

Clinical Evaluation of the Implant Retained Overdenture with OT-Equator Attachments

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Abstract: *Statement of problem:* Successful treatment with the two-implant overdenture has been well documented. There are many different attachments available to connect implants to overdentures. The OT-Equator is a new line of low profile attachment. However, little information is available about this product and its effect on peri-implant tissues. *Purpose:* Evaluation of the mandibular implant assisted overdentures constructed with OT-Equator attachment both clinically and radiographically. *Materials and Methods:* Seven completely edentulous male patients have participated in this study. For each patient two implants were installed in the canine areas of the mandible according to the standardized two-stage surgical technique. Implants were loaded three months later with OT-Equator attachment implant assisted overdenture. Clinical evaluation was performed immediately, three months and six months following final prosthesis insertion and radiographical evaluation was performed immediately and six months later. *Results:* Clinical and radiographical results revealed insignificant differences in peri-implant probing depth, clinical attachment level, modified plaque index, modified gingival index, implant stability quotient and marginal bone height between different follow-up periods. *Conclusion:* The implant assisted overdenture with OT-Equator attachment may be recognized as being predictable and successful treatment option.

Keywords: implant assisted overdenture, low profile attachment, OT-Equator, Osstell, Implant stability quotient.

1. Introduction

Conventional complete dentures are commonly used by dentists to treat completely edentulous patients. There have been problems associated with retention and stability while treating completely edentulous mandibular arches compared to maxillary arch. A lot of factors have been attributed to this, primarily focusing on the decreased area available for support and increased resorption [1].

The development of Osseo integrated implants has broadened the treatment options that are available to edentulous patients [2]. Implant-assisted overdentures have been widely used to improve low retention and stability of complete dentures [3]. It also improves neuromuscular activity and adaptation and thereby substantially improves masticatory function and increases patient satisfaction [4]. The acceptance of implant-assisted overdentures has become so overwhelming that according to Consensus reports by McGill (2002) and York (2009) [5],[6], a mandibular two-implant overdenture has been recommended as the first choice standard of care for edentulous patients.

Various types of attachments have been successfully used to connect implants to overdentures. Ball attachment is the most common attachment used. It is a practical, effective, relatively low-cost prosthetic concept. It is considered the simplest type of attachments for clinical application due to ease of handling and minimal chair side time requirements [7].

The Locator attachment which was introduced in 2001 has become widely applied as it has several advantages over other systems. It is characterized by a low profile design that

is advantageous for cases with limited inter-ridge space. This geometry plays a role in dissipating occlusal loads through the abutment to the implant in a more favorable magnitude and distribution because of the reduced lever arm length thus optimizing loads around dental implants [8]-[10]. Another characteristic of the locator attachment is the dual retention through both external and internal mating surfaces that offers high durability and long lasting performance [11]. However, this leads to limited lateral and hinge movement, which may be responsible for transferring more moment loads to the implant, thus increases the stress in the bone around the implant that may be contributed to increased vertical bone loss while decreasing the stress in the posterior residual ridge with less need for relining [12]-[15].

The OT-Equator is a new line of low profile attachment. It is considered the smallest attachment system available with the least overall dimension (vertical height of 2.1 mm and 4.4 mm diameter).

It combines the simplicity of ball attachments, with the variety of retention levels and easy replacement options of Locators [16]. However, little information is available about this product. The present study was conducted to evaluate implant retained mandibular overdentures constructed with OT-Equator attachment both clinically and radiographically.

2. Material and Methods

Seven male completely edentulous patients with a mean age of 50 years (range: 40-60yr) were selected for this study. Prior to any treatment approach every patient was thoroughly evaluated regarding both medical and dental status. They were selected to be well motivated, cooperative,

nonsmokers, free from any intra-oral or systemic diseases that would otherwise affect the osseointegration of dental implants. They were also selected to have skeletal Angle's class I maxillo-mandibular relationships and enough basal bone height and width for placement of 2 piece implants. The Ethics Committee of the Alexandria University approved the protocol. Written informed consent was obtained from each patient after a full explanation of the clinical trial.

A set of complete maxillary and mandibular denture was fabricated for every patient and duplicated in clear auto-polymerized acrylic resin to be used as a radiographic/surgical template. Gutta-percha radiopaque markers were incorporated in the template to select optimal implant sites. Radiographic evaluation using cone beam computed tomography CBCT (J. Morita, Veraview R100, Japan) was done for each patient.

Two dental implants 3.6mm in diameter, 10mm in length (Dentium Superline, Dentium Co. Ltd., Korea) were screwed in the interforaminal area of the mandible

The patient was left for 3 months according to the standardized two-stage protocol. Every patient was instructed to make regular visit every month to reline the old denture with soft liner (Acrostone Co, England). After three months, the implants were uncovered by small crestal incisions at the location of the implants. The cover screws were removed and the healing abutments were placed for one week. A new set of dentures were made, the OT-Equator attachments (Rhein83 srl, Bologna, Italy) (Fig. 1) were incorporated to the mandibular denture by direct pick-up technique (Fig. 2) [17].

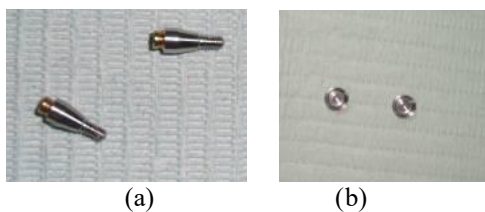


Figure 1: (a) OT-Equator abutment (b) The stainless steel housing.

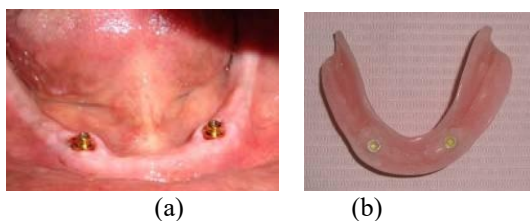


Figure 2: (a) OT-Equator attachments screwed in place (b) Finished denture base.

Clinical evaluation was performed for every patient immediately (BL), 3 months and 6 months after final prosthesis insertion including:

Modified Plaque Index (mPI) [18], Modified gingival index (mGI) [19], Peri-implant Probing Depth (PIPD) [20], Clinical Attachment Level (CAL) [21] and Implant Stability

[22] using resonance frequency analysis measured with the Osstell device instrument (Integration Diagnostics Ltd., Goteborgsvagen, Sweden) (Fig.3).



Figure 3: The Osstell device

The radiographic evaluations were conducted at insertion of the prostheses and six months later for assessment of the vertical bone height changes around each implant using the linear measurement system available on the OnDemand3D software (Cybermed International, Seoul, Korea) supplied by CBCT (Fig.4).

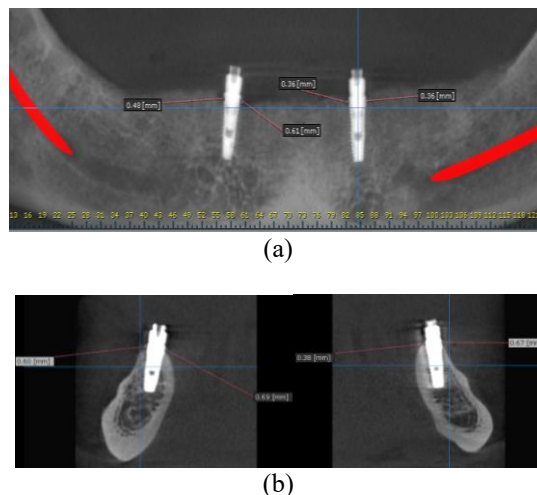


Figure 4: The linear measurements of the distance from the coronal-most level of bone implant contact to the point of reference on the implant at (a) mesial and distal sides (coronal view), (b) buccal and lingual sides (Sagittal views).

3. Results

Statistical analysis

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. Quantitative data were described using Range (minimum and maximum), mean, standard deviation and median. Data analysis was performed with Paired t-test, Wilcoxon signed ranks test, Friedman test, ANOVA with repeated measures and Post Hoc test (LSD). Significance of the obtained results was judged at the 5% level. A p-value of less than 0.05 was considered statistically significant.

3.1 Results of the Clinical Evaluation

Generally there was a minor change in the mean and standard deviation values of peri-implant probing depth, clinical attachment level, Modified Plaque Index, Modified Gingival Index and Implant stability levels throughout the different

periods of follow up. This wasn't statistically significant at $P \leq 0.05$ level as shown in Tables 1 and 2.

Table 1: Comparison between the three studied periods according to peri-implant probing depth, clinical attachment level and Implant stability quotient (n=7)

		Baseline	3m	6m	F	P
Peri-implant probing depth	Min.-Max.	1.0 – 1.0	1.0 – 1.12	1.0 – 1.25	2.39	0.13
	Mean ± SD.	1.0 ± 0.0	1.03 ± 0.06	1.07 ± 0.10		
	Median	1.0	1.0	1.0		
	Sig. bet. periods	$p_1=0.172, p_2=0.106, p_3=0.346$				
Clinical Attachment Level	Min. – Max.	2.0 – 2.0	2.0 – 2.12	2.0 – 2.25	1.99	0.17
	Mean ± SD.	2.0 ± 0.0	2.02 ± 0.05	2.05 ± 0.10		
	Median	2.0	2.0	2.0		
	Sig. bet. periods	$p_1=0.356, p_2=0.203, p_3=0.173$				
Implant stability quotient	Min. –Max.	62.0 – 75.0	62.0 – 71.0	60.0 – 78.0	0.10	0.90
	Mean ± SD.	68.86 ± 5.08	67.57 ± 3.31	68.71 ± 7.02		
	Median	70.0	69.0	68.0		
	Sig. bet. periods	$p_1=0.513, p_2=0.969, p_3=0.759$				

F: F test (ANOVA) with repeated measures

Sig. bet. periods was done using Post Hoc Test (LSD) for ANOVA with repeated measures

p_1 : p value for comparing between baseline and 3m

p_2 : p value for comparing between baseline and 6m

p_3 : p value for comparing between 3m and 6m

*: Statistically significant at $p \leq 0.05$

Table 2: Comparison between the three studied periods according to modified plaque index and modified gingival index (n=7)

		Baseline	3m	6m	$Fr. \chi^2$	P
Modified Plaque Index	Min. – Max.	0.0 – 0.0	0.0 – 1.0	0.0 – 1.0	4.42	0.10
	Mean ± SD.	0.0 ± 0.0	0.25 ± 0.38	0.32 ± 0.43		
	Median	0.0	0.0	0.0		
	Sig. bet. periods	$p_1=0.109, p_2=0.109, p_3=0.577$				
Modified Gingival Index	Min. –Max.	0.0 – 0.50	0.0 – 0.50	0.0 – 0.75	2.47	0.29
	Mean ± SD.	0.13 ± 0.19	0.21 ± 0.22	0.27 ± 0.27		
	Median	0.0	0.25	0.25		
	Sig. bet. periods	$p_1=0.180, p_2=0.074, p_3=0.396$				

$Fr. \chi^2$: Friedman Test

Sig. bet. periods was done using Wilcoxon Signed Ranks Test

p_1 : p value for comparing between baseline and 3m

p_2 : p value for comparing between baseline and 6m

p_3 : p value for comparing between 3m and 6m

*: Statistically significant at $p \leq 0.05$

3.2. Results of the radiographic evaluation

Radiographic evaluation revealed a slight change in marginal bone level change that was not statistically significant as shown in Table 3.

Table 3: Comparison between the two studied periods according to marginal bone loss (n=7)

Marginal Bone loss (MBL)	Baseline	6m	t	p
Min. – Max.	0.34 – 0.77	0.38 – 0.78	1.205	0.273
Mean ± SD.	0.51 ± 0.16	0.59 ± 0.15		
Median	0.54	0.59		

t: Student t-test

4. Discussion

Various attachment systems are used to connect the overdenture to the implant. Some attachments may transmit higher load to the implant that may cause soft tissue

complications and marginal bone loss thus affecting the implant survival rate [23].

The results of the clinical evaluation of the present study demonstrated minimal changes over the 6-months follow-up. No statistically significant differences were found for any of the clinical parameters studied (modified plaque index, modified gingival index, peri-implant probing depth, and clinical attachment loss) over the evaluation period. The scores of the peri-implant indices were very low at all the evaluation periods. The strict oral hygiene regime to which patients were subjected apparently resulted in healthy peri-implant tissues.

The mean peri-implant probing depth in the present study showed insignificant increase between all interval times of the study period. The results demonstrated that the probing depths were <1.5 mm during the entire period of this study. These results were in agreement with studies of Salvi *et al* [24] and Neiva *et al* [25] that have indicated that successful

implants allow probe penetration of approximately 3 mm. probing depths. The increased PD could be related to increased peri-implant vertical bone resorption with time and peri-implant soft tissue enlargement.

In this study, around the implant abutments there was statistically insignificant increase in the mean of attachment level. The results demonstrated that the attachment loss were <0.1 mm during the entire period of this study. These results were in agreement Joseph et al [26] who found that during the first year of function an average attachment loss of 0.4 mm was observed. More specifically, the mean attachment loss over the study period was equal to 0.05 mm, which is the same mean annual attachment loss found by Schatzle et al [27].

Regarding the modified plaque index, it was slightly increased along the different time points; this may be due to the resiliency of the OT-Equator attachment, which allows denture movements and accumulation of food particles and plaque under the denture. No statistically significant differences were identified; this can be attributed to the plaque control by the patient and the repeated reinforcements of oral hygiene measures.

Statistical analysis of changes in mean values of modified gingival index showed insignificant difference between different periods. All evaluated patients showed stable and healthy peri-implant tissue. The level of inflammation was extremely low that only grade one was detected in some cases. These healthy gingival conditions might be due to proper oral hygiene and good plaque control.

Implant stability quotient values was nearly stable during follow up period and within the range reported for successfully integrated implants (57–82) [28]. The use of OT-equator could account for the minimal change as it has been shown that it is effective in transmitting less stress to the implants [29].

The marginal bone around the implant crestal region is usually a significant indicator of implant health since; the occlusal forces are distributed primarily to the crestal bone [8],[30],[31].

Regarding the marginal bone level changes, it was nearly stable during the study. The accumulated mean marginal bone loss recorded after 6 months was 0.59 mm which in agreement with many previous studies such as Fernández [32] who recorded a bone loss of 0.74 ± 0.20 mm after 6 months, Nandal [30] who recorded a mean bone loss of 0.5531 mm and Kamburoglu [33] who concluded that the mean bone loss was 0.60 mm at 6 months. This may be attributed to the low profile and small dimensions of the OT-Equator attachment that decrease stresses transferred to the crestal bone area causing less bone resorption. This explanation is in a line with Abdelhamid [8] who concluded that low profile design played a role in dissipating occlusal loads through the abutment to the implant, John [31] who concluded that the small diameter attachment is the better attachments to be used for implant supported-overdenture in terms of minimizing the stresses to the bone and Negm [29]

who concluded that the distribution of stresses at the peri-implant tissues showed lower magnitude when using OT-equator due to its small dimensions. Hence, according to the results of these studies the chosen attachment is considered successful.

5. Conclusion

Within the limitations of this study regarding the sample size and short study periods, it is possible to conclude that implant assisted overdenture with OT-Equator can be used successfully without negatively affecting peri-implant tissues health.

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