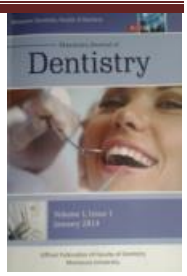

Using of posterior short implants for supporting mandibular complete overdenture retained by two anterior mini-implants: Alveolar bone height changes around mini implants.

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Abstract:

Purpose: This study was conducted to evaluate the effect of using posterior support by bilateral short implants on bone height changes around two anterior mini implants used for retaining mandibular complete overdenture.

Materials and Methods: Six completely edentulous patients of age ranged between 55 and 65 years were selected for this study. Patients were randomly classified into two equal groups. Group (A) patients that would be delivered mandibular complete overdenture retained by two canine mini dental implants with ball attachments without posterior support by short implants. Group (B) patients that would be delivered mandibular complete overdenture retained by two canine mini dental implants with ball attachments with posterior support by bilateral short implants with healing abutments (in first molar regions). The alveolar bone height changes around mini-implants were radiographically evaluated at the time intervals: T0 (immediately), T6 (6 months), T12 (12 months) and T18 (18 months) after mandibular overdenture insertion using standardized periapical radiographs.

Results: In this study, when comparing between the means of peri-implant VBL during the 1st and 2nd 6 months in each group, a statistically insignificant decrease in peri-implant VBL was found during the 2nd 6 months. When comparing between peri-implant VBL during the 2nd and 3rd 6 months of the study, a statistically significant decrease in peri-implant VBL was found during the 3rd 6 months in group B while a statistically insignificant decrease in peri-implant VBL was found during the 3rd 6 months in group A. Finally, the result that can be considered more interested in current study was the significant decrease of vertical bone loss around mini-implants in group B than in group A during each interval of study. **Conclusion:** Posterior support by short implants can be considered an advantageous concept regarding preservation of the alveolar bone around mini-implants used for retaining mandibular complete overdenture.

Keywords: Mini-implants retained mandibular complete overdenture, Short implants, Immediate loading, Peri-implant vertical bone loss.

Introduction

Rehabilitation of completely edentulous mandible with conventional denture is no longer be the first prosthodontic treatment choice as its lack of stability and retention. Implants have been widely used to improve support, retention and stability of mandibular complete dentures and increases patient's satisfaction. In patients whose jaw morphology does not allow conventional implant placement without additional helpful surgical interventions, mini-implants and short implant concept may be alternative treatment options. Many studies[1–3] place two mini implants in interforaminal region with O-rings to retain mandibular complete overdentures resulted in a significant improvement in retention, stability and patient satisfaction. Patients reported improvements in mastication, esthetics, ability to socialize, and comfort levels during the observation times. Placement of posterior Short-length dental implants offer an effective alternative treatment to bone grafting and nerve lateralization for the height-deficient atrophic posterior mandibular residual ridge[4]. The use of only two implants to retain hinging mandibular overdentures showed continued bone resorption in the edentulous posterior regions due to difference in mucosal resiliency and dental implant displacement so stresses transmitted to the posterior residual alveolar ridge as a result of free overdenture rotation during function around the anterior implants and increase the attachment wear[5–8]. Addition of two posterior implants solved the problem of posterior ridge resorption caused by the rotational movement of the overdenture around the anterior two implants. Also, this treatment option decreases the prosthetic maintenance appointments caused by the wear of attachments during this rotational movement[9].

The question was, what is the effect of using posterior short implants for supporting mandibular complete overdenture retained by two anterior mini implants on alveolar bone height changes around mini-implants?

Materials and methods:

Six completely edentulous patients of age ranged between 55 and 65 years were selected from the clinic of Prosthodontic Department, Faculty of Dentistry, Mansoura University according to the following criteria: Maxillary and mandibular residual alveolar ridges covered with healthy firm mucosa**.** Mandibular residual alveolar ridges with quality & quantity of bone that allow inserting two anterior mini implants in the canine areas and two bilateral posterior short implants in the 1st molar areas for assisting mandibular complete overdenture. Angel's class I maxillomandibular relation with sufficient inter-arch space. Exclusion criteria for this study include the patients with systemic disorders affecting bone, history of immunosuppresses, chemotherapy and radiotherapy for any head and neck tumors, patients with Chronic temporomandibular joint disorders, history of Parafunctional habits, Alcoholics and smokers. For each patient, conventional acrylic complete dentures were

constructed and inserted. According to using of posterior short dental implants, patients were randomly classified into two equal groups: **Group A:** Patients that would be delivered mandibular complete overdenture retained by two canine mini dental implants with ball attachments without supporting by posterior short implants. **Group B**: Patients that would be delivered mandibular complete overdenture retained by two canine mini dental implants with ball attachments and supported by bilateral posterior short implants with healing abutments (in first molar regions). For accurate implant placement and angulation during surgery, stereo-lithographic surgical guide was fabricated for each patient and the implants inserted using the one stage surgical technique**.** Healing abutments with 2 mm gingival height were screwed in their posterior short implant fixtures using screw driver for group B**.** Panoramic x ray was made to verify the inserted implants with the predetermined locations, parallelism and inclination in each group then immediate loading protocol was followed. For group B, refitting of the denture base over the healing caps with autopolymerizing acrylic resin using overlay technique was done.

Evaluation of peri-implant alveolar bone height changes:

The alveolar bone height around mini-implants were radiographically evaluated at the time intervals: T0 (immediately), T6 (6 months), T12 (12 months) and T18 (18 months) after mandibular overdenture insertion using standardized periapical radiographs. For standardization of periapical radiographs, a customized bite registration record was made from acrylic resin denture base material and compound occlusal rim for film holder fixation according to **Galasso, L**.[10]. Radiographs were scanned, digitized and stored in a personal computer. The peri-implant alveolar bone loss was measured in mm as recommended by **Walter et al**.[11] and **Heckmann et al**.[12]. The vertical distance was measured between the coronal margin of the implant collar (taken as the reference point) (point A) and the most coronal bone-to-implant contact (point B)[13,14]. The distance between implant collar (point A) and first bone to implant contact (point B) indicated vertical bone level in mm (AB line) (VBL).The alveolar bone loss was measured by subtracting AB line length of each T6, T12 and T18 from AB line (T0) at mesial and distal surface of each mini-implant. The mean readings were statistically analyzed then tabulated.

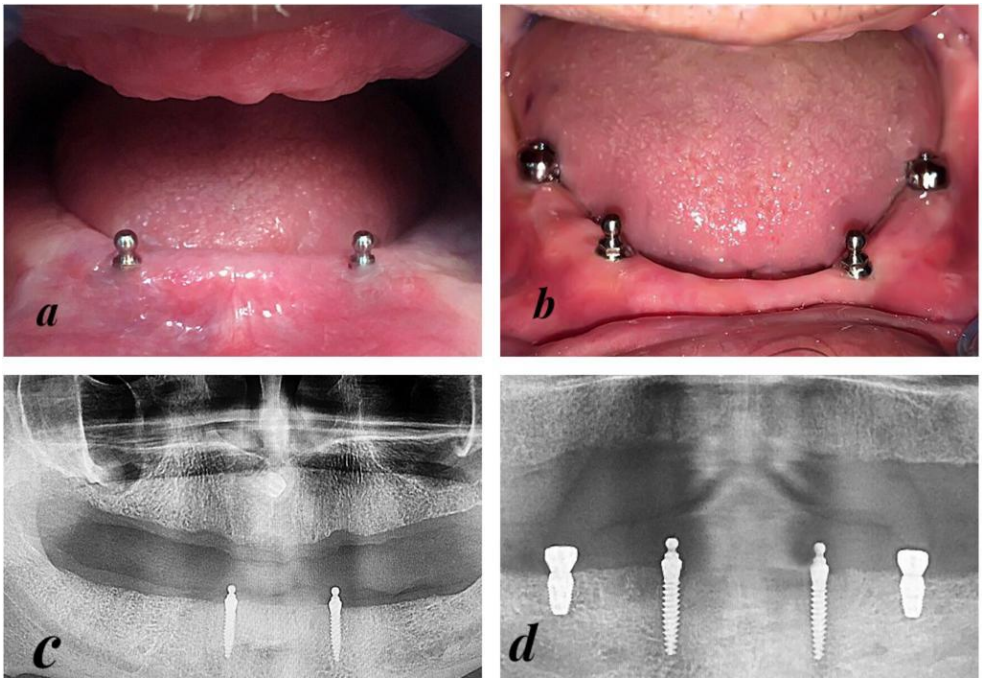

Fig 1: a, Finally placed mini implants with ball attachments for group (A); **b**, Finally placed anterior mini implants with ball attachments and posterior short implants with healing abutments for group (B); **c,** Panoramic view after surgery to

verify the position and orientation of the fixtures for group (A); **d,** Panoramic view after surgery to verify the position and orientation of the fixtures for group (B).

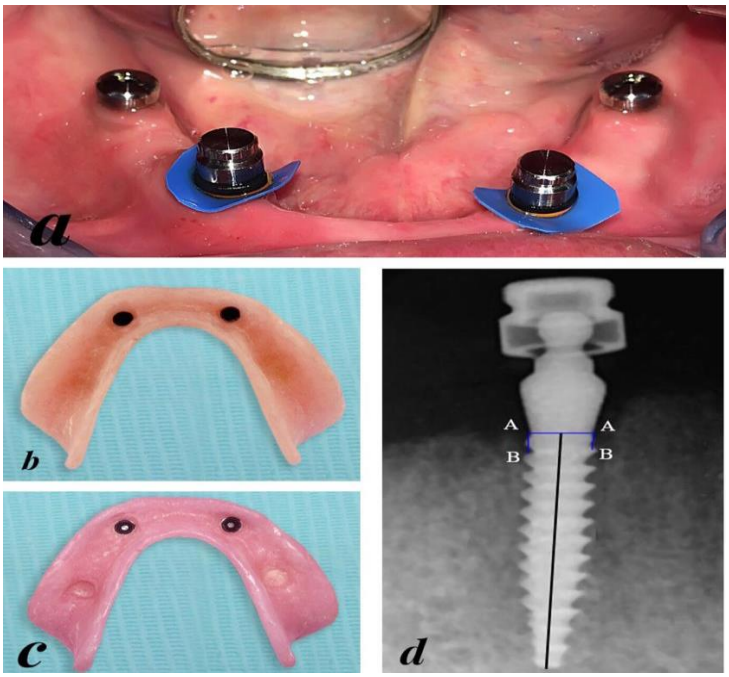

Fig 2: a, Female metal houses placed over their corresponding patrices with two pieces of rubber dam sheets and elastic bands; **b,** The intaglio surface of mandibular overdenture with the picked up female houses for group (A); **c,** The intaglio surface of mandibular overdenture with the picked up female houses for group (B); **d,** AB line represent the peri-implant alveolar bone height measurements

Results:

Table (1): show comparison between the means of peri-implant vertical bone loss during the first 6 (T1), the second 6 (T2) and the third 6 months (T3) after insertion of the mandibular complete overdenture in the same group.

* statistical significance when p ≤0.05

	The means of peri-implant vertical bone loss	
	Group A	**Group B**
T1 (T6-T0)	0.36±0.05	0.299±0.03
T2 (T12-T6)	0.353±0.06	0.275±0.04
T3 (T18-T12)	0.293±0.03	0.191±0.04
P1 Comparison between T1 and T2	0.858	0.251
P2 Comparison between T2 and T3	0.068	0.001*
P3 Comparison between T1 and T3	0.054	0.006*

Table (2): show comparison of the means of peri-implant vertical bone loss between the two groups in each interval of study.

Intervals	Group (A)	Group (B)	t-test	p-value
T1 (T6-T0)	0.36±0.05	0.299±0.03	2.34	0.041*
T2 (T12-T6)	0.353±0.06	0.275±0.04	2.42	0.036*
T3 (T18-12)	0.293±0.03	0.191±0.04	4.27	0.002*
T1+T2 (The whole 12 months)	0.713±0.08	0.575±0.06	3.24	0.009*
T1+T2+T3 (The whole 18 months)	1.006±0.11	0.766±0.09	4.25	0.002*

* statistical significance when p ≤0.05

The results of this study showed that the mean of peri-implant vertical bone loss (VBL) along 12 months after insertion of the mandibular complete overdenture was (0.713 mm) in Group A and (0.574 mm) in Group B. This results were within the accepted limits of peri-implant vertical bone loss (VBL) as stated within the success criteria set by **Albrektsson et al**.[15] in which marginal bone level changes in the first year after implant insertion should be less than 1.5 mm and the ongoing annual bone loss should be less than 0.2 mm. This is in line with the study performed by **Jofre et al**.[16] reported a mean of 1.4 mm VBL around mdis in the first year after loading which is higher than VBL recorded in our study.

In this study, when comparing between the means of peri-implant VBL during the 1st and 2nd 6 months in each group, a statistically insignificant decrease in peri-implant VBL was found during the 2nd 6 months. This result may be explained by the early peri-implant crestal bone loss which may be due to the trauma associated with surgical procedure, high bone remodeling rate during the stage of osseointegration and /or immediate loading. **Fouad et al.**[17] reported that the increased bone loss in the first 6 months may be attributed to an organization of the surrounding bone after implant insertion. Several important events take place during this period that may impact bone remodeling. One factor that may influence bone remodeling is the preparation of the implant osteotomy. Simply preparing a hole in the alveolar bone results in the interruption of the vascular supply and continuity of the bony structure This results in an acute inflammatory response and initiates a wound-healing process as stated by **Cochran et al**.[18]. **Fouad et al.**[19] who explained the increased enzyme activity during the initial period after implant insertion by the post-surgical risk of inflammation and immediate prosthodontic loading. Also, **El-Mekawy et al**.[20] concluded that the immediate loading is a factor causing early bone loss around implants in a study of osseointegration failures of dental implants that support mandibular overdentures. This is in line with **Romanos and Nentwig** [21] who stated that the loading immediately after surgery may result in micromotions at the interface, thus interfering with the healing process. This is in contrast with **Sanda et al.**[22] who concluded that no statistically significant differences in MBL around implants supporting a mandibular IOD irrespective of loading protocol.

The decreased bone loss in the second 6 months may be due to maturation of bone to withstand functional forces as strength of the bone increased from the beginning of loading after surgical exposure and up to 1 year after loading This explanation was in agreement with the study performed by **Albrekesston et al.**[15] who described this phenomenon as a "steady state." and correlated the decrease of bone loss around dental implants at the end of first year to maturation of bone after implant placement and adaptation of bone to resist functional force.

On the other hand, the comparison between peri-implant VBL during the 2nd and 3rd 6 months of the study in each group, a statistically significant decrease in peri-implant VBL was found during the 3rd 6 months in group B while a statistically insignificant decrease in peri-implant VBL was found during the 3rd 6 months in group A. This minimal bone loss attributed to several factors such as implant primary stability, implant surface roughness, control of the occlusal forces and denture stability, which may reduce excessive micromotion transmitted to immediately loaded implants. This was in accordance with **Elsyad et al.**[23] who confirmed that Most VBLO and HBLO occurred in the first year after loading, and no significant bone loss occurred in subsequent years. Moreover, **Marzola et al**.[24] reported low rates of marginal bone loss (0.3to 0.7mm) after 1 year.

Finally, the result that can be considered more interested in current study was the significant decrease of vertical bone loss around mini-implants of group B than of group A during each interval of study. This may be the result of the using of supporting posterior short implants in group B which minimize the rotational movements of the overdenture around the fulcrum axis formed by two anterior mini-implants that in turn stabilize the prosthesis and reduce the stresses transmitted to the mini-implants and subsequently decreasing the peri-implant VBL of mini-implants. This explanation was agree with **Fouad and Marzook**[25] who stated that posterior implants in minimizing rotation of the overdenture base around the anterior implants which in turn reduce stresses transmitted to the anterior implants. **Kreisler et al.**[26] and **Krennmair et al.**[27] mentioned that adding two posterior implants prevents rotational movements of the prosthesis around the anterior implants and creates a stable prosthesis. Another explanation to the decreased VBL around mini-implants in group B is the increasing number of implants that enabled more even stress distribution on the implants which reduce the stresses transmitted to the mini-implants and subsequently decreasing the peri-implant VBL of mini-implants. This is in agreement with **Ogawa et al**.[28]and **Duyck et al**.[29] who found that implant loading increased with a lower number of supporting implants and concluded that the resultant forces on implants are significantly associated with number and distribution of implants and prosthesis material. **Elsyad et al.**[30] mentioned that the presence of posterior implants provides effective vertical support, permits favorable stress distribution between the anterior and posterior implants, and provides a quadrilateral support similar to four-legged chair which decreases the VBL[30]. Also, **Petrie et al**.[31] noted that addition of posterior implants caused a reduction in the harmful strains around anterior implants supporting overdentures.

Conclusion: Posterior support by short implants can be considered an advantageous concept regarding preservation of the alveolar bone around mini-implants used for retaining mandibular complete overdenture.

Recommendations: Other prolonged studies with other evaluation methods are recommended to evaluate the importance of posterior support using short implants when anterior two mini-implants.

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