Effects of Angulated and Non-Angulated Mini-Implants Abutment Supporting Mandibular Overdenture on Peri-Implant Bone Height

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Background: Mini-implants have been successfully used when there is a little bone to support complete dentures, using of mini-implants abutment is the key solution for stable and retentive overdentures.

Objective: To compare peri-implant bone height post angulated or non-angulated mini-implants insertion.

Design: A Randomized Two-Arm Parallel Study.

Setting: Faculty of Dentistry, Al-Azhar University-Assiut Branch, Egypt.

Method: The study was performed from October 2012 to December 2014. Twenty patients were included in the study based on two criteria (1) free from any systemic diseases and (2) their lower flat ridges resorbed with ill-fitted lower dentures. The patients were divided into two groups. The first group received lower overdenture with non-angulated abutment while the second group received lower overdenture with angulated abutment. The bone height for each subject was evaluated with panoramic X-ray after 6, 12, 18 and 24 months. The data were analyzed using SPSS program.

Result: Twenty edentulous patients participated in this study. They were homogenous in their personal characteristics. Their education levels varied between primary and secondary levels. Insignificant differences in age, education level and gender were found (p > 0.05).

The differences between the two groups were highly significant. Mean bone height was found to be significantly higher in Group 1 than in Group 2 (p = 0.03). The paired sample t-test showed a significant improvement in bone height in the non-angulated group (p = 0.03) and insignificant increase in the angulated group (p = 0.14).

Conclusion: Lower overdenture mini-implant with non-angulated abutment is better for edentulous patients compared to angulated abutment in term of bone height.

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Implant-supported overdentures with normal ridges may be the treatment of choice for flat ridge relations. However, if an inadequate number of implants and poor implant distribution or alignment is found, it is appropriate to use mini-implants to support the overdentures\(^1\). In the lower ridge dentures, patients usually reflect poor retention. This is mainly related to the vertical and lateral forces received\(^2\).

The satisfaction of wearers is mainly influenced by denture retention\(^2,3\). Satisfied wearers of complete dentures could enjoy more stable dentures by adding additional means of retention. Dissatisfaction of lower dentures has been a common problem for denture wearers in cases of severe bone resorption\(^4\).

Various types of treatment modalities include adhesive materials and pre-prosthetic surgery, such as ridge augmentation therapy. The purpose is to improve the ridge and conventional dentures\(^5,6\).

However, the old patients are not willing to use such extensive surgical procedure or conventional stage implant therapy\(^7,8\). Conventional dental implants have proven to have long-term clinical success\(^9,10\).

Mini-implants were used in difficult positions where there is little bone density\(^11\). There are studies using mini-implants to maintain removable prostheses and support partial and complete dentures\(^12,13\). The treatment of edentulous patients with mini-implants is used as minimally invasive dentistry. It offers some advantages, such as less damage exposure and bone displacement compared to standard-size implants\(^2\). Full implants replace teeth; they have been used since the 1970s while mini-implants were not approved for use until 1999. Mini-implants are about half the width of full implants and cost considerably less\(^14\). Therefore, mini-implants could be a more acceptable alternative in these conditions.
The success of osseointegration of implant depends on several factors: anatomical, operative techniques and post-operative distribution of biomechanical stress on the supporting bony structure. The bone morphology and density were found to be very important for long-term implant success. The anatomy of the peri-implant site may force the surgeons to adjust for variation in prosthetic axis by using angulated abutments. Angulated abutments are the treatment of choice if there is difficulty to place implants in the usual axial positions. The effects of such angulation and biomechanical stresses that may arise have not been fully studied. Two types of forces usually generated in peri-implant bony structure, vertical and lateral forces. Studies on the biomechanical behavior of implants have found that the main concentration of stresses at the implant-bone interface usually occurs at the crestal bone level. In angulated abutments these forces might be massive and could cause bone resorption.

The aim of this study is to evaluate the effect of angulated and non-angulated mini-implants which support mandibular overdenture on peri-implant bone height.

METHOD

A randomized two-arm parallel design was performed from October 2012 to December 2014. The first group received non-angulated abutment, and the other group received angulated abutment. Twenty patients met the selection criteria. Patients with confirmed healthy bone at the implant site and have no chronic diseases that could affect bone remodeling such as diabetes, renal failure or liver cirrhosis were selected. All completely edentulous patients with ill-retentive lower dentures, due to bone resorption affecting lower alveolar ridge, were included.

The selected patients were divided into two groups. The first group represented patients who have received mandibular overdentures with non-angulated abutments of supporting mini-implants. The second group represented patients who had received mandibular overdentures with angulated abutments of supporting mini-implants. The angulation was indicated to compensate for resorbed bone and redirect the abutments in ideal axial positions.

Patients received four mini dental implants (1.8 mm × 13 mm) in the anterior region of the mandible. The mini-implants were loaded on pre-made overdentures. The peri-implant marginal bone level was measured in implant’s proximal sides from the polished platform to the crestal bone. X-rays were taken at postoperative follow-up sessions. The square neck of mini-implant was located supra-gingivally. O-ring shaped abutments were attached to spherical part of mini-implants. Holes were drilled in the lower surface of complete dentures in pre-determined locations.

In some cases, where redirection of screw in pre-determined 45° angle of abutments was not possible, the closest possible abutment angle to 45° were used. The height of crestal bone was assessed every six months for two years. Panoramic radiographs were used to evaluate bone height by two independent investigators. They compared radiographs of each follow-up sessions with pre-operative baseline radiographs. The mini-implants used in this study were fabricated by Dentium, Slim Line, No: SDM1304.

The informed consents were obtained from all the participants. The trial was registered in the (ISRCTN) registry with study ID ISRCTN17902623 (International Standard Randomized Controlled Trials Number).

The data were analyzed by SPSS version 22. The significant differences in characteristics were examined using Chi-square test. The independent t-test was used to identify differences between the two groups. The mean and standard deviations were obtained for each numerical variable. The results were considered significant (p < 0.05) with a 95% confidence level.

RESULT

Twenty edentulous patients participated in this study. They were homogenous in their personal characteristics. Their education levels varied between primary and secondary levels. Insignificant differences in age, education level and gender were found (p > 0.05), see table 1.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1 (N 10)</th>
<th>Group 2 (N 10)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>Primary</td>
<td>6 (60%)</td>
<td>5 (50%)</td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>Intermediate</td>
<td>3 (30%)</td>
</tr>
<tr>
<td></td>
<td>Background</td>
<td>Secondary</td>
<td>1 (10%)</td>
</tr>
<tr>
<td></td>
<td>University</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gender of Patients</td>
<td>Male</td>
<td>10 (100%)</td>
<td>10 (100%)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Age of Edentulous Patients</td>
<td>56.2 ± 1.34</td>
<td>55.62 ± 1.21</td>
<td>0.64</td>
</tr>
</tbody>
</table>

A: not comparable

Panoramic X-ray was performed after 6, 12, 18 and 24 months. The differences between the two groups were highly significant. Mean bone height was found to be significantly higher in Group 1 than in Group 2 (p = 0.03). The paired sample t-test showed a significant improvement in bone height in the non-angulated group (p = 0.03) and insignificant increase in the angulated group (p = 0.14), see table 2.

<table>
<thead>
<tr>
<th>Time of Evaluation</th>
<th>6 Months</th>
<th>12 Months</th>
<th>18 Months</th>
<th>24 Months</th>
<th>P-value between 6m and 24m</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Group (Non-angulated)</td>
<td>2</td>
<td>0.7</td>
<td>2.5</td>
<td>0.8</td>
<td>3</td>
</tr>
<tr>
<td>Second Group (Angulated)</td>
<td>1.5</td>
<td>0.5</td>
<td>1.5</td>
<td>0.5</td>
<td>1.75</td>
</tr>
</tbody>
</table>

P-values

(*) significant  (***) highly significant (m) months
DISCUSSION

The initial interventions were conducted with the mini-implants with either angulated or non-angulated abutment for 24 months. Throughout this period, the loaded mini-implants were assessed for bone height by X-ray. This duration was based on the average duration of use for mini-implants in humans and the bony remodeling period. The mini-implant has only been used recently in dental practice with undetermined life expectancy.

High forces applied on peri-implant bone may cause bone resorption. There are many confounding variables, such as the type of bone, loading forces, construction of prosthesis and angulation of abutment. Studies showed that strains produced around 35° angulated abutments were physiologically tolerable by the bone. Also, angulation of abutment with 0°, 15° and 20° showed similar results.

In the present study, the bone height for the first group with non-angulated abutment was significantly more (p=0.03) than the bone height for the second group (p=0.14). This result was highly significant after 18 months and 24 months. Different studies found that mini-implants are effective; Pearce et al mentioned a series of protocols for different animal models used for implant experimentation. Implants with a diameter no greater than 2 millimeters and a thread length of 6 millimeters should be used, with a maximum of six implants placed in a single rabbit. Other studies have exceeded this range with success. These results contrast with other findings.

In this study, the effect of abutment axis angle was assessed using prefabricated 45° angulated abutment. Previous studies suggested that the optimum angle of an abutment was 25°. It was reported that the abutment angulation changed from 0° to 20°; however, this was the tolerated limit of the bone.

The mini-implants were successfully used in many cases to overcome problems associated with the types of implant. Bone height in patients with mini-implants was found to be comparable to conventional implants.

CONCLUSION

Mini-implants with non-angulated abutment provide a stable, immediately functional aesthetic overdentures in flat ridges. In addition, it improves bone height. This is possibly due to how force is distributed during mastication. It could be concluded that non-angulated abutments may be capable of better force distribution than angulated abutment.

REFERENCES


