any angulation. Each implant was inserted manually through the guide.

0-degree multiunit abutments were placed at the anterior and the posterior sites, so they emerge toward the occlusal surface of the denture.

Prosthetic protocol was the same for the 2 groups and was carried as follows. Index position of the multiunit abutments was done using bite material in fitting surface of already presented lower complete denture. Four holes were made in the denture for titanium sleeves (temporary coping multiunit cylinders), holes were large enough and rechecked intraoral for proper seating.

Titanium sleeves were screwed to the four multiunit abutments and the hollowed-out denture was placed over the titanium sleeve to check the passive fit. Fig (4)



Fig. (4): Temporary coping secured to multiunit abutments.

Reduction of titanium sleeves height was done using a marker (red high spot indicator) to make proper height of the sleeves to the level of the occlusal plane before pick up step.

The sleeves were unscrewed from the multiunit abutments and trimming of the excess was done using a metallic disc till the previously determined mark.

Rubber dam material was used after being cut into small sized squares and attached around the titanium sleeves. Small pieces of cotton were used on the top of the screw access of the titanium sleeves.

Cold curing acrylic resin was used to pick up the titanium sleeves in the lower denture. The borders and flanges were trimmed. A sharp angle or edges were removed. The acrylic provisional prosthesis was then screwed back to the multiunit abutments in the mouth and occlusion was rechecked with articulator paper to be adjusted. Fig (5)



Fig. (5): Screwed final prosthesis

Patients were recalled every six months for follow-up radiographic evaluation. CBCT was taken to evaluate marginal bone loss

surrounding the four implants in each case of both groups after loading and 6,12 months. All the data were collected, tabulated, and statistically analyzed.

For the purpose of standardization two parallel lines one at the fixture platform and the other at the apex were drawn, a vertical line indicating the distance between them, this distance and lines are kept the same during the different follow-up measurements for the same implant. Fig (6)

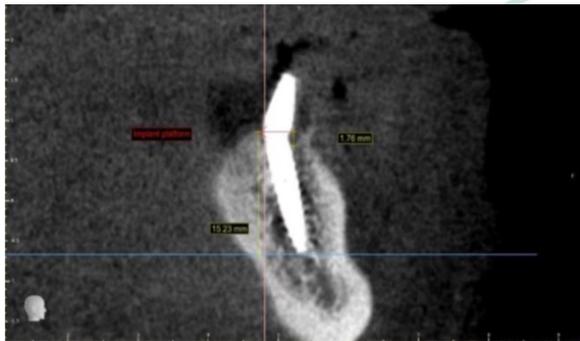


Fig. (6): Measuring bone change around angled implants.

## Results

Patients attended all the appointments of follow-up in its time during which data were obtained from their radiographs to evaluate prei-implant bone height changes around implants in Group 1 (All on 4) and in Group 2 (Straight).

To evaluate the effect of time on prei-implant bone height changes within the same group during the follow up period (1 year), paired t-test was used. An Independent t-test was used to evaluate prei-implant bone height changes within the two groups during the follow-up period. The significance level was set at  $p \leq 0.05$ .

Table (1): Comparison between All on 4 group & straight group regarding bone changes of anterior implants:

Anterior implants	All on 4		Straight		P value
	M	SD	M	SD	
0-6	0.35	0.13	0.43	0.22	0.22
6-12	0.43	0.10	0.48	0.05	0.08
0-12	0.78	0.10	0.90	0.18	0.02*

M; mean SD: standard deviation \* Significant difference

Comparison between All-on-4 group & straight implants group regarding anterior implants was performed by using Independent t-test which revealed that, bone height changes in straight implants group was significantly higher than All-on-4 group in (0-12) intervals as  $P < 0.05$ , while there was insignificant difference between them in (0-6) & (6-12) interval as  $P > 0.05$ .

Table (2): Comparison between All on 4 group & straight group regarding bone changes of posterior implants:

Posterior implants	All on 4		Straight		P value
	M	SD	M	SD	
0-6	0.68	0.15	0.5	0.08	0.009*
6-12	0.48	0.1	0.33	0.1	0.008*
0-12	1.16	0.23	0.83	0.16	0.004*

Comparison between All-on-4 group & straight implants group regarding posterior implants was performed by using Independent t-test which revealed that, bone changes in straight implants group was significantly lower than All-on-4 group in all intervals as  $P < 0.05$ .

## Discussion

Completely edentulous cases were chosen in this study to exert the least number of forces on lower overdenture as our study implement immediate loading. The mandible was chosen for implant placement in this study, as the amount of bone resorption is generally greater in the mandible than the maxilla, and because the mandibular denture usually shows greater clinical problems for patients and prosthodontist. Many patients usually complain of ill-fitting dentures, lack of retention and stability. <sup>(9)</sup>

CBCT was used because of its ability to reconstruct a fully three-dimensional model of the maxilla and mandible, CBCT produce a highly sophisticated format for precisely defining the jaw structure and locating critical anatomic structures. CBCT scans, in conjunction with software that readers immediate treatment plans using the most real and accurate information, provide the most precise radiographic modality

currently available for the evaluation of patients for oral implants.<sup>(10)</sup>

Flapless technique was chosen for this study because of its advantage of not elevating the periosteum, unlike flap surgery thus minimizing bone height changes, as elevating the periosteum decreases the blood supply to the bone, which aids in bone resorption after the surgery.<sup>(11)</sup>

After placing the temporary coping over the multiunit abutments, the denture was relieved over the temporary coping for pick up and converting the denture into a fixed provisional prosthesis delivered to the patient within the same day of surgery.<sup>(12)</sup>

Block out rubber dam pieces were cut and inserted around the temporary coping before picking up technique to prevent the escape of resin around the multiunit abutments, which render them worthless. The direct pickup technique used rather than the indirect technique to avoid errors that may occur with the indirect technique.

After pick up the gingival surface of the provisional prosthesis is slightly oversized, highly finished and polished to shape the soft tissue.

Cone beam radiography was used in this study for radiographic evaluation of crestal bone changes because of its 3D diagnostic image, accuracy, and low-radiation dose. Alveolar bone height around implants was measured in relation to the implant apex at the sagittal view to ensure standardization. A horizontal tangent line was drawn to the apex of implant and then three successive vertical measures were taken for alveolar bone height for each side and the mean length of three measures for each side was taken to ensure the reliability of the measured height.<sup>(13)</sup>

The results showed that the amount of marginal bone loss around posterior implants in All on 4 group was higher than posterior implants of straight group after 6 months of functional loading, but this difference was

statistically non-significant. This marginal bone loss was found probably as an adaptive response to healing and loading that will not threaten implant anchorage and is not necessarily of predictive values for later changes of bone level.<sup>(14)</sup>

After 12 months of functional dynamic loading, the amount of marginal bone loss around posterior implants in All on 4 group increased significantly to exceed the amount of marginal bone loss around the posterior implants in straight group, this may be due to the angulation of dental implant in group 1. This is coincided with other study that concluded that stresses are directly proportional to the increase of the angulation of the distal implant<sup>(15)</sup>.

### Conclusion

Tilted posterior implants in All on four concept induce more bone resorption than straight posterior implants in cases with four straight implants within interforamina space.

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