



EVALUATION OF RETENTION OF THE MANDIBULAR IMPLANT SUPPORTED OVERDENTURE WITH TWO TYPES OF LOW-PROFILE ATTACHMENT

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ABSTRACT

Objective: This study was conducted to compare the retention of the mandibular implant-supported overdenture with OT Equator and mini ball and socket attachments (nucleoss, menderes ,izmir , Turkiye). **Subjects and Methods:** From the removable prosthodontics department clinic, Faculty of Dental Medicine, (Boys, Cairo), Al-Azhar University, ten completely edentulous patients were randomly chosen. The patients were divided into two groups, group I received two implant-supported overdenture with OT Equator attachment while group II received two implant-supported overdenture with mini ball and socket attachment. The retention was measured using a digital force gauge at the time of attachment connection(T1), after six months(T2), and after twelve months(T3). Statistical analysis was done using SPSS software version 20.0. Data distribution of normality was done by using the shapiro-wilk test. Student t-test was used for comparing the means of two groups. Paired t-test was used for comparison between T1, T2, and T3. **Results:** It was found that group I recorded significantly higher values of retention than group II and there was a gradual loss of retention values in the two groups. **Conclusion:** OT Equator attachment is significantly more retentive than mini ball attachment.

KEY WORDS: OT Equator attachment, implant over denture, low profile attachment, retention

INTRODUCTION

Resorption of the alveolar ridge and atrophy of the denture supporting areas leading to poorly fitting denture, lack of stability, and impaired masticatory efficiency are the most important problems. These problems can be treated by various methods, starting with vestibuloplasty, ridge augmentation, and eventually implantation ⁽¹⁾. Implant-supported overdentures give edentulous patients comfort, stability, and painless option. It improves survival rates and oral health. The big problem with overdentures, however, is its high cost ⁽²⁾.

Different concepts are evolved not only related to the type of implant used (conventional, narrow, mini implant), its number, placement or loading, but also to the type of implant used as the attachment system used and its impact on the overdenture balance ⁽³⁾.

The choice of an implant-retained overdenture attachment system depends on cost-effectiveness, adequate retention level, expected degree of oral hygiene, accessibility of the bone, social role of the patient, perception of the patient, maxillomandibular relationship, the gap between implants and adversarial jaw status ⁽⁴⁾.

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Due to their low-cost, easy handling, limited chair side time specifications and their potential implementations for both root and implant assisted prostheses, ball attachments are commonly used as the easiest of all stud attachments^(5,6).

A new line of low-profile attachments is the OT-Equator. With the least dimension, it is considered the smallest attachment system available. It blends the simplicity of ball attachments with the range of levels of retention and Locators' simple replacement choices. However, there would be little information available on this product⁽⁷⁾.

Retention is a significant factor in satisfying patients with removable dentures⁽⁸⁾. To avoid overdenture displacement, the attachment system must have an adequate retentive force, which can be based on mechanical and frictional contacts⁽⁹⁾. Moreover, the efficiency of overdentures assisted by implants depends on the retention ability of the attachment device used^(10,11).

This study was conducted to compare the retention of the mandibular implant supported overdenture with OT Equator and mini ball and socket attachments.

SUBJECTS AND METHODS

Ten completely edentulous males patients were selected by power test according to Bhat et al.⁽¹²⁾ using SPSS version 20 power of the sample was 80%.

The study was completed in a crossover design. The patients were divided into two groups. Each group contained five patients.

From the Removable Prosthodontics Department Clinic, Faculty of Dental Medicine, (Boys, Cairo, Egypt), Al-Azhar University, ten completely edentulous male patients were randomly chosen, with an age of 55-65 years, angle class I with well developed ridges, free from any systemic diseases that might affect implant placement. Patients with any diseases that may affect osseointegration, patient with neuromuscular diseases, drug or alcohol abuse or patient

with history of radiation therapy at head and neck were excluded. After a clarification of the technique prior to study enrolment, informed consent was obtained from all participants. Ethical approval was obtained from Research Ethics Committee, Faculty of Dental medicine Al-Azhar University Under the No.. (EC Ref No.: 161/012019/110C).

For each patient, a thorough diagnosis was done by taking medical and dental history. Soft, hard tissue evaluation and radiographic investigation were done to detect any abnormality then an acrylic complete denture was designed according to the conventional steps for complete denture construction with bilateral balanced occlusion principle. The denture was inserted into the patient's mouth after polishing, and verification of esthetics, stability, retention, occlusion, high spots and any sharp or overextension that could cause pain were checked. Post insertion instructions were done and patients were instructed to wear the dentures till adaptation was acquired.

Mandibular alveolar ridge height, bone quality and the type of bone were evaluated by the cone beam computerized tomography. Measurements were carried out in cross-sections from the most superior point of the crest of the ridge to the most inferior point of the mandible⁽¹³⁾.

By the aid of conventional surgical stent, an initial penetration through the cortex of the bone using a pilot drill through the hole of the stent which represented the planned position of the implant then the sequence of the drills in the selected surgical kit until the osteotomies were completed. Two dental implants fixtures (Nucleoss, Menderes, Izmir, Turkey) with Implant length 10 mm, Implant diameter 3.5 mm were placed at the osteotomy site. After three months, the healing abutment was secured to each implant to allow the mucosa healing around the abutment for two weeks. Then the patients were divided randomly in to two groups: group I:(Five patients) received complete dentures supported by two implants with OT-equator attachment system and group II (five

patients) received complete dentures supported by two implants with mini ball and socket attachment system and retention was measured at the time of attachment connection (T1), after six months (T2) and after twelve months (T3).

After one year the attachments were exchanged; patients who received dentures with OT-equator attachment system received ball and socket attachment system and vice versa. The measurements were repeated after another six and twelve months. This randomization was made to reduce the effect of prosthesis type and inherent bias on patient satisfaction.

Group I Patients:

A metallic cap was placed over the male part of the OT Equator attachment then its place was transferred to the denture with the aid of marker paste. A space was created in the fitting surface of the denture base correspond to the implant site using a large acrylic bur mounted in a straight handpiece. Auto-polymerizing acrylic resin (Acrostone, Egypt) was used to attach the metallic cap (female part of the OT Equator attachment) to the denture base after blocking of undercut, Small amount of auto polymerizing acrylic resin was placed in the created space in the fitting surface of the denture and another amount intraorally on the top of the metal cap. The denture was inserted into the patient mouth, and the patient was instructed to close in the maximum intercuspation. When the acrylic resin had set, the denture with the metal cap was removed from the mouth, inspected, and the excess material was removed with a suitable bur.

Group II Patients:

A metallic cap was placed over the male part of the mini ball and socket attachment, then the rest of the steps were done as group I.

Retention evaluation:

The mandibular overdenture was modified following the BURN⁽¹⁴⁾ method so that two hooks were attached; one at the mid labial flange on each

side. On the hooks passing over the occlusal surface of posterior teeth, an orthodontic wire (18 gauge diameter) was attached. Dentures were inserted and the “pull” end of the force gauge at the midpoint was attached to the wire and adjusted to determine the peak force required to dislodge the overdenture in Newton (N). The force gauge was pulled vertically upwards until denture retention was lost and the prosthesis moved vertically and the reading was registered three times and the mean value was calculated. The measurements were performed at the time of overdenture insertion (T1), after six months (T2) and after twelve months (T3).

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. Quantitative data were described using mean, the standard deviation for parametric data after testing normality using **Shapiro-wilk test**. Significance of the obtained results was judged at the 5% level. Student t test; for parametric quantitative variables was used to compare between two studied groups. The **Paired t test** was used for comparison between T1, T2 and T3.

RESULTS

As shown in table (1), all values showed a statistically significant difference between the two groups during all of the follow-up periods.

TABLE (1) Mean retention values at different observation times.

	(T1)	(T2)	(T3)
Group(I) n=10	6.663	6.246	6.074
X±SD	±0.9008	±0.6111	±0.5725
Group(II)n=10	2.58	2.476	2.321
X±SD	±0.479	±0.4613	±0.4212
P-value	0.000**	0.000**	0.000**

*Highly significant if (P<0.001), values marked with (**) are significant.*

TABLE (2) Comparison of means of retention between each two observation times for group (I)

Observation times	X±SD	Paired -T test P-value
(T1) Vs	6.663±0.9008 Vs	0.07519
(T2)	6.246±0.6111	
(T1) Vs	6.663±0.9008 Vs	0.0209*
(T3)	6.074±0.5725	
(T2) Vs	6.246±0.6111 Vs	0.0013**
(T3)	6.074±0.5725	

Significant difference if ($p \leq 0.05$),

values marked with () are significant.*

Highly significant if ($P < 0.001$),

*values marked with (**) are significant.*

As regard T1VsT2 the difference was non-significant as $P > 0.05$. The difference was Significant regarding T1 Vs T3 with $P < 0.05$. Also, T2 Vs T3 is Significant with $P < 0.01$.

TABLE (3) Comparison of retention (R) between each two observation times for group (II)

Observation times	X±SD	Paired t-test P-value
(T1) Vs	2.58±0.479 Vs	0.000034**
(T2)	2.476±0.4613	
(T1) Vs	2.58±0.479 Vs	0.0000004**
(T3)	2.321±0.4212	
(T2) Vs	2.476±0.4613 Vs	0.000028**
(T3)	2.321±0.4212	

very highly significant if ($P < 0.001$),

*values marked with (**) are significant.*

As regard T1VsT2 the difference was significant as $P < 0.001$. The difference was Significant regarding T1 Vs T3 with $P < 0.001$. Regarding T2 Vs T3 is significant with $P < 0.001$.

DISCUSSION

Because of its relative simplicity and minimal invasiveness, the implant-retained overdenture for the mandible is a highly effective prosthetic procedure that increases retention, durability, improved function, and overall satisfaction for patients. ⁽¹⁵⁾

According to many studies, two-implant overdentures should be the first choice of treatment for the edentulous mandible ⁽¹⁶⁾.

In this study, each patient in group I received mandibular overdenture retained by OT Equator attachment to improve denture retention and stability. Ammar et al., presumed that the implant-assisted overdenture with OT-Equator attachment would be accepted as a safe and effective treatment choice ⁽¹⁷⁾.

In this study, each patient in group II received mandibular overdenture retained by mini ball and socket attachment. Implant overdenture retained or supported by ball attachment systems showed high implant and prosthetic survival and success rates. In the mid-term follow-up, there were few complications, high patient satisfaction, and good biological parameters ⁽¹⁸⁾.

The retention force is ensured by a retention system that must be sufficiently as its magnitude, in order to prevent overdenture from moving. Prosthodontists often rely on selecting retention systems empirically, by assuming their retention characteristics, and considering the level of satisfaction of the patients using that system ⁽⁸⁾.

Descriptive statistics of the results concluded that, OT Equator attachment recorded a significant higher retention values than mini ball and socket attachment in all observation times.

These results agreed with Marin et al., ⁽¹⁹⁾ who used a simulation of the cyclic dislodging of implant-supported overdentures to evaluate the retention force and wear characteristics of three attachment

systems (1-O-ring, 2-Mini Ball, and 3-Equator) and found that the Equator system had the highest retention force values. After each cycle span, the Equator system showed a large and progressive loss in retention power. After 5500 insertion-removal cycles, the retention force had decreased by approximately 33.08 percent compared to baseline. The Equator system's loss of retention may be explained by increased deformation and wear on the internal and external surfaces without the polyamide ring breaking.

Satti ⁽²⁰⁾ compared retentive properties of the ball attachment and OT-equator attachment and found that the latter offers more advantageous features. Titanium Nitride (TiN) coating provides maximum resistance to wear, also a small-scale metal housing and replaceable nylon caps, offering various retention levels. Retention caps can be replaced easily within seconds.

There was a significant decrease in retention values for both groups. This could be attributed to wear of resilient overdenture attachments.

According to Rutkunas et al., ⁽¹⁰⁾ retention loss with equator attachment was mainly due to wear and permanent dimensional changes of the nylon inserts. This finding was also in agreement with Abi Nader⁽²¹⁾.

According to Passia et al., ⁽²²⁾ and Ludwig et al., ⁽²³⁾ because of friction between male and female parts, resilient attachments wear under functional loading or after several cycles of insertion and removal. These finding agreed with Tomás et al., ⁽²⁴⁾ who explained in an in vitro study that the higher wear of both locator and OT equator attachment systems may be due to the various geometries of the plastic matrices of the two attachment systems that may resulted in higher friction forces or higher wear resistance of the retentive male components.

The clinical outcomes of overdentures with two mini dental implants with Equator attachments, four

mini dental implants with Equator attachments, or two conventional dental implants with O-ring attachments were evaluated by Aunmeungtong W et al., ⁽²⁵⁾ who used two mini dental implants with Equator attachments, four mini dental implants with Equator attachments, or two conventional dental implants with O-ring attachments. After a year, the O-ring attachment had more attachment problems than the Equator, and Equator users were satisfied than O-ring users.

The results showed a significant decrease in retention values for mini ball attachment. These findings disagreed with Botega DM et al., ⁽²⁶⁾ who concluded that the O-ring system retention values remained stable during all of the cycle periods tested. The elasticity of the ring and the design of the patrix, as well as the frictional resistance between them, all contribute to this stability. In addition, after 5500 cycles, SEM showed a small amount of wear, a smooth surface, and the preservation of the nitrile ring's original features, findings that may explain the consistent retention values. This difference in results could be due to different attachment system companies tested and this was an invitro study that differ from our clinical one.

The limitation of the study was the patients had a well developed ridges. This study excluded patients with atrophic ridges or patients with class II or III arch relationship that might affect the results.

CONCLUSION

Within the limitation of the study, it can be concluded that:

1. The mandibular implant supported overdenture with OT Equator attachment was more retentive than mini ball attachment.
2. There was a gradual loss of retention values in the two groups.

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