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EVALUATION OF PATIENT SATISFACTION AND MASTICATORY EFFICIENCY OF SINGLE IMPLANT RETAINED MANDIBULAR OVERDENTURE USING TWO TYPES OF MATRICES

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ABSTRACT

Objective: The aim of this study was to evaluate masticatory efficiency and patient satisfaction of ball and silicone-based soft liner and metal matrices for mandibular single implant-retained overdenture**. Subjects and Methods:** From the removable prosthodontics department clinic, Faculty of Dental Medicine, (Boys, Cairo, Egypt), Al-Azhar University, 10 completely edentulous patients were randomly chosen. The patients were divided into two groups, group I received a single implant-retained overdenture with the ball and metal socket, while group II received a single implant-retained overdenture with the ball and silicone-based soft-liner attachment. Statistical analysis was done using student t-test, the data distribution of normality was done by using the Kolmogorov Smirnov test**. Results:** It was found that group I recorded a significant increase in masticatory efficiency and there was no significant difference between the two groups in patient satisfaction. **Conclusion:** Silicone-based soft liners when used as a matrix instead of metal housing produce lower values of masticatory efficiency and equal values of patient satisfaction.

KEY WORDS: Single implant-retained overdenture, silicone-based soft-liner, masticatory efficiency, patient satisfaction.

INTRODUCTION

Dentures construction is among the most demanding dental jobs. The most common complaint of elderly patients is a loose lower denture. The lower denture which dislodges during operations like chewing and speaking considered as an important source of functional and psychological problems until acceptable level of retention and stability is achived [(1)].

Mandibular dentures occupy less surface area than maxillary prostheses so they are affected more by the lower adhesive and other retentive forces. Likewise, in patients with small jaws or small basal seats, or very flat alveolar ridges, the dentures should be extended to the limits of oral tissue safety and function, and attempts should be made at all times to maintain the alveolar height to optimize retention [(2)].

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[(3)].

Economic factors make this treatment strategy financially difficult, particularly amongst the growing elderly population in developing countries. The idea of single implant-retained overdenture offers another alternative for the elderly populations to reduce the cost and time of care. Clinical studies have shown that single implant-supported

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overdenture provides good durability, as well as being a viable alternative when considering the cost[3-6].

Several researchers compared the effect of various types of attachment systems and found that single implants with dome-type magnets or ball attachments retained overdentures have comparable effects on retention with the two implant-supported overdentures. Attachment systems with larger dimensions provide higher retention and ball attachment distribute stress well [7].

Selection of an implant-retained overdenture attachment device depends on cost-effectiveness, an appropriate amount of retention, anticipated degree of oral hygiene, bone availability, patient social position, patient perception, maxillomandibular relation, inter-implant distance, and adversarial jaw status [8].

The application of soft material is intended to enhance the comfort of denture wearers as well as to promote prosthetic therapy, long term soft denture lining materials (LTSDLs) may help to equally distribute the biting force transmitted to the soft tissues during chewing and to alleviate the mechanical stress [9].

Silicone-based long-term soft denture linings (SLTSDLs), acrylic-based long-term soft denture linings (ALTSDLs) and, sporadically, other polymer-based materials are commercially available dental products. Polymethyl methacrylate materials are currently less commonly used as a denture lining material and are available as two-part powder-liquid systems, SLTSDLs are available as single-component bonding materials and as two-part bonding materials [10].

When used as a method of retention for implant-retained overdentures, these liners obturate the spaces around the bar, absorb energy, distribute masticatory forces to the implants and edentulous ridge, and provide greater latitude of movement and comfort to the patient [11-13].

The aim of this study was to evaluate masticatory efficiency and patient satisfaction in patients with single implant-retained mandibular overdenture. with ball and socket attachment versus ball and silicone based soft liner.

SUBJECTS AND METHODS:

Ten completely edentulous males patients were selected by power test according to Bhat et al. [14] using SPSS version 18 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, free from any systemic diseases that might affect implant placement. 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.: FDAzUC-REC_66/25/2018).

An acrylic complete denture was constructed for each patient according to the conventional steps of complete denture construction with bilateral balanced occlusion. The denture was inserted into the patient's mouth, verification of esthetics, stability, retention, occlusion, high spots, and any sharp or overextension that could cause pain were checked, Post insertion instructions were given, follow up visits were secluded, 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 [15].

Construction of the surgical guide that direct the initial implant drill into its planned position to ensure proper implant location and angulation was carried out. The easiest method to construct the implant surgical template is to use a modification of Preston's clear splint [16] . A full arch irreversible hydrocolloid impression (Tropicalgin, Zhermack, Italy) was made and poured into dental stone. On the cast, a vacuum acrylic shell was pressed and trimmed (Bioart, Brazil). The occlusal acrylic was removed over the desirable and optional sites of the implant, preserving the surgical template's facial and facio occlusal line angle. This provides maximum freedom for implant placement and communicates the ideal implant angulation during surgery [17].

Following single stage surgical protocol, a single dental implant fixture (Nucleoss, Menderes, Izmir, Turkey) with a length of 10 mm, diameter of 3.7 mm was inserted at the midline of the mandibular alveolar ridge. Depending on the attachment used, patients were randomly divided into two groups. Group I: received ball and socket attachment. Group II: received ball and silicone-based soft-liner attachment. Loading was done three months after implant placement.

The study was completed in a crossover design. The first group received ball and socket attachment. Patient satisfaction and masticatory efficiency were measured after six and 12 months after loading and denture insertion then ball and socket attachment were replaced by ball and silicone based attachment and after six and 12 months measurements were repeated. The second group received ball and silicone-based attachment. Patient satisfaction and masticatory efficiency were measured after six and 12 months after loading and denture insertion then ball and silicone-based attachment were replaced by ball and socket attachment measurements were repeated after another six and 12 months. This randomization was made to reduce the effect of prothesis type and inherent bias on patient satisfaction.

Group I Patients:

A metallic cap was placed over the male part of the 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 was used to attach the metallic cap (female part of the 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 correct occlusion. 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:

With the aid of marker paste; space was created in the fitting surface of the denture base correspond to implant site using a large acrylic bur mounted in a straight hand piece. Silicone-based soft liner (Mollosil, German) was mixed and placed in the created space in the fitting surface of the denture after application of adhesive. The denture was inserted into the patient mouth, and the patient was instructed to close in correct occlusion. When the silicone based soft liner was set, the denture was removed from the mouth, inspected, and the excess material was removed with a blade.

1) Masticatory efficiency measurment:

The masticatory efficiency measurement was done using three types of food with a different degree of hardness (carrot, peanut, and banana). Carrot and banana cut into standardized cubes (1cm x 1cm) and one grain of peanut were used [18].

Patients were set in an upright position wearing their mandibular overdenture; patient's assurance

was don to reach with them to a relaxed unstrained state. They were asked to eat in a normal manner and the number of chewing strokes up to the first swallow, the number of chewing strokes until the mouth was free of food, the time (in seconds) elapsed until the first swallow, the time (in seconds) until the mouth was free of food and the number of swallows until the mouth was free of food were recorded. The measurements were recorded by two persons, one recorded the number of chewing strokes and swallows, and the other recorded the time.

These parameters were recorded five times for each test food and the mean was recorded. The masticatory efficiency test was made after six and 12 months for each patient**.**

2) . Oral health related quality of life (OHRQoL):

The oral health related quality of life was evaluated using the Arabic version of the oral health impact profile for edentulous patients [OHIP EDENT] [19] The denture wearing status was recorded after completion of the questionnaire, after 6 and 12 months of overdenture loading for each patient.

Question about functional limitation including difficulty chewing any foods, food catching in dentures and dentures fitting. Physical pain questions including painful aching in mouth, uncomfortable to eat any foods, sore spots in mouth and uncomfortable dentures. Psychological discomfort questions including worry by dental problems and self-conscious. Physical disability questions including avoid eating some foods, unable to eat and interrupt meals. Psychological disability questions including upset and a bit embarrassed. Social disability questions including avoiding going out, less tolerant to partners or family and irritable with other people. Finally, the handicap questions about ability to enjoy other people's company as much and fell that life in general was less satisfying.

Numerical data were explored for normality by checking the distribution of data and using the Kolmogorov Smirnov test of normality. Data showed normal (parametric) distribution. The Independent t-test was used to compare mean values between two groups. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with SPSS Statistic version 18.

RESULTS

1. Masticatory efficiency:

Table (1) shows the mean values of masticatory efficiency for the two groups. A statistically significant difference was found for the food stuff between the two groups during all of the follow-up periods.

TABLE (1) Mean values of masticatory efficiency parameters for different groups

Chewing efficiency parameters	Time	Type of food	Metal housing group (Mean ±S.D)	Soft liner group (Mean ±S.D)	P value
Number of chewing strokes up to the first swallow.	6 Months	Carrot	16.67 ± 3.07	19.91 ± 1.55	0.039642*
		Banana	9.05± 1.28	12.78 ± 2.89	0.013561*
		Peanuts	14.22± 1.31	15.79 ± 1.17	0.049051*
	12 Months	Carrot	15.14 ± 2.36	17.93 ± 1.19	0.023847*
		Banana	9.2 ± 1.57	11.76 ± 2.33	0.045456*
		Peanuts	12.65 ± 0.97	14.98 ± 2.21	0.035742*

Chewing efficiency parameters	Time	Type of food	Metal housing group (Mean ±S.D)	Soft liner group (Mean ±S.D)	P value
Number of chewing strokes until the mouth was free of food.	6 Months	Carrot	27.65 ±4.17	32.96 ± 1.77	0.014059*
		Banana	12.01±2.67	14.89 ± 0.91	0.02787*
		Peanuts	23.64±0.98	26.13 ± 2.06	0.020273*
	12 Months	Carrot	23.99 ± 5.36	30.51 ± 3.88	0.032697*
		Banana	11.66 ± 2.37	13.98 ± 0.77	0.041643*
		Peanuts	20.79 ± 0.57	22.99 ± 2.06	0.026849*
Time (in seconds) elapsed until the first swallow.	6 Months	Carrot	15.12± 2.78	17.83 ±1.02	0.044661*
		Banana	6.33± 0.79	9.31 ±1.85	0.003459*
		Peanuts	10.5± 0.61	13.24 ±2.36	0.017491*
	12 Months	Carrot	14.96 ± 0.25	17.14 ± 1.93	0.017804*
		Banana	5.93 ± 1.77	8.51 ± 0.31	0.017804*
		Peanuts	10.12 ± 1.23	12.45 ± 0.74	0.00184*
Time (in seconds) until the mouth was free of food.	6 Months	Carrot	17.55± 5.03	23.01 ± 3.19	0.044363*
		Banana	9.14± 1.17	13.79 ± 4.03	0.018807*
		Peanuts	15.38± 2.14	21.25 ± 0.96	0.079483*
	12 Months	Carrot	17.18 ±3.1	22.41 ± 2.59	0.00805*
		Banana	8.96 ±2.08	13.42 ± 1.77	0.001762*
		Peanuts	14.51 ±5.66	21.09 ± 1.34	0.016929*
Number of swallows until the mouth was free of food.	6 Months	Carrot	3.42 ± 0.49	5.57 ± 0.49	0.014059*
		Banana	1.42 ± 0.72	2.28 ± 0.45	0.030622*
		Peanuts	1.57 ± 0.49	3.43 ± 0.49	0.020273*
	12 Months	Carrot	2.71±1.27	5.14 ±0.63	0.001313*
		Banana	1.14±0.34	2 ±0.75	0.026*
		Peanuts	1.29±0.45	2.71 ±1.03	0.009007*

Significant difference if (p≤0.05), values marked with (*) are significant

2. Oral health related quality of life (OHRQoL):

Mean OHRQoL for different groups six and twelve months after loading are shown in table (2).

It was found that the group I recorded a total mean value of OHRQoL (**13.77**) at six months and (12.08) at 12 months and group II recorded (**16.72**) at six months and (15.01) at 12 months. The difference between the two groups was statistically non-significant, as indicated by the t-test as (p>0.05).

TABLE (2) Mean OHRQoL for different groups.

	Grouping	Time	Mean	Std. Deviation	P-Value	Significance
Total	Metal housing	6 m	13.77	0.58	0.75	Nonsignificant
	Soft liner	6m	16.72	0.64		
	Metal housing	12m	12.08	0.54	0.73	Nonsignificant
	Soft liner	12 m	15.01	0.67		
Function	Metal housing	6 m	1.94	0.31	0.52	Nonsignificant
	Soft liner	6 m	2.35	0.76		
	Metal housing	12 m	1.88	0.41	0.93	Nonsignificant
	Soft liner	12 m	2.36	0.66		
Physical Pain	Metal housing	6 m	3.11	0.92	0.066	Nonsignificant
	Soft liner	6 m	3.72	0.57		
	Metal housing	12 m	2.79	0.74	0.081	Nonsignificant
	Soft liner	12 m	3.50	0.63		
Psycho-Discomfort	Metal housing	6 m	1.41	0.28	0.14	Nonsignificant
	Soft liner	6 m	2.08	0.64		
	Metal housing	12m	1.23	0.37	0.71	Nonsignificant
	Soft liner	12 m	1.78	0.29		
Physic-Disability	Metal housing	6 m	1.78	0.31	0.37	Nonsignificant
	Soft liner	6 m	2.11	0.59		
	Metal housing	12m	1.64	0.51	0.07	Nonsignificant
	Soft liner	12 m	1.98	0.47		
Psycho Disability	Metal housing	6 m	2.36	0.71	0.083	Nonsignificant
	Soft liner	6 m	2.46	0.79		
	Metal housing	12 m	1.91	0.36	0.12	Nonsignificant
	Soft liner	12 m	2.08	0.59		
Social disability	Metal housing	6 m	1.22	0.08	0.26	Nonsignificant
	Soft liner	6 m	1.43	0.56		
	Metal housing	12 m	0.92	0.17	0.069	Nonsignificant
	Soft liner	12 m	1.07	0.43		
Handicap	Metal housing	6 m	1.95	0.61	0.74	Nonsignificant
	Soft liner	6 m	2.57	0.83		
	Metal housing	12 m	**1.71**	0.47	**0.27**	Nonsignificant
	Soft liner	12 m	2.23	0.55		

DISCUSSION

The implant retained overdenture for the mandible is a highly successful prosthetic treatment because of its relative simplicity, minimal invasiveness, and economy and improve retention, stability, better function, and overall satisfaction for the patients [20].

A single symphysial implant was placed in the midline to minimize the risks in a surgical procedure, avoid injury to the inferior alveolar nerve and it is a good area for the best bone quality, thickness, and height [21].

In this study, each patient in group I received mandibular overdenture retained by ball and sockets to improve denture retention and stability. Due to the low-cost, ease of handling, limited chairside time specifications, and their potential uses for both root and implant-supported prostheses, ball attachments are one of the most commonly used stud attachments [22].

In this study, each patient in group II received mandibular overdenture retained by a ball, and metal housing is replaced by a silicone based soft liner that can solve many problems when the implant locations or angulations differ from the proposed treatment plan [23]. As an attachment for overdentures, protecting male parts from wear makes soft liner female housing an easier, cheaper process [24].

Masticatory ability is a measure and a perception of how well subjects think they break down foods. The measurement method of this study was based on the number of masticatory cycles which is the most common and powerful since it reveals the distribution of food chewed in the number of cycles[18].

Measuring the oral health related quality of life (OHQoL) is essential for epidemiological and clinical studies for health improvement and disease prevention [25].

The results of the masticatory efficiency for both types of matrices showed that the female metal housing recorded higher masticatory efficiency than silicone-based soft liner with differences was statistically significant. This may be explained by the durability of soft liners to absorb energy, distribute masticatory forces to the implants and edentulous ridge, and provide greater latitude of movement and comfort to the patient [11-13].

The results of patient satisfaction for both types of matrices found that there was no significant difference between the two groups after six and 12 months of loading.

These results agree with a study that evaluated patient satisfaction and marginal bone loss in rigidly and resilient retained mandibular implant overdenture and found insignificant differences between the studied groups regarding patient satisfaction [26].

These results agree with another study that evaluated prosthetic aspects and patient satisfaction with resilient liner and clip attachments for bar- and implant-retained mandibular overdentures and found that there was no significant difference between the two groups [27].

The limitation of the study was that the time and number of strokes were not measured by a throat strain gauge but was measured by a stopwatch using the examiner naked eyes to determine the act of swallowing.

CONCLUSION

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

- Ball and socket attachment when used with single implant-retained mandibular overdenture significantly increased the masticatory efficiency and patient satisfaction.
- There is no significant difference in patient satisfaction between ball and socket attachment or ball and silicone-based soft liner.

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