Effect of Two Different Maxillary Treatment Options on Supporting Structures of Mini Implant Retained Mandibular Overdenture

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EFFECT OF TWO DIFFERENT MAXILLARY TREATMENT OPTIONS ON SUPPORTING STRUCTURES OF MINI IMPLANT RETAINED MANDIBULAR OVERDENTURE

Fardos N. Rizk

ABSTRACT

Objectives: This study was conducted to evaluate whether maxillary conventional complete denture or narrow diameter implant retained maxillary overdenture is more compatible on opposing crestal bone height surrounding mini implants retaining mandibular overdenture.

Materials and Methods: Fourteen male completely edentulous patients received mandibular overdentures retained by four one piece mini implants with ERA attachments placed anterior to the mental foramen. Patients were randomly divided into two groups: Group I received opposing maxillary conventional complete denture and Group II received opposing maxillary overdenture retained by four one piece narrow diameter implants with ball attachments placed in the anterior maxilla. Once patients were comfortable to the prostheses, they were placed on zero, six and twelve months follow-up periods using cone beam computed tomography. Measurements were taken on crestal bone height surrounding the mandibular mini implants then the results were statistically analysed.

Results: There was decrease in crestal bone height surrounding the mandibular mini implants in both studied groups where Group II showed statistically significant higher crestal bone resorption than Group I after one year follow-up period.

Conclusion: Maxillary conventional complete denture is more compatible on the opposing crestal bone height surrounding mini implants retaining mandibular overdenture than narrow diameter implant retained maxillary overdenture

KEYWORDS: Mini implants, Narrow diameter implants, Maxillary overdenture, Mandibular overdenture

INTRODUCTION

Implant-supported overdentures offer many practical advantages over conventional complete dentures including decreased bone resorption, reduced or eliminated prostheses movement, better aesthetics, improvement in masticatory performance, better occlusion, improved occlusal load direction, increased occlusal function and...
maintenance of the occlusal vertical dimension in addition to improved phonetics, patient’s psychological outlook and quality of life. In severe resorption cases, implant-supported overdentures may be more aesthetic than a fixed restoration. Bone loss dictates the appearance of the inferior third of the face. An implant-supported overdenture provides improved support for the lips and soft tissues of the face allowing the teeth to be the same length as natural teeth. When there is marked loss of alveolar height, the teeth on a conventional fixed restoration will be very long. The presence of a large labial flange in a conventional denture may result in exaggerated facial contours for the patient with recent extractions. Implant-supported prostheses do not require great labial extension or as much extended soft tissue coverage as is necessary for a conventional denture. An implant-supported overdenture can provide the soft tissue support to the facial features often required for a patient with advanced bone loss.  

For good prognosis of an implant treatment, it was suggested that at least 1mm of supporting bone should be present around each implant. However, human edentulous mandible and maxilla go through resorption processes that might prevent restoration with implant supported prostheses. Grafting procedures can restore bone volumes available for bone placement. As an alternative to these invasive reconstruction techniques, placement of narrow diameter implant (3-3.5mm) was introduced for residual alveolar ridges that were too narrow for regular implants. In a study aimed at assessing the clinical outcome of narrow diameter implants in the treatment of edentulous maxilla, the implant outcome was evaluated clinically and radiographically after the first year of loading and it revealed 100% survival rate of implants with 0.3mm mean bone loss. Sohrabi et al., concluded that the survival rates reported for small diameter implants are similar to those reported for standard width implants. A five years prosthetic loading of 159 narrow diameter implants showed an overall success rate of 98.74% and mean marginal bone loss of 1mm on mesial side and 0.98mm on distal side of implants. A retrospective study on 510 narrow diameter implants ranging from 3 to 3.5mm diameter placed in 237 patients over an 88-month period, half of which were immediately restored showed survival rate of 99.4% and no implants fracture.

Recently root form mini-implants ranging in diameter from 1.8 mm to slightly more than 2mm have been used to support conventional denture with atrophied mandible without bone grafting. These mini implants were introduced for treatment of partially and completely edentulous patients. In comparison to conventional diameter implants, mini implants are cost effective, have fewer complications during flapless implant placement and can be used in edentulous arches with minimal remaining bone in a facial-lingual dimension to avoid bone graft. Mini implants also have the advantages of single stage conventional diameter implants including; short healing time, minimal postoperative discomfort, and immediate restoration of mastication and aesthetics for patients during the healing period. Shatkin et al., reported in their study an overall 94.2% survival rate for 2514 mini implants after a follow-up period of 2.9 years. The treatment of completely edentulous mandible with two implant retained overdenture is well-accepted treatment option yet, with mini implants sufficient number of implants must be placed to adequately distribute loads generated during mastication. If too few implants are used, cyclic occlusal loading may fatigue the small-diameter implant neck to the point of fracture. In order to compensate for reduced mini implants diameter and surface area, it is recommended to increase the number of implants with maximum length according to the available ridge height.

Studies have been published regarding number of implants, diameter and length of mini implants retaining mandibular overdenture but there is lack
of an ideal treatment concept and specific guidelines for the effect of the type of opposing prosthesis on crestal bone height surrounding the mini implants. This study was thus conducted to evaluate whether maxillary conventional complete denture or narrow diameter implant retained maxillary overdenture is more compatible on crestal bone height surrounding mini implants retaining mandibular overdenture.

MATERIALS AND METHODS:

Patients Selection

Patients eligible for the study were male patients completely edentulous for at least one year with age ranging between 50 to 65 years and for whom a decision had already been taken to incorporate dental implants for the treatment of complete edentulism. The exclusion criteria was limited to severe maxillomandibular skeletal discrepancy, tempromandibular joint disorders, drug abuse, smoking, local radiotherapy to the head and neck region for malignancies, chemotherapy, chronic renal or liver disease, diabetes, stroke, bleeding disorders, acute infection of the implant site and signs of chronic bone disease. The inclusion criteria included patients with good health, firm healthy mucosa, bone quality of 850-1250 HU (D2) in the anterior mandibular alveolar ridge and 400-850 HU (D3) in the anterior maxillary alveolar ridge, bone height not less than 14mm and bone width not less than 4mm and 5mm in the anterior mandible and maxilla respectively. According to this criteria fourteen qualified patients were enrolled and motivated to the treatment. They signed an informed consent form to cooperate and follow the recommendations and instructions.

Prosthetic Procedures

Complete dentures were fabricated for all patients prior to implant installation. For each patient upper and lower primary impressions were taken using alginate (Alginmax, Major Prodotti. Dentari SPA. Moncalieri. Italy) in stock trays and upper and lower secondary impressions were taken using medium body rubber base (Swiss TEC, Coltene, Whaledent, Altstatten, Switzerland) in specially constructed special trays. Occlusion blocks were fabricated on the poured master casts. Centric occluding relation was recorded following the conventional wax wafer technique. Upper casts were mounted on semi-adjustable articulator (Dentatus type ARH, AB, Dentatus, Stockholm, Sweden) according to face bow record (Dentatus face bow, Dentatus, Stockholm, Sweden) while the lower casts were mounted using the wax wafer centric occluding record. Setting up of modified anatomical cross linked acrylic resin teeth (Vitapan acrylic teeth, Vita Bad Sackingen-Germany) was done following modified lingualized occlusion scheme. Waxed up dentures were tried in the patients’ mouths then flanked and processed into high impact heat cure acrylic resin (Lucitone 199, Dentsply, York, PA-USA). Laboratory remounting was done before finishing the dentures and occlusal discrepancies were adjusted.

Any necessary adjustments were carried out to eliminate occlusal interference and the dentures were delivered to the patients. Dentures were checked after twenty four and seventy two hours for any needed adjustment and to ensure that the patients were satisfied with aesthetics, stability and retention of the dentures. Following dentures placement and patients’ adaptation, the mandibular dentures were duplicated in clear acrylic resin stents (Vertex Rapid Simplified; Vertex-Dental BV, Zeist, The Netherlands) to act as a surgical guide for implant positioning to assure proper implants installation beneath the planned position which was determined by ideal denture contour and aesthetics.

Patient Randomization

All patients received

Mandibular overdenture retained by four one piece mini implants with dimensions 2.2x13mm and supra structure ERA attachment (Zimmer ERA
MDI, USA) placed anterior to the mental foramen (Fig 1).

The fourteen patients were then randomly divided equally into two groups:

**Group I received**

Maxillary conventional complete denture

**Group II received**

Maxillary overdenture retained by four one piece narrow diameter implants with dimensions 3x12mm and supra structure ball attachment (INNO SLA system. Cowellmedi Co., Ltd) placed in the anterior maxilla (Fig 2).

**Surgical Procedures:**

**Mandibular arch:**

For all patients in Groups I and II, entry points for four mini implants were marked anterior to the mental foramen on the patient’s tissue by the aid of the surgical stent. The pilot drill (1.6 mm) was lightly pumped up and down vertically; penetrating the crestal bone 3-4 mm. Sterile internal and external saline irrigation was used throughout the drilling procedure. The pilot holes were deepened to a depth of the implants to be placed using osteotomy drill of 13 mm. The parallel pins (0-degree) were used to check the parallelism between the implants.

The one piece ERA mini implant with dimensions 2.2x13mm was carried to the osteotomy site, rotated in a clockwise direction, while exerting a slight downward pressure using a finger driver. This procedure initiates the self-tapping process and is used until noticeable bony resistance is encountered. Then, the winged thumb wrench was used to thread the implant into place until the wrench becomes difficult to turn. The final stage of placement was carried out with the ratchet wrench. Mini-implant placement was completed with the protrusion of the full length of the abutment head from the mucosa, but with no thread portions visible.

**Maxillary arch**

For all patients in Group II semi lunar incision was made to expose the surgical site in the anterior maxilla in one side. Drilling was started by pilot drill followed by sequential drilling using larger drills; 1.3, 1.8 and 2.3mm in diameter to complete drilling of the osteotomy and the depth of drilling was only half the length of the implant. A sterile vial containing 3mm diameter, 12 mm length one piece ball implant was inserted in the osteotomy site and rotated clockwise using the finger driver. The ratchet wrench was then used until the implant was fully seated with its threads covered. After placement of the two implants the flap was sutured and the former procedures were then repeated to install the other two implants in the other side.

![Fig. (1) ERA mini implants for all patients](image1)

![Fig. (2) Maxillary implants for patients in Group II](image2)
Pick-up procedures

For all patients in Groups I and II pick-up procedures were carried for mandibular overdentures (Fig 3).

For patients in Group II pick-up procedures were carried for maxillary overdentures (Fig 4).

Mandibular overdenture:

For all patients tissue surfaces of the mandibular overdentures were relieved to accommodate the mini implants and metal housings with the male nylon caps of ERA attachments. For patients in Groups II tissue surfaces of the maxillary overdentures were relieved to accommodate the implants and metal housings with the female nylon caps of the ball attachments. The dentures were tried in the patients’ mouths to ensure complete seating. Any undercuts in the ERA attachments were blocked out using temporary filling (Litark, Lascod SpA-Vita L. Longo, Sesto F. no Firenze Italy). A mix of self-cure acrylic resin (Lucitone 199; Dentsply) was applied in the relieved region of the maxillary overdenture and the patients were instructed to occlude on the dentures in centric relation for direct pick-up of the metal housings with the female nylon caps of ball attachments.

All Patients were asked to return for follow-up after 24, 72 hours, one week, 6 months and 12 months following denture insertion.

Maxillary overdenture:

For patients in Groups II, following the pick-up of mandibular overdentures any undercuts in the ball attachments inserted in the maxillary arch were blocked out using temporary filling (Litark, Lascod SpA-Vita L. Longo, Sesto F. no Firenze Italy). A mix of self-cure acrylic resin (Lucitone 199; Dentsply) was applied in the relieved region of the maxillary overdenture and the patients were instructed to occlude on the dentures in centric relation for direct pick-up of the metal housings with the female nylon caps of ball attachments.

Follow-up Procedures:

Radiographic evaluation using Cone Beam Computed Tomography (CBCT):

Images were acquired using the Scanora 3D Imaging system (Scanora 3D, Sorredex-Finland) (voxel size 133um-350 um) which allows the recording of linear bone height of images. The personal computer utilized was an Intel Core Duo- 2.13 Mhz-3.25 Gbites-21 inches flat screen 9 Hewlett-Packard Pavilion Elite m9200t series (Hewlett-Packard Pavilion Elite m9200t series USA).
Image Analysis

Linear measurements of crestal bone height surrounding mini implants inserted in the mandibular arch

For all patients mesial and distal crestal bone levels surrounding the mandibular mini implants were calculated from panoramic views by drawing a line parallel to the mini implant serration extending from the crestal bone to the apical end of the implant (Fig 5,6). Similarly, buccal and lingual bone levels were calculated by using cross-sectional views. Average readings of the four sides at each interval were calculated for each mini implant and tabulated for statistical analysis.

Statistical analysis

Numerical data were explored for normality by checking the data distribution, calculating the mean and median values, evaluating histograms and normality curves and using Kolmogorov-Smirnov and Shapiro-Wilk tests.

Data were presented by mean and standard deviation (Std. deviation).

Independent t test was used to compare between groups.

Anova for repeated measures was used for comparison between follow up periods followed by simple main effect with Bonferroni correction.

The significance level was set at $P \leq 0.05$.

Statistical analysis was performed with IBM® SPSS® Statistics Version 20 for Windows.

RESULTS:

Effect of time on crestal bone height within each group

There was decrease in mean value of crestal bone height surrounding the mandibular mini implants throughout the study period in both groups with statistically significant difference between follow-up periods as shown in table I and II

Comparison between crestal bone height changes in both groups

By comparing the decrease in crestal bone height of both groups student-t-test showed that there was statistically none significant difference between the two studied groups at the interval of insertion-six months while, there was statistically significant difference between them at 6-12 months and at insertion-12 months where Group II with opposing implant retained maxillary overdenture showed more crestal bone resorption than Group I with opposing maxillary conventional complete as shown in table III and Fig. 7.
TABLE (I) Effect of time on crestal bone height in Group I (patients with opposing maxillary conventional complete denture)

<table>
<thead>
<tr>
<th>Time</th>
<th>Mean mm</th>
<th>Std. Deviation</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>At delivery</td>
<td>11.5029</td>
<td>.30858</td>
<td></td>
</tr>
<tr>
<td>6 months</td>
<td>11.2614</td>
<td>.31788</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>12 months</td>
<td>10.8900</td>
<td>.30795</td>
<td></td>
</tr>
</tbody>
</table>

TABLE (II) Effect of time on crestal bone height in Group II (patients with opposing implant retained maxillary overdenture)

<table>
<thead>
<tr>
<th>Time</th>
<th>Mean mm</th>
<th>Std. Deviation</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>At delivery</td>
<td>11.5943</td>
<td>.38716</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>6 months</td>
<td>11.2271</td>
<td>.38239</td>
<td></td>
</tr>
<tr>
<td>12 months</td>
<td>10.7400</td>
<td>.38406</td>
<td></td>
</tr>
</tbody>
</table>

TABLE (III) Comparison between crestal bone height changes surrounding the mini implants in both studied groups at different intervals of follow-up period

<table>
<thead>
<tr>
<th>Time</th>
<th>Mean Difference Mm</th>
<th>Std. Deviation</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion – 6months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 1</td>
<td>.2800</td>
<td>.10033</td>
<td>0.074</td>
</tr>
<tr>
<td>Group 2</td>
<td>.3671</td>
<td>.06211</td>
<td></td>
</tr>
<tr>
<td>6-12 months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 1</td>
<td>.3714</td>
<td>.03288</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Group 2</td>
<td>.4871</td>
<td>.05219</td>
<td></td>
</tr>
<tr>
<td>Insertion-12months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 1</td>
<td>.6514</td>
<td>.08415</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Group 2</td>
<td>.8543</td>
<td>.01272</td>
<td></td>
</tr>
</tbody>
</table>

DISCUSSION

Narrow diameter implants and mini implants were used in the maxilla and mandible respectively as the residual alveolar maxillary and mandibular ridges were too narrow for the placement of regular diameter implants. Four mini implants were inserted in the mandible instead of the conventionally used two regular implants to adequately distribute loads generated during mastication and to avoid fatigue and fracture of the small-diameter mini implant neck. Four narrow diameter implants were inserted in the maxilla as studies showed that
implant survival rate in the maxilla is 96.3% per year in case of four implant supported overdenture and that there was no difference in patient ratings of a splinted design as compared to unsplinted one for maxillary overdenture.24,25

Group I with opposing maxillary conventional denture showed 0.65mm crestal bone resorption surrounding the mandibular mini implants while Group II with opposing implant retained maxillary overdenture showed 0.85 mm crestal bone resorption surrounding the mandibular mini implants in one year follow-up period which agrees with the findings of Geckili et al., 13 which reported mean marginal bone loss of 1mm on mesial side and 0.98mm on distal side of narrow diameter implants. This bone reduction might be due to bone osteotomy and healing process. Also it might be considered an immediate bone reaction after insertion of the prosthesis which attributed to the healing and reorganization following trauma to the bone combined with remodelling due to functional stresses following prosthesis connection.26, 27

Crestal bone surrounding mini implants retaining mandibular overdenture was subjected to more resorption in case of opposing implant retained maxillary overdenture than in case of opposing maxillary conventional complete denture.28-33 This is in accordance with other studies which revealed that implant retained overdentures resulted in almost twice as much bone resorption than conventional complete denture. These results were attributed to the increase in biting forces of patients wearing implant retained overdentures, in comparison to conventional complete denture wearers.33,34 Furthermore, another study claimed that the functional loads are concentrated in the areas of implant placement, resulting in higher rate of bone resorption at these areas.35

CONCLUSION

Within the limitations of this study it could be concluded that:

Acceptable amount of crestal bone resorption surrounding mini implants retaining mandibular overdenture occurs when the opposing maxillary prosthesis is either conventional complete denture or narrow diameter implant retained maxillary overdenture however, maxillary conventional complete denture is more compatible on the crestal bone height surrounding mandibular mini implants than narrow diameter implant retained maxillary overdenture.

REFERENCES


