

## Effect of mini implant number and distribution on the supporting structure of implant retained mandibular overdentures

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### Abstract:

*Aim:* The aim of the present study To evaluate the effect of using different mini-implant number and distribution on the supporting structure of implant supported mandibular overdenture using cone beam computed tomography.

*Materials and Methods:* twenty one patients were categorized into three groups, each group was treated by a 2.4 mm width and 13 mm length 3M mini-implant. two MDI in group I, three MDI in group II, four MDI in group III. All patients were radiographed using CBCT at 3, 6, 12 months to measure bone height changes anteriorly and posteriorly. Intergroup comparisons were done utilizing one-way ANOVA followed by Tukey's post hoc when the ANOVA test. While intragroup comparisons were done using one-way repeated measures ANOVA followed by bonferroni post hoc when the ANOVA test.

*Results:* the bone height change (bone loss) anteriorly for group III was lesser than that for group II which was lesser than group I, this difference in bone height change was non significant at most aspects around the implants. Posteriorly for group III was lesser than that for group II and group I, this difference could be attributed to load distribution on more implant number. However, difference in the bone height change was statistically non significant for most aspects around the implants.

*Conclusion:* There is no significant difference between using two, three and four un-splinted mini-implants, in regard to the reduction of the peri-implant bone loss

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## Introduction

Edentulism is defined as the loss of all permanent teeth. It affects millions of people, and considered to be unresolved issue of sustained significance in the old age, it is considered to have several negative effects on the patient; It is associated with a residual ridge resorption, altered facial form, diminished masticatory function, and subsequently a reduced general health and quality of life, the ultimate goal is to restore a satisfactory level of function for the patient. The classical treatment option for the edentulous patients is the conventional complete dentures. Although this treatment option is inexpensive and restores most functions, it has several drawbacks in regard to the supporting structures, retention, and stability. Although, the problems of the conventional complete dentures can be managed using fixed prostheses supported by five or six endosseous implants, many patients are satisfied with implant supported overdenture that is simple, less invasive, and less expensive. The main limitations of using implant overdentures are that implants are expensive, also, the bone volume may be insufficient for conventional diameter implants without some interventions like bone augmentation which will increase the cost and time of the treatment. Mini dental implants are less expensive than conventional implants, they can be inserted in the narrow ridges without the need for additional bone augmentation, they can achieve a suitable primary stability and can be immediately or early loaded to reduce the time of the treatment, and they can be inserted without reflection of a periosteal flap.

Although, four mini dental implants have been recommended to support the mandibular overdentures, there are several studies that reported good results of using only two or three mini dental implants to support the mandibular overdentures.

Bar and ball attachments are the most used attachments with the implant overdentures. Several studies revealed that the ball attachments can distribute forces more evenly

and could be advantageous compared to the bar attachments.

In This study, a cone beam computerized tomography was used to compare the use of two separate mini implant and three separate mini implant retained mandibular overdentures

## Materials and Methods

Twenty one completely edentulous patients were selected randomly for the study according to the following criteria:

- Age ranged between 55-65 years.
- The last tooth was extracted not less than 6 months before the date of surgery.
- Residual bone and mucosa were free from any pathological signs or bony undercuts.
- Patients had adequate inter-arch space and normal ridge relationship.
- The radiographic examination revealed adequate bone width and height in the interforaminal region to accept mini-implants of 2.4mm diameters and 13mm lengths.
- All patients received detailed oral and written information on the study before the start of the treatment; the surgical and prosthetic procedures, the risks and the benefits of the implant retained overdenture as an alternative treatment option, and the purpose of the study were explained thoroughly for all patients. All patients agreed to be a part of this study and agreed to undergo a follow-up period for one year. Ethical approval for the study was obtained by local Ethics Committee in Ain Shams University.

### A- Grouping of the patients:-

*The Patients were allocated randomly in to three equal groups:-*

***The first group (seven patients):-*** Patients of this group were treated by two mini-implants of 2.4mm diameters and 13mm lengths (in the canine regions) retaining mandibular overdentures and by conventional maxillary complete dentures.

**The second group (seven patients):-** Patients of this group were treated by three mini-implants of 2.4mm diameters and 13mm lengths (equally distributed in the interforaminal region) retaining mandibular overdentures and by conventional maxillary complete dentures.

**The third group (seven patients):-** Patients of this group were treated by four mini-implants of 2.4mm diameters and 13mm lengths (equally distributed in the interforaminal region) retaining mandibular overdentures and by conventional maxillary complete dentures.

### **B- Dentures construction:-**

The dentures were constructed by the conventional method.

### **C- Insertion of the implants:-**

- Flapless technique used to insert the implants, the surgical stent used to make an initial penetration through the cortex of the bone using 1.1mm Pilot Drill through the holes of the stent which represented the planned positions of the implants for group I at canines regions, and for group II at canines and midline regions. The stent then removed and the drilling then continued by the 1.1mm pilot drill through the initial hole to about two thirds of the drill.

- The angulation of the drilling was confirmed by using the Initial Drill as a paralleling pin, this Drill disconnected from the hand piece and placed in the osteotomy site, and its angulation was observed, any adjustments needed were performed while inserting the implants. The 1.7mm Surgical Drill the used to widen the osteotomy site to about only one third of the length of the drill as the implant is tapered, and this done to give adequate initial stability for immediate loading of the implants, all the previous drilling procedures are done at approximately 800-1000 RPM associated with continuous copious amount of sterile irrigation.

- The initial 1.1mm pilot drill then used again as a paralleling pin which placed in the first osteotomy sit to act as a guide for the angle of drilling for the rest of implant sites and

the previous drilling steps repeated for each implant site for both groups.

- The implant is supplied in a sterile vial that boxed in a plastic box, the sterile vial is opened and the implant is carried to the site using the vial cap that is attached to it. After inserting the implant into the pilot opening through the attached gingiva, the first turns was done with the vial cap until resistance is met. The Winged Thumb Wrench then attached to the implant and rotated clockwise while exerting downward pressure until a noticeable bony resistance was encountered. The Graduated Torque Wrench then used to finalize the insertion process. The square neck of the Ratchet adapter is engaged into the square opening of the wrench. The wrench was grasped with the directional arrow facing clockwise and attached to the implant to exert more torque for inserting the implant to its full length; in which The ideal implant position allows the abutment head to protrude from the gingival soft tissue at its full length but with no neck or thread portions visible. After inserting the implant to it full length, the resistance torque should be at least 35 NCM to allow immediate loading of the implants.

- All the previous steps were followed to insert all other implants for all groups.

### **D- Loading of the implants:-**

- The implants were loaded immediately after insertion of the implants for both groups. Silicon based soft liner used to load the implants for all groups.

### **E- Follow-up of the patients:-**

- The patients were frequently recalled for the clinical evaluation of the denture bearing areas, the peri-implant soft tissue conditions, and for the post-insertion adjustments needed.

### **F- The radiographic evaluation of the patients:-**

- Radio-opaque markers (Two pieces of gutta percha) were inserted in grooves made between the lower second premolars and first molars of the lower denture in both sides to evaluate the bone loss at the posterior residual

ridge.

- Digital Cone Beam Computed Tomography (CBCT) was used to monitor the changes occurred in the marginal bone height around the implants at the time of the implant loading as a zero or base line image, six months, and twelve months after implant loading for all groups.

- Results were collected, tabulated, and statistically analyzed to evaluate the effect of using two, three, or four mini-implants to retain mandibular overdenture on the marginal bone loss around the implants.

## Results

Numerical data were explored for normality by checking the data distribution, calculating the mean and median values and using Kolmogorov-Smirnov and Shapiro-Wilk tests. Data showed parametric distribution so; it was represented by mean and standard deviation (SD) values.

A- Inter and intragroup comparisons of total bone height:

- For all follow-up intervals, there was no significant difference between different groups and Group (III) had the highest (mean±SD) value followed by Group (II) then Group (I).

- For different groups, there was a significant difference between different follow-up intervals. (Baseline) had the highest (mean±SD) value followed by (6 months) then (12 months). Pairwise comparisons showed all follow-up intervals to be significantly different from each other.

### **B- Inter and intragroup comparisons of bone height in posteriorly:**

- For all follow-up intervals, there was no significant difference between different groups and Group (III) had the highest (mean±SD) value followed by Group (II) then Group (I).

- For different groups, there was a significant difference between different follow-up intervals. (Baseline) had the highest

(mean±SD) value followed by (6 months) then (12 months). Pair-wise comparisons showed all follow-up intervals to be significantly different from each other.

## Discussion:

### **A- Discussion of Methodology:**

In this study, mandibular implant overdentures were constructed opposing conventional maxillary dentures as most problems occur with the mandibular conventional dentures.

The ages of the patients ranged between 55 and 65 years old, the healthy implant candidates older than 65 years should be considered as patients with a mild systemic disease.

In the present study, Tokuyama Dental, Japan silicone-based soft liners were used in the construction of attachment for mini-implant overdenture, based on their high performances.

The diagnostic casts were mounted on a mean value articulator by provisional jaw relation in the correct centric relation and vertical dimension to examine an adequate interarch space. The estimated interarch space required for an implant-retained overdenture measured from the implant shoulder to the incisal edge should be more than 12 mm.

Compared with the standard diameter implants, the mini-ones have less surface area for anchorage and reduced resistance to fracture.

In this study, the radiographic examination was performed using a dual purpose (diagnostic as well as surgical) stent in conjunction with a CBCT scan imaging for the determination of the position of the implants. Although, the conventional diagnostic aids such as diagnostic casts, periapical, and panoramic radiographs are routinely used for determining the adequacy and the angulation of the bone while determining the position of the implants, but, none of these can determine the three-

dimensional (3D) position of the implant, all conventional radiographic techniques collapse a three-dimensional (3D) structure onto a two-dimensional (2D) plane. The resulting superimposition of the anatomical structures complicates the image interpretation and landmark identification, the resulted distortion and magnification may lead to a reduced measurement accuracy.

The mini dental implants are considered to be a good alternative to the standard dental implants due to their small diameters, low costs, and avoidance of additional surgical procedures such as bone augmentation. Patients reported a significant improvement in the quality of life, overdenture stability and comfort, speaking, and chewing ability following the rehabilitation by these implants.<sup>1</sup>

The diameter of 2.4mm was used as several studies were performed using this diameter and compared the outcomes with conventional larger diameter implants. In most studies there was no difference between them.<sup>2,3,4,5</sup>

In this study, for inserting the implants a flapless technique was used, many advantages were recorded for this technique that made it increasingly demanded by the clinicians and patients. Flapless surgery prevents the reflection of soft tissues reducing the surgical trauma. As a result, the necessary process of healing of the wound is minimal, with an absence of scar and its typical complications of conventional surgery as the dehiscence of the flap. The absence of suture in the majority of cases contributes equally to the best postoperative appearance of the surgical area<sup>163</sup>. As flapless technique implies only an essential orifice on the mucosa, blood supply is minimally affected compared to what takes place in surgeries with large flaps which are forced to be designed broad-based in order to avoid flap necrosis.<sup>6</sup>

When the change in the bone height around the implants in the three groups compared at the all follow-up intervals, it was found that the bone height change (bone loss) for group III was lesser than that for group II which was lesser than group I, this difference in bone height change was non significant at most

aspects around the implants.<sup>7</sup>

## **B- Discussion of Results:**

When a comparison between the groups at the end of the year (the whole period from the base line to 12 months) was done, it was found that the bone height change (bone loss) anteriorly and posteriorly separately for group III was lesser than that for group II and group I, this difference could be attributed to load distribution on more implant number. However, difference in the bone height change was statistically non significant for most aspects around the implants.<sup>7</sup>

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