Evaluation of Implant Overdenture Retention with Two Different Attachments at 23mm Standard Inter-Implant Distance

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Abstract

**Purpose:** Evaluation of implant overdenture retention at 23mm standard inter-implant distance using OT Equator and locator attachments.

**Materials and methods:** Twelve completely edentulous patients were selected for this study. For all patients, conventional complete dentures were constructed. Mandibular dentures were replicated into stereolithographic implant placement guide using CBCT. Every participant received 2-implants in the anterior mandibular area with inter-implant distance of 23 mm. After the osseointegration period, the mandibular conventional dentures were converted into implant retained overdentures attached with Locator attachment for (group I) (six patients) and OT Equator attachments for (group II) (six patients). Retention was evaluated for conventional mandibular complete dentures (T0), 3-months (T3) and, 6-months (T6) after overdenture insertion using digital force-meter.

**Results:** Results revealed that there was a statistically significant difference between the study groups representing mean retention force (P<0.05) except at T0 (baseline evaluation with conventional dentures) with higher mean values for group I (Locator attachment) than group II (OT Equator attachment).

**Conclusion:** Regarding the limitations of this study:
- Inter-implant distance of 23 mm for 2-implant overdentures could be considered a reliable modality for edentulous mandible.
- Locator attachment may be preferable than OT Equator attachment regarding 2-implant overdenture retention at 23 mm inter-implant distance.
Keyword
2-Implant overdenture; Ot Equator Attachment; Locator attachment; Inter-implant distance; Retention.

Introduction

In developed countries, living people general health and socio-economic conditions improvements have led to a gradually aging of the population. Actually, despite the fact that the teeth are lost, the population longevity had meant that the prosthetic oral rehabilitation procedures were increased in number, including complete dentures. Several researches have indicated that traditional mandibular complete dentures were not fit to quietly reestablish the function of mastication or ameliorate the quality of life sufficiently of most participants [1].

The mandibular implant –tissue –supported overdentures (MITSO) utilizing 2-implants are the chief standard of maintenance for the edentulous mandible particularly when finances prohibit more implants to be employed. The overdentures should be accurately designed to achieve optimal form, adequate stability, contour, appearance, and, patient’s ultimate wellbeing [2].

Implant retained overdentures may utilize a diversity of attachments as bar and clip or incorporated a different solitary attachments so-called stud attachment as magnets, ball and, resilient stud attachments for instance Locator or OT Equator. Many influences affecting the selection of an attachment system; including maintenance requirements, the extent of available space, distribution of load to the implant and mucosa, and the degree of desired retention [3].

Locator attachment has dual retention, self-aligning, and is presented in different colors corresponding to different values of retention. They are retentive, resilient, long-lasting and possess certain built-in angulation compensation. Additionally, replacement and repair are fast and easy. While OT Equator attachment is considered to offer optimum retention with its low profile of 2.1 mm Furthermore; its diameter of 4.4 mm. which produce numerous solutions for planning of overdenture treatment where inter-occlusal space limitation are indicated [4,5].

Retention is the capacity of the prosthesis to resist vertical dislodging forces. It plays significant roles in resuming function and patient satisfaction; moreover, retention is influenced by the type of attachment and the design of implant overdenture [6].

Once employing two implants for the mandibular implant-tissue supported overdentures, the implants are usually situated inter-foraminal, therefor additional influence that could be measured is the inter-implant distance. It was found that the inter-implant distance can affect the retention of MITSO according to the used attachment type. The mean inter-canine distance (22.88 mm) was then rounded to the nearest mm, as the minimum inter-canine

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distance is 16 mm the decision was made to use a distance of 19 mm as the minimal inter implant distance. While; the maximum inter-implant distance is 31 mm, a 29 mm inter-implant distance was applied for anatomic restrictions as the curvature of mandibular arch and the place of the mental foremen [7,8].

Although the different designs of overdenture attachments have been the scope of previous investigation, the potential influence of varying inter-implant distances on prosthesis retention has evaluated by few in-vitro studies. Inter-implant distance is either overlooked or chosen arbitrarily in studies on paired attachment retention. Therefore, the goal of this research was the evaluation of implant overdenture retention at 23 mm standard inter-implant distance using OT Equator and locator attachments.

Materials and Methods

Twelve participants were enrolled in this study from the out patients clinic, Prosthodontics Department, Faculty of Dentistry, Mansoura University.

They were healthy and, have no systemic diseases relating to the bone osseointegration such as uncontrolled diabetes or osteoporosis. This was achieved through medical history and clinical examination by physician. They were completely edentulous, all patients are of Angels class I maxillo-mandibular relationship, and had mandibular inter-foramina distance more than 22mm. A cone beam C.T made for each participant to determine the bone quality and quantity and the adequate sites for the employment of implants.

The research protocol was accepted by the Dental Research Ethical Committee of the faculty of dentistry, Mansoura University. All the patients have signed written consents after being informed about the treatment plan in details and the required follow-up appointments.

Surgical and prosthetic procedures

For each patient, conventional complete denture with lingualized occlusal contact was fabricated. Patients used their dentures for at least one month to allow for muscles adaptation to the dentures. The patients were recalled for baseline retention measurement (T0).

A stereolithographic surgical template was designed to help for implants installation. Two implants (Neo- biotech, Korea. 11.5 mm length implant with 3.5 mm diameter) were bilaterally positioned in the canine areas with inter-implant distance of 23 mm, following standardized 2 stage surgical protocol. The mandibular overdenture was relined by soft liner (Acrostone, Egypt).

Patients grouping

Participants were randomly classified into two equal groups as follow:
**Group I:** The overdentures were retained by locator attachment (Neo-biotech, Korea) with clear insert.

**Group II:** The overdentures were retained by OT Equator attachments (Rhein 83, Italy) with yellow insert.

After osseointegration period (3 months) all implants were exposed. Locator attachments (for group I) (Figure 1) and OT Equator attachments (for group II) (Figure 2) were screwed to the implants with 30 Ncm torque.

![Figure 1: Locator abutments.](image1)

![Figure 2: OT Equator abutments.](image2)

![Figure 3: Picked up female housing of Locator attachment.](image3)


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For all participants, the attachment female housings were picked up intraorally to the mandibular overdenture fitting surface using autopolymerized acrylic resin (Acrostone Dental Factory, Egypt) (Figures 3 and 4). All participants were organized for follow-up appointments.

**Figure 4:** Picked up female housing of OT Equator attachment.

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**Retention Evaluation**

Retention of mandibular denture was assessed for every patient at (T0: with conventional denture, T3: 3-months and T6: 6-months after overdenture insertion) using digital force-meter. The retention of the mandible complete overdenture was measured by digital forcemeter device according to Burns et al [9] as follows: 0.9 mm orthodontic wire was employed in metal hooks equipped in the mandibular denture buccal flanges. The wire was located at the 2nd premolar and 1st molar area with auto polymerized resin. Thus; the force-meter device is capable to apply a vertical dislodging force on the mandibular denture, and evaluate its retention.

**Figure 5:** 0.9 mm orthodontic wire was placed in metal hooks equipped in the mandibular denture buccal flanges.
The device hook was inserted in the shaft of digital force-meter; the hook was engaged to the halfway point of the wire loop. The pull end of the digital force-meter was linked to the 0.9 mm wire. The force-meter was dragged vertically till detachment of the overdenture, the reading was documented in Newton. For each patient, the average of more than three readings were calculated. (Figures 5 and 6).

**Figure 6:** hook was insert in the shaft of the digital force-meter and hook engaged the halfway point of the wire loop.

**Statistical Analysis**

Data were analyzed using IBM SPSS software package version 20.0. Data were defined using mean, standard deviation for parametric data after using normality using Shapiro-wilk test. Significance of the achieved results was adjudicated at the 5% level. Student t test was applied; for parametric quantitative variables, to compare between the two studied group. Paired t test was applied; to compare between T0, T3 and T6.
Results

Comparison of retention values (R) between the two groups at different observational times is presented in table (1). Results revealed that there is a statistically significant difference between group I & group II representing mean retention force (P<0.05) except at T0 (baseline evaluation with conventional dentures), with higher mean values for group I (Locator attachment) than group II (OT Equator attachments).

<table>
<thead>
<tr>
<th></th>
<th>With conventional denture (T0)</th>
<th>After 3 months overdenture insertion (T3)</th>
<th>After 6 months overdenture (T6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (locator)</td>
<td>1.61 ± 0.87</td>
<td>7.23 ± 0.87</td>
<td>7.20 ± 0.83</td>
</tr>
<tr>
<td>Group II (OT Equator)</td>
<td>1.22 ± 0.45</td>
<td>4.31 ± 0.56</td>
<td>4.29 ± 0.54</td>
</tr>
<tr>
<td>Student t test (p-value)</td>
<td>0.18</td>
<td>0.001*</td>
<td>0.001*</td>
</tr>
</tbody>
</table>

All results defined as mean ± Standard deviation
P: probability * statistically significant (if p<0.05)

Multiple comparisons of retention values between every two follow up times for each group are introduced in table (2). Results revealed that there is a statistically significant difference between each two observation times except T3 and T6 for both groups.

<table>
<thead>
<tr>
<th></th>
<th>T0-T3</th>
<th>T0-T6</th>
<th>T3-T6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (locator)</td>
<td>&lt;0.001*</td>
<td>&lt;0.001*</td>
<td>0.65</td>
</tr>
<tr>
<td>Group II (OT Equator)</td>
<td>0.001*</td>
<td>0.001*</td>
<td>0.76</td>
</tr>
</tbody>
</table>

T0: With conventional denture, T3: after 3 months of overdenture insertion, T6: after 6 months of overdenture insertion; p value of paired t test statistically significant (if p<0.05)

Discussion

Comparison of mean retention forces between the two groups at different observation times shown that there is a statistically significant difference between the study groups except at T0 (baseline evaluation with conventional dentures), with recorded higher mean retention values at T3 and T6 for both groups. This could be explained by the improvement in prosthesis retention obtained by adding overdenture attachments [10].

The present research revealed significant difference between the study groups where Locator attachment (group I) exhibited higher retention values than OT Equator attachment (group II). This difference may be owing to the double retention of Locator attachment along with the comparatively wider surface area of its retentive nylon male insert that should help in
maximizing the influence of friction between the attachment two components. Satti et al. [11] concluded that, Locator with pink nylon insert recorded higher retention values than OT Equator with clear insert.

This result is in agreement with Gonuldas et al. [12] who compared retention forces between (locator with clear nylon insert), (OT Equator with yellow insert) and (ball attachment with orange insert) using two implants (22 mm inter-implant distance). They concluded that locator attachment provided higher initial retention than OT Equator and ball attachments. This also was reported by Minguez Tomas et al. [4].

The results showed a slight decrease of the retention forces after six months of overdenture use. This is in accordance to Kleis et al. [13] who reported that when comparing Locator and ball attachment, Locator reported a higher rate of maintenance and no retention problem was recorded primarily but after multiple pulls the retentive values were reduced significantly.

The present study reported that retention values for the Locator attachment and OT Equator attachment with inter-implant distance of 23 mm after six months of overdenture use were 7.2 N and 4.29 N respectively. While a previous study by Sallam et al. [14] reported that the retention values after six months of overdenture use at 25 mm inter-implant distance with the Locator attachments was 6.65 N and with OT Equator attachment was 3.90 N. This was in agreement with El Mekawy and Yosry-Elhawary [15] who concluded that wear was more notable on locator and OT equator attachments retentive inserts at 25 mm inter-implant distance which result in the reduction of the retention values. In the same line; Pigozzo et al. [16] concluded that retention of 5-7 N is enough for overdenture retention. Consequently, the results of locator group are more satisfying than that of OT Equator group.

The inter-implant distance studied in this research was 23 mm. Shayegh et al. [8] demonstrated that inter-implant distances must affect the locator attachments initial retention. Additionally, they revealed variable retention values when comparing the inter-implant distances of 29 and 23mm. However, 23 mm inter-implant distance was correspondent to superior retention value. Regarding the rate of decreasing the retention value, the 23 mm inter-implant distance was accompanying to better performance. Nevertheless, Tabatabaian et al. [17] affirmed that inter-implant distance neither influence the vertical retention nor oblique resistance. However, it affected anterior-posterior resistance.

**Conclusion**

It could be concluded that:

- Inter-implant distance of 23 mm for 2-implant overdenture could be considered a reliable modality for edentulous mandible.
- Locator attachment may be preferable than OT Equator attachment regarding 2-implant overdenture retention at 23 mm inter-implant distance.
References


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