ORIGINAL ARTICLE

Evaluation of Two Different Attachment Systems Used with Mandibular Implant-retained Overdenture

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Abstract

Objectives: The aim of this study was to evaluate the effect of two different attachment systems on the retention and implant stability of implant-retained mandibular overdenture.

Materials and methods: Fourteen completely edentulous patients with age ranged from 47 to 65 years planned to receive conventional complete denture. Following the treatment protocol, each patient received two implants in the mandibular anterior region and after insurance of the osseointegration, the patients were randomly divided into two groups; group I received ball /O-Ring attachment and group II received locator attachment. The retention of two groups was assessed by the digital forcemeter at three times (T); (T0) retention of the conventional complete denture, (T1) at time of insertion of implant retained mandibular overdenture and (T3) retention after three months of insertion of implant retained mandibular overdenture. The implant stability quotient (ISQ) was done using magnetic resonance frequency analyzer (Osstell, ISQ) at the time of loading then after 3 and 6 months.

Results: The retention values before the insertion of overdenture (T0) were considerably low in comparison with those at time of insertion of overdenture (T1) and after three months from denture insertion (T3). Regarding the ISQ values, there was no significant difference between the two groups before and at the time of insertion of the implant while there was a significant difference between the two groups with better stability results in the locator attachment group after three months (p <0.05).

Conclusion: Within the limitation of this study, both types of attachment systems; ball / O-ring and locator attachments, are reliable modalities for improving the retention and stability of implant retained mandibular overdenture with superior initial stability results for the locator attachment.

Keywords: Implant-retained overdenture, Implant stability, Locator attachment, Retention, Stud attachment, Resonance frequency analysis.

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Introduction

Prosthetic rehabilitation with a complete denture is the most well-known treatment for the edentulous state, and its advantages and disadvantages have been explained and discussed.[1] The successful incorporation of the denture with the patient's oral functions in addition to the psychological acceptance of the dentures by the patient is important factors to achieve favorable results of complete denture treatment.[2]

Different researches have confirmed that conventional mandibular dentures can not restore masticatory function, or enhance patient satisfaction and the quality of life.[3] Retention and stability problems of the mandibular complete denture affect the oral function and masticatory functions. To overcome these problems, prosthetic management using implant-retained overdentures are extremely valuable.[4,5] Rehabilitation with mandibular implant-tissue-supported overdentures using two implants can be considered the main treatment modality when more implant can not be placed.[6]

Many types of attachments can be used with implant overdentures such as magnets, ball/O-ring, bar(s)/ clip(s) and locator attachments. To guarantee sufficient stability, finest shape, form, appearance, and comfort, the overdentures should be cautiously planned.[7] The interarch space, stress distribution between implant and mucosa, and the amount of retention and resistance needed are the main factors affecting attachment systems selection.[8]

The simplicity of use and maintenance of ball/O-ring, its low cost, elimination of a superstructure bar, its wide range of movement, and great patient satisfaction are the main advantages of Ball/O-ring which make it one of the most successful stud attachments to enhance the retention of implant and tooth supported complete and partial overdentures. On the other hand, it wears over time, steadily loses retention, and must be changed from time to time and the ball attachments must be parallel to each other.[9]

The advantages of the locator attachment are its self-aligning, has double retention, rotational action, built-in guide planes providing precise insertion; it can also be used in non-parallel situations, can be used in cases with reduced interarch spaces and is available in different colors with different retention values; resilient, retentive, and durable. Besides, its repair and replacement are easy and fast.[10]

Implant stability is very important for dental implants success and is provided initially by mechanical engaging in the implant bed bony walls. Secondary stability occurs during healing by deposition of bone on the implant surface (osseointegration).[11] Different methods have been used to measure implant stability such percussion and mobility testing by applying lateral forces with mirror handles, measuring cutting torque resistance, insertion

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torque values, reverse torque tests, periotest, dental fine tester, and Osstell electronic device. The Osstell instrument is a modern, noninvasive and a relatively precise technique, which enables the measuring using resonant frequency analysis (RFA) and provides both information on implant stability in the bone and reliable guidance to the further course of implant therapy.[12]

There are limited clinical data evaluating retention of the prosthesis and implant stability when ball/ O-ring attachment and locator attachments are used with two implant supported anterior overdenture. So, the aim of this study was to compare the effect of attachment type (dentium ball/O-ring attachment and zest locator) on implant stability and retention of mandibular implant overdentures.

Materials and methods

Fourteen completely edentulous male patients, ranging from 47 to 65 years of age were assigned in current research according to the following criteria: At least one year of total edentulism in the maxilla and the mandible, mandibular residual alveolar ridge of at least 12 mm height and 6 mm width at the canine region, covered with firm, relatively even compressible mucosa, and Angle's class I maxillomandibular relations with adequate inter-arch space. While the exclusion criteria included: any systemic disease that may affect bone and soft tissue health, temporomandibular joint (TMJ) disorders, abnormal habits, e.g., bruxism and clenching, Smokers, history of radiation therapy in the head and neck region, Un-cooperative patients. Any logistic, psychiatric or physical reasons that could affect follow-up, and lack of motivation for adequate home care.

The study was planned and performed at the specialty clinics of Prosthodontics Department, Faculty of Dentistry, Taif University in accordance with Declaration of Helsinki and approved by the Research and Ethics Committees in Faculty of Dentistry, Taif University. After the patients were informed about the line of treatment and need of their regular and frequent recall, they approved their treatment plan on a written consent to follow the study protocol throughout the total period of the research.

Routine medical and dental investigations were performed for each patient. Preoperative radiographic planning of the implant sites was conducted using cone beam computed tomography (CBCT) and a replica of the patient's lower denture.

Following the conventional two-stage surgical approach (Fig. 1) the patient received two identical implant fixtures (self tapping vacuum titanium plasma sprayed (VTPS) implant (PITT-EASY-implant, Oraltronics, Bremen, Germany) with the same length (10mm) and diameter (4 mm) in the mandibular anterior region with low speed, high torque drilling and double coolant preparation of implant osteotomy sites. The flap was sutured by continuous mattress suture using 3/zero black silk (M-Natur, International sutures manufacturing Co. Egypt) (Fig. 2) and the patients were informed about postsurgical care, medications, and instructions. After 1 week, the old dentures were relieved at the implant sites and relined with tissue conditioner material (Alpha-dent, Alpha dental products Co., Chicago, USA) and used for 3 months healing period.

After three months healing period, the cover screws were loosened by using the hex driver and then healing abutments were screwed to the implants for seven days. Healing abutments were removed and the patients were randomly divided into two equal groups (each consists of seven patients) according to the type of attachment used. Group I: patients received mandibular overdenture retained by ball/ O-ring attachment system (Dentium Co, Korea) (Fig. 3) and Group II: patients received mandibular overdenture retained by locator attachment system (Zest dental solutions, USA) (Fig. 4)

Fig. 2: Continuous matrix suture of the mucoperiosteal flap

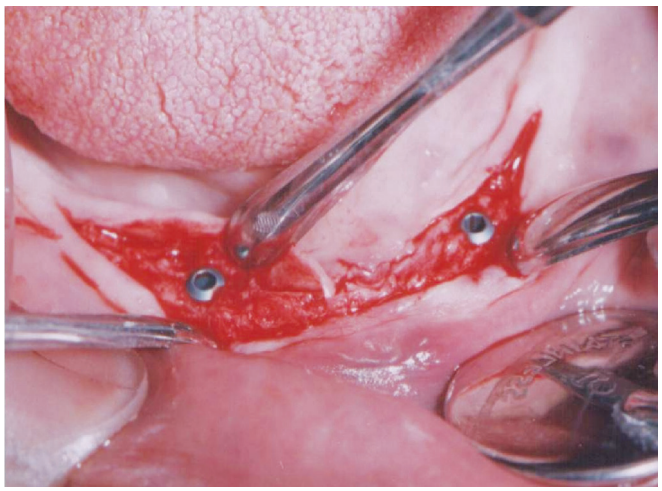

Fig. 1: Cover screws were screwed into the fixtures

Fig. 3: Ball abutments screwed into the fixture

Fig. 4: Locator abutments with blockout spacer at time of loading

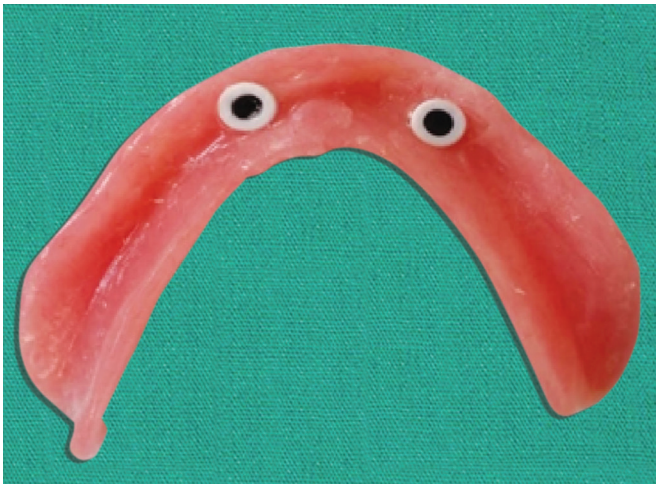

Fig. 5: O-ring inserted into their sleeves inside the metal houses

The matrices of the ball attachments and locator were integrated into the dentures with a direct intraoral pick-up technique using a cold-curing, MMA free, hard relining material for chairside relining in one single session (Hardliner CD, Promedica, Germany) a block out spacer was used to prevent adherence of the acrylic resin to the abutment or the implant (Fig. 5).

Evaluation

Retention

The retention of two groups was assessed at three times (T); (T0) retention of the conventional complete denture, (T1) at time of insertion of implant retained mandibular overdenture and (T3) retention after three months of insertion of implant retained mandibular overdenture. The digital forcemeter device was used to measure the retention of the mandibular complete overdenture. Metal hooks were prepared in the buccal surface of mandibular denture flange. A 0.9 mm orthodontic wire was placed buccal to 2nd premolar and 1st molar area with cold-curing acrylic resin so the forcemeter device could exert a vertical displacing force on the denture, and test its retention. The hook attachment was placed on the shaft of the forcemeter device, and the hook engaged the center of the wire loop (Fig. 6). The pull end of the forcemeter device was connected to the 0.9 mm orthodontic wire. The forcemeter device was pulled vertically until the denture was detached; the force reading was recorded in Newton. For each patient, more than three records were taken each time and divided to get the average.[13]

Implant Stability

Magnetic resonance frequency analyzer (Osstell ISQ, Gote-borg, Sweden) (Fig. 7) was used to measure the implant stability quotient (ISQ) at the time of loading then after three and six months. A special smart peg was connected to the implant body at 4–5 N/cm torque, and measurements were made at 2–3 mm away so that the probe tip of the analyzer would point to the small magnet above the smart peg. Measurements were made at two directions, buccolingual and mesiodistal directions (Fig. 8). The measurements were made three times for each direction to ensure reproducibility. The mean of these values was used for statistical analysis.

Statistical Analysis

The collected data were analyzed using statistical package for social sciences (SPSS 20.0) for Windows. Kolmogorov–Smirnov test

Fig. 6: Patient during measuring retention

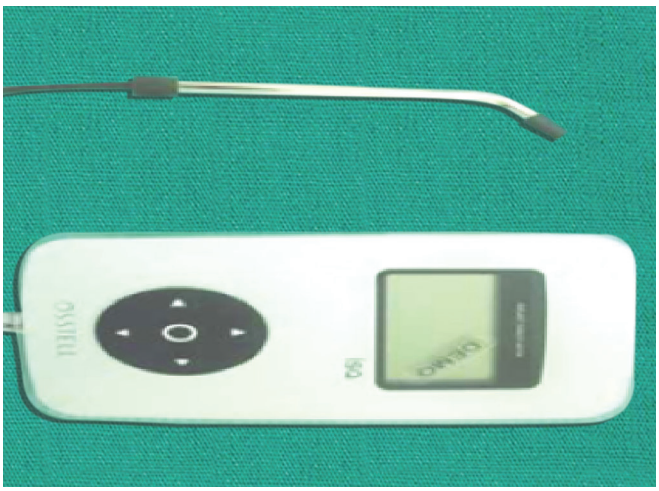

Fig. 7: Osstell ISQ device

Fig. 8: Smart peg connected to the implant for ISQ measurement

was used as a test for normality, and the independent sample t-test was used to compare the two groups, the statistical significance level was set at $p < 0.05$.

Results

All the 14 implants in this study were considered successfully osseointegrated as they show no signs of peri-implant pathology and successful rigid fixation clinically and radiologically.

The retention values (R) in the two groups at different observation times is presented in Table 1. There was no statistically significant difference between groups I and II before overdenture insertion (T0) while there was a statistically significant difference between them at the time of loading (T1) and after 3 months (T3) with group I has higher mean values than group II ($p < 0.05$).

Table 2 shows the mean ISQ values for both groups. There was a decrease in the ISQ values in group I from the loading (ISQ = 69.06) to the 3rd month (ISQ = 68.21), followed by an increase from the 3rd month to the 6th month (ISQ = 71.25). On the other hand there was an increase in mean ISQ values group (II) throughout the follow-up intervals from loading (ISQ = 70.25) to (ISQ = 73.00) after 6 months. However, when comparing both studied groups together, there was a statistically significant difference at the 3rd month follow-up ($p = 0.047$), while no statistical significance was found after 6 months of follow-up at $p < 0.05$.

Discussion

Fourteen patients were selected for this study with their age ranging from 47 to 65 years as it was found that the success rates might be less than optimal with advancing age.[14]

Table 1: Retention values in the two groups

	(T0)	*(T1)*	*(T3)*
Group I X ± SD	2.54±0.60	8.46±0.72	8.35±0.71
Group II X± SD	2.3±0.50	5.6±0.55	5.11±0.8
p value	0.09	0.003*	0.004*

*Significant at 5%c level of significance
Group I; Dentium Ball/ O-ring attachment system; Group II; Zest Locator attachment system
(T0) Before overdenture Insertion; (T1) At time of overdenture insertion; (T3) 3 months after overdenture insertion

The variation in implant diameter and or length may affect the biomechanics of dental implant, so a standardized implant size was used.[15]

Salvi and Lang stated that the modalities used to evaluate oral implants during maintenance care must be highly sensitive, easy to measure and create reproducible data.[16]

Retention was measured in Newton using forcemeter before insertion of overdenture (T0), at time of insertion (T1) and three months (T3) after overdenture insertion. At each time, 5 records, with 1-minute rest between each reading, were registered and take the average for each patient.[13]

Different techniques have been introduced to measure implant stability such as percussion and mobility testing, measuring cutting torque resistance, insertion torque values, reverse torque tests, periotest, dental fine tester, and histomorphometric and histologic analysis of the bone-implant interface. All of these have some drawbacks such as debatable accuracy and reliability, and invasive or destructive nature.[17] Osstell electronic device, based on RFA, measures implant stability and quantifies it in ISQ values.[18] The Osstell instrument facilitates optimizing implant healing, prosthetic construction, and surgical protocol because it can provide repeated measurements of implant stability at placement, during healing, and during and after loading, allowing the clinician to detect implant instability and take appropriate steps to remedy it and to rescue an implant before failure.[19]

The results of the retention values in this study revealed that there was no statistically significant difference between groups I and II before overdenture insertion (T0) while there was statistically significant difference between them at the time of loading (T1) and after three months (T3) with higher mean values for group I than group II ($p < 0.05$).

Regarding the findings of the implant stability, there was an increase in the ISQ value of both groups with time as there is an increase in the bone-implant contact area, this was in accordance with other researches.[20] Comparing the ISQ results of both groups, there was a statistically significant difference between the two groups at the 3rd month after loading with higher values for the locator group while no significant difference at the other follow up periods. This can be explained by the difference in stiffness of the retentive components of the two systems and that the Ball/O-ring system relocates high bending forces to the implants under lateral forces.[21,22]

Conclusion

Both the ball/ O-ring and locator attachment systems are successful and useful. Regarding the retention, there was no statistically

Table 2: Mean ISQ values at different intervals

Follow-up interval	*Group I*	*Group II*	*Statistical analysis*	
	Mean ± SD	*Mean ± SD*	*t*	*p*
At the time of loading	69.06 ± 5.11	70.25 ± 5.21	0.564	0.578
3rd month	68.21 ± 3.76	71.75 ± 4.44	2.108	0.047*
6th month	71.25 ± 3.98	73.00 ± 4.02	0.960	0.295

*Statistically significant at $p < 0.05$
Group I; Dentium Ball/ O-ring attachment system; Group II; Zest Locator attachment system

significant difference between groups I and II before overdenture insertion (T0) while there was a statistically significant difference between them at the time of loading (T1) and after three months (T3) with higher mean values for group I than group II (p <0.05). Regarding the implant stability, there was a statistically significant difference between the two groups at the 3rd. A month after loading with higher values for the locator group while no significant difference at the other follow-up periods.

References

1. Carlsson GE. Clinical morbidity and sequelae of treatment with complete dentures. J Prosthet Dent 1998;79:17-23.
2. Toshio H, Masakazu M, Naoyuki S et al. Influence of denture treatment on brain function activity. Jpn Dent Sci Rev.
3. Frometin O, Lassauzay C, Abi Nader S, et al. Testing the retention of attachments for implant overdentures validation of an original force mea-surement system. J Oral Rehabil2010;37:54-62.
4. Vasant R, Vasant MK. Retention systems for implant-retained overdentures. Dent Update. 2013;4:28-31.
5. Fontijn FA, Slagter AP, van-der Bilt A et al. Biting and chewing in Overdentures, full dentures, and natural dentitions. J Dent Res2000;79:1519-1524.
6. Laurito D, Lamazza L, Spink MJ,et al. Tissue-supported dental implant prosthesis (overdenture). the search for the ideal protocol. A literature review. Ann Stomatol (Roma)2012;3:2–10.
7. Evtimovska E, Masri R, Driscoll CF, et al. The change in retentive values of locator attachments and Hader clips over time. J Prosthodont 2009;18:479-483.
8. Mentag P, Kosinski T .A clinical case illustrating a new implant. Dent Today 1991;10:48-49
9. Winkler S, Piermatti J, Rothman A, et al. An overview of the O-ring implant overdenture attachment. Clinical reports. J Oral Implantol2002;28:82-86.
10. Kleis WK, Kämmerer PW, Hartmann S, et al. A comparison of three different attachment systems for mandibular two-implant overdentures: one-year report. Clin Implant Dent Relat Res2010;12:209-218.
11. Huwiler MA, Pjetursson BE, Bosshardt DD, et al. Resonance frequency analysis in relation to jaw¬bone characteristics and during early healing of implant installation. Clin Oral Implants Res 2007;18: 275-280.
12. Sennerby L, Meredith N. Implant stability measurements using resonance frequency analysis. Biological and biomechanical aspects and clinical implications. Periodontol 2008;47: 51-66.
13. Burns DR, Unger JW, Coffey JP, et al. Randomized, prospective, clinical evaluation of prosthodontic modalities for mandibular implant overdenture treatment. J Prosthet Dent 2011;106(l): 12-22.
14. Porter JA, von Fraunhofer JA. Success or failure of dental implants? A literature review with treatment considerations. Gen Dent. 2005;53:423-432.
15. Meijer HJ, Kuiper JH, Starmans FJ, et al. Stress distribution around dental implants: influence of superstructure, length of implants, and height of mandible. J Prosthet Dent 1992;68:96-102.
16. Salvi GE, Lang NP. Diagnostic parameters for monitoring peri-implant conditions. Int J OralMaxillofac Implants 2004;19:116-217.
17. Meredith N. Assessment of implant stability as a prognostic determinant. Int J Prosthodont. 1998;11:491-501.
18. Sennerby L, Meredith N. Implant stability measurements using resonance frequency analysis: biological and biomechanical aspects and clinical implications. Periodontol 2000. 2008;47:51-66.
19. Herrero-Climent M, Santos-Garcia R, Jaramillo-Santos R, et al. Assessment of Osstell ISQ's reliability for implant stability measurement: A cross-sectional clinical study. Med Oral Patol Oral Cir Bucal 2013;18:877-882.
20. Karakoca-Nemli S, Aydin C, Yilmaz H, et al. Stability measurements of craniofacial implants by means of resonance frequency analysis: 1-year clinical pilot study. Int J Oral Maxillofac Implants. 2012;27:187-193.
21. Fanuscu MI, Caputo AA. Influence of attachment systems on load transfer of an implant-assisted maxillary overdenture. J Prosthodont. 2004;13:214-220.
22. Ibrahim AM. Evaluation of low profile attachments for implantretained mandibular overdentures in restoring cases with limited interarch space. Cairo Dent J. 2009;25:191-203.