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Implant stability evaluation of two different types of attachments in single implant retained mandibular overdenture.

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Abstract

Objectives: This study was performed on completely edentulous patients to evaluate ball and socket versus spheroflex attachment systems for mandibular single implant-retained complete over denture. **Subjects and methods:** Twelve completely edentulous patients divided into two groups: First group wore mandibular complete overdenture with ball and socket attachment. Second group wore mandibular complete overdenture with spheroflex attachment. Clinical evaluations were done to evaluate implant stability using Osstell at the time of the over denture insertion, 6 weeks, 3 and 6 months after over denture insertion. **Results:** The results showed an increase in implant stability in both groups and the variation amongst both groups was statistically not significant. **Conclusion:** Within the limitation of this study, we can conclude that spheroflex attachment could be a treatment option in single implant retained mandibular overdenture.

keywords: Overdenture**,** Ball and socket, Spheroflex attachment, Implant stability, Single implant.

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Introduction

Edentulism is a great problem all over the world especially in developing countries [1]. Bone resorption occurs as a result of edentulism, which is greater in the mandible than in the maxilla [2]. So mandibular complete denture has been introduced as a treatment option [3].

Many people who wear mandibular complete dentures have problems with keeping them in place and stable because the bone and mucosa that support the dentures have shrunk or deteriorated. This also affects the patients' comfort and satisfaction levels [4].

Overdenture is a good alternative treatment option for restoring the oral function of edentulous patients[5]. Overdentures that are retained by implants are very successful and can help preserve the structures that support the mandibular dentures, leading to better stability, retention and durability of the prostheses [6].

The choice of attachment system for overdentures that are retained by implants depends on many factors such as how much retention is required and how much space there is between the arches. Different types of attachments are used for this purpose[7].

Ball and socket attachments are commonly used to support implant overdentures because they have several benefits such as easycare methods, less time needed in the dental chair, more cost-effective options and less technique-sensitive procedures [8]. These attachments have been shown to improve patient comfort, fit, stability and reduce the functional problems when used with single implant assisted mandibular overdentures [9].

Self-parallelizing ball attachments (spheroflex attachments) are a new type of attachment that have a moderate retention feature [10].

The mechanical fixation of the implant provides primary stability, which depends on the design and thread shape of the fixture [11]. When the implant stability is adequate, it can reduce the healing time and enable immediate implant function [12].

The current research was performed to assess implant stability of spheroflex and ball and socket two attachments in single implant retained mandibular overdenture.

Materials and methods:

Twelve completely edentulous patients were randomly selected from the outpatient clinic of Removable Prosthodontics Department, Faculty of Dental Medicine (Boys), Al-Azhar university;(Cairo).

The study proposal was approved by the Research Ethics Committee of Al-Azhar University Faculty of Dental Medicine (EC Ref No.: FDAzUC- **REC_** 800/1705).

Every patient signed an Informed consent after an explanation of the methods before enrolment in the study. In this study we selected patients who have completely edentulous ridges, no systemic illnesses which may impact bone loss, mandibular

residual alveolar ridge of suitable height, width and covered with healthy firm mucosa, inter arch space with 12 mm at least and have Angle class I maxilla-mandibular skeletal relation. While patients who have systemic conditions that might influence implant placement and osseointegration or contribute to bone resorption as uncontrolled diabetes, severe neuropsychiatric disease, Immunocompromised patients ,uncooperative patients lack the understanding of the need for regular follow-up, smoking more than ten cigarettes or cigar equivalents per day or chewing tobacco, history of head and neck radiotherapy or chemotherapy, history of parafunctional habits bruxism or clenching habits, TMJ disorders and patients with inadequate oral hygiene were excluded.

The participants were split into two groups. Every group incorporated 6 participants. (Group I): Patients with ball and socket attachment. (Group II): Patients with spheroflex attachment.

Surgical procedures:

Before the surgery, the ridge bone width, length, and density were measured from the radiograph. The dental unit and the patient were disinfected and sterilized. The patient was rinsed with Chlorhexidine and got local anesthesia. An incision was made, and a flap was lifted to expose the bone. The bone was trimmed and drilled. A JD dental implant (JD Icon Plus, Italy) of 3.7mm diameter and 13mm length was inserted and covered with a screw.

The flap was sutured with proline sutures. Postoperative treatment was prescribed including combination of amoxicillin and clavulanic acid in the form of Augmenting tablets twice daily per 12 hours, Alpha chymotrypsin in the form of Alphintern tablets two tablets twice daily before meals and brufen 600 mg tablets twice per 12 hours for 5 days.

Patient was instructed to remove the pack one hour later and to keep his mouth cold by eating soft cold food like ice cream and making cold pack all over the mandible and in the next day to do routine mouth rinsing using 0.25mg/ml Chlorhexidine mouth rinse and to keep the food soft for 5 days and instructed to return to the clinic after 2 weeks. The patient returned to the clinic after two weeks, the wound was healed completely, and the sutures were removed.

Prosthetic procedures:

The patients were given an acrylic complete denture that was made using the traditional method of complete denture fabrication with bilateral balanced occlusion. The denture was checked for appearance, stability, retention, occlusion, high spots, and any discomfort or overextension. The patients received instructions after the insertion, had follow-up appointments scheduled, and were told to continue wearing the dentures until they got used to them.

Pick up procedures:

The patient came back after three months. They were randomly assigned to one of two groups (six each): Group I: Single implant with ball and socket attachment (JD Icon Plus, Italy). Group II: Single implant with spheroflex attachment (RHEIN83, Italy). A flap was lifted in the mandibular midline to expose the implant. The cover screw was replaced by the healing abutment. After two weeks, the healing abutment was replaced by the attachment (ball or spheroflex) Fig (1). An index was made with alginate (Zermack, Thixoflex, Rovigo, Italy) for the attachment location on the denture. A hollow was made in that area to fit the female housing.

Figure (1) : Spheroflex attachment

For group I, the female housing was placed over the male attachment and the undercut around the attachment was blocked with Teflon. A rubber dam was put around the attachment on the tissue to protect it from acrylic.

For group II, a protective disk and a zero-degree directional ring were put around the attachment, then the female housing was placed over it. The self-cure acrylic resin (Eray, Eralar, Turkey) was mixed and injected into the hollow space on the denture. The dentures were inserted and the patient bit in centric occlusion. The mandibular denture was removed and trimmed Fig (2). The patient learned to insert and remove the denture several times.

Figure (2): Finished fitting surface

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Implant stability measurement:

Could be measured by resonance frequency analysis using osstell (W&H, Austria) [13].

- The attachment was then unscrewed and after being placed into the fixture, the smart peg was securely screwed into place.
- The Osstell probe was pointed in two directions—buccolingual and mesio-distal—at a 45-degree angle avoiding coming into contact with the smart peg (3 mm from it).
- Two measurements were averaged and computed.
- This procedure was repeated for each patient at 6 weeks, 3 months and 6 months Fig (3).

Fig (3): Osstell measuring implant stability

Statistical analysis:

Data was fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). Quantitative data were described using range mean, standard deviation. value for Post Hoc Test (adjusted Bonferroni) for ANOVA with repeated measures for comparing between different periods. Independent t test for comparing between groups.

*: Statistically significant at $p \leq 0.05$.

Results:

Implant Stability Quotient (ISQ)

At T0, T1, T2, and T3: there was a statistically non-significant difference in mean ISQ in the two groups (p=0.720, 0.773, 0.723, 0.769) respectively.

Table (1): Comparison between the two studied groups according to Implant Stability Quotient (ISQ)

	Ball and socket attachment group		**Spheroflex attachment group**		**P**
	Mean	**±SD**	**Mean**	**±SD**	
T0	66.33	3.98	65.50	3.83	0.720
T1	69.83	3.37	69.16	4.35	0.773
T2	71.66	3.61	70.83	4.26	0.723
T3	72.33	3.07	71.66	4.45	0.769

Independent t test for comparing between groups *: Statistically significant at $p \leq 0.05$

T0: Baseline

T1: 6 weeks

T2: 3rd month

T3: 6th month

Discussion:

Edentulous patients can benefit from implant-retained overdentures, which can decrease the alveolar bone loss by adjusting neuromuscular adaptation, increase prosthesis retention and improve the chewing function. Implant-retained mandibular overdentures can enhance function and success rates compared to the conventional complete denture [14].

The implant surgery followed the conventional method, which included flap lifting, which gave a direct access to implant locations, increased the control of placement angle, lowered the chance of bone fenestrations and dehiscences and enabled assessing the shape and state of underlying alveolar bone and anatomical regions [15].

To avoid early loading of the implant in the crucial healing phase of osseointegration, two stages (delayed) loading procedure was chosen over one stage immediate or early loading. Delayed loading is likely to have better outcomes than immediate or early loading [16].

For un-splinted implants the ball attachment is considered the most common attachment used. Ball attachments are less costly, less technique sensitive and easier to clean than bars. Also, it shows reduced potential for mucosal hyperplasia than bars which shown to be more retentive [17].

Spheroflex attachments (self-aligning ball attachments) are a new type of attachment that have a medium retention feature. They are a variation of ball and socket attachment, with a rotating ball that has a 2.5 mm diameter and can bend to 7.5° in any direction. Spheroflex can fix the implant divergence up to 21.5° when used with a 14° directional ring [10].

One of the methods that was used to assess the primary and secondary stability of implants was resonance frequency analysis (RFA) with the osstell device. This is a

noninvasive technique that is widely utilized to assess the stability of the implant stability and bone quality at different stages of healing. It uses vibration and structural principle analysis based on RFA to measure these parameters [13].

The implant stability results of this study showed that right after loading, group (I) had a higher ISQ mean value than group (II), however the variation was statistically not significant as shown by t-test. After six weeks, group (I) had a higher ISQ mean value than group (II), however the variation was statistically not significant as shown by t-test. After three months, group (I) had a higher ISQ mean value than group (II), however the variation was statistically not significant as shown by t-test. After six months, group (I) had a higher ISQ mean value than group (II), however the variation was statistically not significant as shown by t-test.

Using nonsubmerged and submerged protocols for a single-implant retained mandibular overdenture, Salah A et al [18] also noticed an improvement in implant stability.

The results of this study are consistent with the results of Ahmed M &Tamer M[19] and Mari A [20], who also observed an increase in implant stability in their studies. The implant being exposed to further mechanical stimulation after loading caused the ISQ increase, which stimulated bone formation.

The majority of the bone that developed under loading circumstances was mature lamellar bone, that was denser than the bone that developed under unloading circumstances. This phenomenon was known as “form follows function,” meaning that the initial loading induced physiologic mechanical stimulation that resulted in mature lamellar bone development, which in turn improved the bone to implant contact and thus increased the ISQ values throughout 6 months observation period[21-22].

Conclusion:

Under the limitation of this research, we could conclude that spheroflex attachment could be a treatment option in single implant retained mandibular overdenture. It showed a desirable result in terms of improved implant stability compared to ball and socket attachment with a statistically non-significant difference in result.

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Conflict of interest:

There are no disclosed conflicts of interest for the authors.

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