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COMPARING PATIENT SATISFACTION, RETENTION AND MAINTENANCE FOR DIFFERENT SOLUTIONS OF MIDLINE FRACTURE OF IMPLANT RETAINED MANDIBULAR OVERDENTURES

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ABSTRACT

Purpose: The purpose of this study was to evaluate Patient Satisfaction, Retention and Maintenance of Repaired midline fracture Implant Retained Mandibular Overdentures by different methods of repair: a) Direct re-assembly of the denture b) Reinforcement of the fitting surface with a metal framework.

Materials and methods: 45 completely edentulous patients seeking for implant installation in the mandible were included in this study. All patients had received single midline implant & a stud attachment; 3-4 months after implant installation. Patients were rehabilitated with implant retained overdentures. Bone height changes, retention and patient satisfaction were evaluated at regular recall visits for one year. 14 patients had reported midline fracture of their mandibular overdentures at the follow up period from 3 to 6 months. The 14 patients were randomly divided in two groups; Group (a): Included seven patients had the fractured denture repaired by direct reassembly using self- cured acrylic resin. Group (b): Included seven patients; had the fractured denture reinforced with a metal framework embedded in the fitting surface of the denture. Patient satisfaction, overdenture retention, and prosthetic maintenance were assessed after dentures repair for patients of the two groups. Evaluation was carried-out at the day of dentures insertion after repair, 2 weeks, 3 months and 1 year after dentures' repair

Results: The results of this study had revealed that Group (b) patients rehabilitated with (Dentures repaired by Reinforcing metal framework) had reported significant improvement in the patients satisfaction, significant decrease in the prosthetic maintenance required after 1 year follow-up compared to patients of Group:(a) patient rehabilitated with (Dentures repaired with direct reassembly using self cure acrylic resin). After 1 year follow up, there was no significant difference in the mean values of retention in both studied groups.

Conclusions: Within the limitations of the present study; the following conclusions may be achieved: For a single implant retained mandibular overdenture, midline fracture may better repaired by reinforcement of denture base with a metal framework embedded in the fitting surface of the denture. Metal reinforcement may increase the rigidity of the overdenture, improve the patient satisfaction and may decrease the number of visits required for maintenance.

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INTRODUCTION

Implant retained mandibular overdenture have reported greater patient satisfaction, improvement in speech, mastication and quality of life when compared with conventional mandibular dentures [1].Consequently the Mc Gill and York consensus have recommended the installation of two implants as a treatment option for the edentulous mandible. Two implants installed have been considered to be the minimum number of implants required.[2-4]

A new emerging theory claims that a single implant installed in the midline of the edentulous mandible is a viable treatment option. **Cordioli et al** [5] was the first to publish a study using a single implant retained mandibular overdenture. The new concept of a single retained mandibular overdenture have proved to be successful, and when compared with the two implant retained mandibular overdenture it has proven to be less expensive [6], no difference in patient satisfaction with a single and two implant retained mandibular overdenture [7], in addition to that a single implant retained overdenture was able to share and distribute the load, while the two implant retained overdenture will result in a movement through a fulcrum line[8], also a single implant retained have shown fewer post-operative complications when compared to a two implant retained overdenture.

The influence of the number of implants and their relation to increased retention, stability and stresses is not well documented, as very few clinical trials reported the effect of the number and distribution of implants on the stresses generated [9,10]. Despite the fact, it is believed that the greater the number of implants the better will be the retention and stability of implant supported overdenture. The value of fewer implants as a cost-saving approach has a merit for many patients, where the financing of implant restoration is a major factor in patient acceptance.[11]

One of the important criteria in assessing the success of implant retained overdentures is assessing the prosthetic maintenance, especially adjustments, repairs and reporting patient satisfaction. Walten and MacEntee [12] have reported that removable implant supported prosthesis required a lot of prosthetic maintenance with percentage 78% when compare to fixed implant prosthesis, and the most commonly reported prosthetic repair was related to fracture of the acrylic resin or denture teeth. Denture fracture could either be mechanical or accidental[13]. Fractures will mainly occur as a result of a many factors, the most common factors would be as a result of forming areas of stress concentration and dentures that have been previously repaired.

Fractured dentures would be either repaired or reinforced with a metal framework. Dentures repaired by direct reassembly using auto-polymerizing resin which is rapid and economic[14], but in most cases the repaired part will lose some of the transverse stresses and most repaired dentures will break at the junction between the old and new material[15]. Reinforcement of the denture base supporting implants will increase the resistance to stress concentrations and reduce the incidence of fracture[16, 17].

In the present study, two repair methods; a direct re-assembly technique and a metal reinforcement of the existing denture base, will be compared with respect to patient satisfaction, retention and maintenance of the prosthesis

MATERIALS AND METHODS

45 completely edentulous patients were recruited from the Out- Patient Clinic of the Prosthodontics Department Cairo University. All patients included in the study were of an age range from 50-70 years old. All patients were seeking installation of implants in the mandible due to unsatisfactory retention of the lower dentures. Patients to be included in the study had to be free from any systemic disease that would contraindicate implant placement. All patients had to sign a written consent before performing the surgery.

Conventional Maxillary and mandibular dentures were constructed before implant placement. The lower denture was then duplicated into a radiographic stent. Each patient had undergone CBCT examination before implant installation; for proper evaluation of the bone height and width. CBCT was made while the patient was wearing the radiographic stent. The radiographic stent was then converted into a surgical stent, by drilling holes in the site of area of future implant, to guide for accurate implant placement. The 45 patients were selected to single implant placement. The single implant was installed in the mandibular midline area. All installed implants were Implant direct of diameter 3.7 mm, and 10 mm in length. * They were all installed according to the manufacturer instructions, starting with the pilot drill, intermediate, and then final drill. All implants were delayed loaded (3-4months after implants' installation. Conventional dentures were modified, relined with a soft liner and inserted into the patients' mouth at the day of surgery. Patients were recalled 3-4 months later for a secondary stage surgery. Patients had received stud attachments; that were picked-up in the fitting surface of the denture. Conventional complete dentures were modified to implant retained overdentures.Patients had undergone regular follow-up visits for 1 year to evaluate bone height changes, patient satisfaction and dentures' retention.

14 patients had a mid-line fracture during follow up period from 3- 6 month after dentures' insertion. Patients with the mid-line fracture were randomly divided into two groups; Group (a): 7 patients had their dentures re-assembled using self-cured acrylic resin .Group (b): 7 patients had their dentures reinforced with a metal framework embedded in the fitting surface of the denture following the "reinforced technique". **Fig 1(A)**

Group (a): Dentures were repaired following Direct re-assembly method as follows:

The two fractured parts of the lower denture were re-assembled together to be in a fixed position using glue. Then the fitting surface of the denture was blocked out, and a stone cast was poured with the two fractured parts re-assembled. A slight roughness of the two approximated ends was done. The self-cure acrylic resin was added at the fracture line**. The denture was processed in the curing unit*** for 20 min at100°C, and then finishing and polishing were done.

Group (b): Dentures were repaired following metal reinforcement technique

This technique of reinforcement would aim for embedding a metal framework in the fitting surface of the fractured denture, with no need of fabricating a new denture.

The fractured denture would be reassembled outside the patient mouth using a self-cure acrylic resin. The re-assembled denture would then be relieved to be ready for a relining impression. A relining impression would be made using a medium addition silicone rubber base impression material****, with the patient mouth closed in centric relation position. A processing cap will be placed on top of the stud attachment in the patient's mouth. After setting of the relined impression, the denture (relined impression) would be taken outside the patient mouth, and an attachment analogue would be place in the impression, and then a production of a plaster tooth index will be carried out. **Fig 1(B)**

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* Implant DirectTM LLC Spectra-System Dental Implants) Calabasas Hills CA, USA
** Cold cure acrylic resin acrostone, egypt
*** Pressthерm rapid curing unit BEGO, Germany
**** (Speedex, Coltène/Whaledent Company, Altstätten, Switzerland). medium consistency

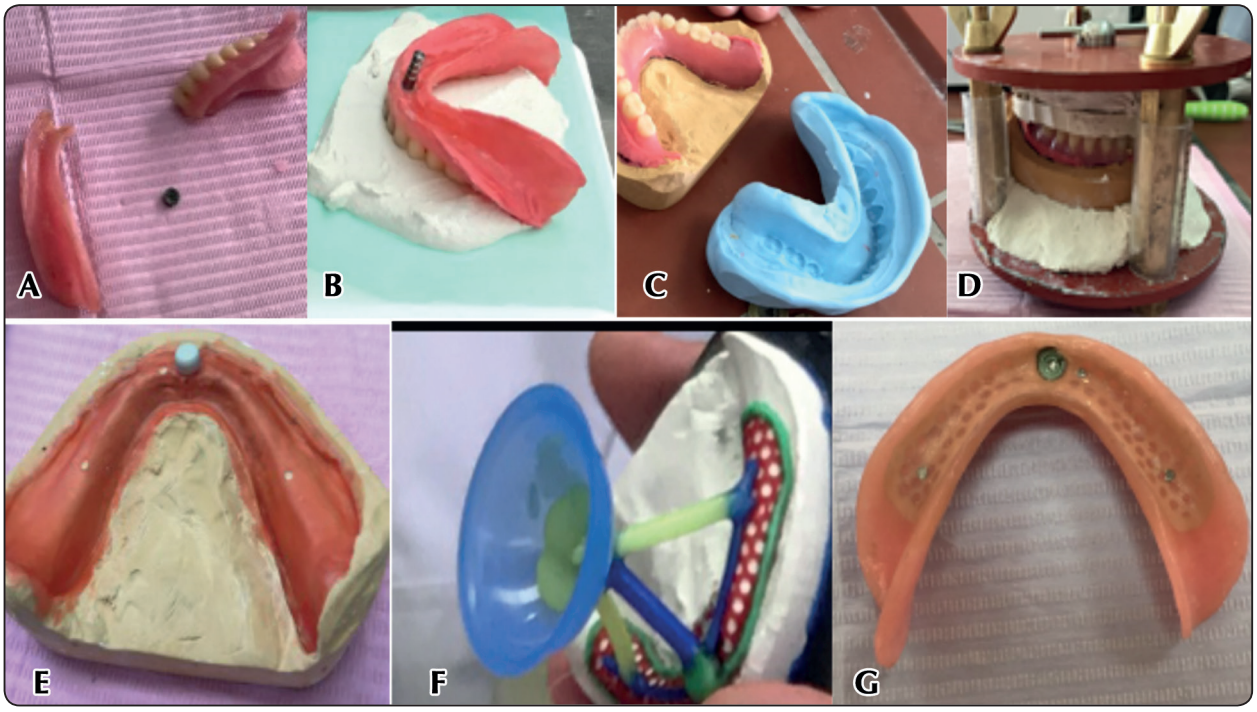

Fig. (1) Steps of metal reinforcement of midline fracture single implant retained mandibular overdenture

The relined denture with the attachment analogue will be poured in a stone cast. A rubber base index* for the denture will be carried out. **Fig 1(C)** It will be used as a guide for controlling the space between the denture and the cap. The plaster tooth index, the relined denture and the stone cast will be placed in the relining unit** .**fig 1(D)**

The cast with the processing cap will be relieved with a layer of base plate wax with three tissue stops, two posterior and one anterior, then the relieved cast will be duplicated into an investment model. **Fig 1(E)** A retentive mesh will be waxed on the investment model then sprued and casted. **Fig 1(F)**

After casting of the metal framework the casting rods will be removed except for the metal backing over the attachment, and then the relieved denture will be adapted over the metal framework to check for proper adaptation. The fitting surface of the metal framework will be layered with a pink opaquer and then adapted to the model. A soft mix of self-cure acrylic resin will be placed over the metal framework, and then the denture adapted over it, and the whole assembly placed back in the relining unit. After complete setting of the self-cure acrylic resin, the denture will have the framework embedded in its fitting surface. The retentive cap of the attachment was picked up intra-orally inside the patient's mouth. **Fig 1(G)**

The aim of the small study is to compare the difference in patient satisfaction, retention, and maintenance between the patient conventional complete denture at the day of loading (when the attachment was picked up in the fitting surface of the denture), with the re-assembled denture in the first group, and in the second group between the patient conventional complete denture and the reinforced denture.

* (Speedex, Coltène/Whaledent Company, Altstätten, Switzerland) putty consistency
** REFLEX™ RELINE JIG © 2013 Lang Dental Mfg. Co., Inc. USA

The 14 patients were recalled 2 weeks after the re-assembly and the reinforcement, and were then followed up after 3 month, and then after 12 month from reassembly and repair.

In each follow up, the patient satisfaction chart[18] was filled up by the patient, retention of the denture was measured using a force meter* that was placed in the midline of the labial frenum of the lower denture and recorded in newton's **Fig 2**. The maintenance was recorded using a chart that recorded the number of visits of patient during the different follow ups for; occlusal adjustment, selective grinding, activation of the nylon cap, and fracture of the denture base or teeth.

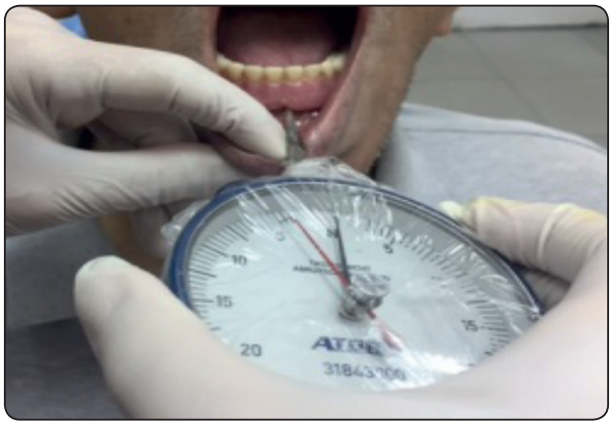

Fig. (2) Measuring retention using a force gauge

The results of this study were statistically analysed to evaluate patient satisfaction, maintenance and retention of single implant retained mandibular overdenture midline fracture when two difference lines of treatments were followed; direct re-assembly, and a metal reinforced framework embedded in the fitting surface of the denture.

Statistical Methods

Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests. ***For non-parametric data:*** Mann Whitney test was used to compare between two groups in non-related samples. Friedman test was used to compare between more than two groups in related samples. ***For parametric data:*** Independent sample t-test was used to compare between two groups in non-related samples. Repeated measure ANOVA was used to compare between more than two groups in related samples. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM® SPSS® Statistics Version 20 for Windows.

14 patients with a single implant retained overdenture experienced midline fracture of their mandibular denture. The 14 patients were randomly divided into two equal groups according to the line of repair. The first group the fractured denture was repaired by direct reassemble using rapid heat cure acrylic resin. The second group was repaired by a metal reinforced framework to the fitting surface of the mandibular denture. The two groups were compared to the single implant retained overdenture at the day of loading (pick up of the attachment) which is considered to be a base line value.

Patient satisfaction was recorded for all patients at the following intervals; at the day of loading (base line value), then for both groups of patients, patient satisfaction was recorded after 2 weeks after repair (re-assembled and the reinforced), 3month after repair (re-assembled and the reinforced), and 1 year after repair (re-assembled and the reinforced) **Table 1**.

When comparing the mean patient satisfaction scores with in the two groups of patients, it was a found that in the reassembled group, no statistically significant difference was found between the single implant retained overdenture at the day of pick up (Base line), After 2 weeks from reassembly and After 3 months from reassembly. While a statistically

* ATORN Force Gauge 3-30 N, Correx, Hahn+Kolb Werkzeuge Gmbh, Stuttgart, Germany

TABLE (1) The mean, standard deviation (SD) values of Satisfaction in both groups. Superscripts with different capital letters indicate statistically significance difference within the same row.

Variables	Patient Satisfaction				p-value
	Reassembled overdenture		Reinforced overdenture		
	Mean	SD	Mean	SD	
Base line (at day of loading)	1.60 ^{aA}	0.52	0.70 ^{aB}	0.67	0.007*
After 2 weeks	1.70 ^{aA}	0.48	1.00 ^{aB}	0.67	0.019*
After 3 months	1.90 ^{aA}	0.32	1.30 ^{aB}	0.48	0.008*
After 1 year	2.70 ^{bA}	0.48	0.20 ^{bB}	0.42	≤0.001*
p-value	0.001*		0.001*		

; significant (p≤ 0.05)

significant difference in patient satisfaction was found after 1 year from reassembly and each of Base line value , After 2 weeks and After 3 months from reassembly where p=0.015, p=0.015 and p=0.011 respectively patient Satisfaction decreased after 1 year from re-assembly. The lowest mean patient satisfaction score was found in Base line (1.60 ± 0.52) while the satisfaction score increased at intervals of After 2 weeks from reassembly (1.70 ± 0.48) and After 3 months from reassembly (1.90 ± 0.32), the highest mean score was found in After 1 year from reassembly (2.70 ± 0.48) which is considered to be the Lowest satisfaction. **Table 1**

However in the reinforced overdenture group it was found that no statistically significant difference was found between single implant retained overdenture at the day of loading (Base line), After 2 weeks from reinforcement and After 3 months from reinforcement. While a statistically significant difference was found in patient satisfaction score After 1 year from reinforcement when compared to the patient satisfaction scores at Base line, After 2 weeks from reinforcement and After 3 months from reinforcement where p=0.025, p=0.005 and p=0.009 respectively , showing an increase in patient satisfaction. The lowest mean satisfaction score was found after 1 year from reinforcement (0.20 ± 0.42) while the highest mean score was found after 3 months from reinforcement (1.30 ± 0.48) which is considered to be the lowest satisfaction score **Table 1**.

When comparing the patient mean satisfaction scores between the two groups during the different intervals of time, it was found that there was a statistically significant difference between the group of re-assembled denture and the group of reinforced denture, where The highest patient satisfaction was found in reinforced denture the lowest satisfaction was found in the reassembled denture during the 1 year follow up **Table 1**.

When initially comparing the retention values in newton's of the single implant retained mandibular overdenture at the day of loading (base line value) with the values after the repair of the mandibular mid line fractures in the two groups during the different intervals ; after 2 weeks after repair, after 3 month after repair, and after 1 year after repair, it was found that there was no statistically significant differences in retention values between the reassembled group and the reinforced group, with a slightly higher mean retention value in the reinforced group **Table 2**.

When comparing the mean of retention values with in each group during the 1 year follow up there was no statistically significant difference found. In the reassembled group there was no statistically

significant difference between the different intervals initially between the single implant retained overdenture at the day of loading (Base line), then after 2 weeks from re-assembly, after 3 months and after 1 year from reassembly (p=0.096). Similarly there was no statistically significant difference in the retention values in the reinforced group during the different intervals; single implant retained overdenture at the day of loading , 2 weeks after reinforcement, 3 month and 1 year after reinforcement (p=0.309). Respectively with in each group the highest mean value of retention was found after 1 year from repair followed by after 3 months from repair and after 2 weeks from repair and the lowest mean value was found in the Base line.

When recording the total number of visits needed for prosthetic maintenance (occlusal adjustment, need for relining, selective grinding, mucosities, fracture of denture base or teeth, activation of the nylon cap) with in each group, it was found that there was a statistically significant difference between the two groups within the different follow up intervals; 2weeks after repair (p=0.031), 3months (p=0.015) and 1 year after repair (p=0.004). The highest mean prosthetic maintenance score was found in the reassembled group and the lowest mean maintenance score was found in the reinforced denture during the 1 year follow up **Table 3.**

TABLE (2) The mean, standard deviation (SD) values and the p value of Retention.Superscripts with different small letters indicate statistically significance difference within the same column. Superscripts with different capital letters indicate statistically significance difference within the same row.

Variables	Retention				p-value
	Re-assembled denture		Reinforced denture		
	Mean	SD	Mean	SD	
Base line (at day of loading)	11.23 ^{aA}	0.13	11.56 ^{aA}	0.49	0.321ns
After 2 weeks	11.68 ^{aA}	0.58	12.01 ^{aA}	0.90	0.622ns
After 3 months	12.05 ^{aA}	0.53	12.18 ^{aA}	0.33	0.744ns
After 1 year	12.57 ^{aA}	0.49	12.66 ^{aA}	0.53	0.839ns
p-value	0.096ns		0.309ns		

; significant (p≤ 0.05)

TABLE (3) The mean, standard deviation (SD) values of Maintenance in both groups. Superscripts with different small letters indicate statistically significance difference within the same column. Superscripts with different capital letters indicate statistically significance difference within the same row.

Variables	Prosthetic Maintenance				p-value
	Re-assembled denture		Reinforced denture		
	Mean	SD	Mean	SD	
After 2 weeks	2.60 ^{aA}	0.55	1.60 ^{aB}	0.55	0.031*
After 3 months	2.80 ^{aA}	0.45	1.80 ^{aB}	0.45	0.015*
After 1 year	4.00 ^{bA}	0.00	0.20 ^{bB}	0.45	0.004*
p-value	0.009*		0.015*		

; significant (p≤ 0.05)

As shown **in table 3** when comparing the maintenance score within each group during different interval, in the reassembled group there was no statistically significant difference found in prosthetic maintenance after 2 weeks and after 3 months from reinforcement. While a statistically significant difference was found after a 1 year follow up when compared to after 2 weeks and After 3 months from reassembly where p=0.038 and p=0.034 this would indicate an increase in the prosthetic Maintenance needed. The highest mean maintenance score was found after 1year (4.00 ± 0.00) followed by after 3 months (2.80 ± 0.45) and the lowest mean maintenance score was found in after 2 weeks (2.60 ± 0.55).

While in the reinforced group there was no statistically significant difference found between After 2 weeks and After 3 months from reinforcement. While a statistically significant difference was found between After 1 year follow up when compared to After 2 weeks and After 3 months from reinforcement where p=0.038 and p=0.038 respectively, giving an indication of a decrease in the prosthetic maintenance required. The highest mean maintenance score was found after 3 months (1.80 ± 0.45) followed by after 2 weeks (1.60 ± 0.55) and the lowest mean maintenance score was found in after 1 year (0.20 ± 0.45).

When a correlation was carried out between the patient satisfaction mean score and the prosthetic maintenance mean score in the reassembled group and the reinforced group There was a significant negative relationship between mean patient satisfaction and mean maintenance score, r = -0.791, p (2-tailed) ≤0.001.and r =-0.645, p (2-tailed) ≤0.001.respictivley.as shown in **Fig 3**

DISCUSSION

One of the most common site of denture base fracture has been revealed by many studies to be in the midline, it has been reported to be 59% of all fractures and the main reason for midline fracture was mainly due to cyclic deformation during function[13,19-21] .One of the simple methods of mid line fracture repair is by direct re-assembly using auto-polymerizing resin, but it has been proven that repaired denture by the direct re-assembly method will lose 40-60% of their transverse strength[13], and eventually all repaired denture will be fractured again. This would be a good explanation to the interpretation of patient satisfaction and prosthetic maintenance results in this study. In the direct re-assembly group there was no significant difference for both patient satisfaction and prosthetic maintenance scores between 2 weeks, 3 month after repair when compared to the patient single retained

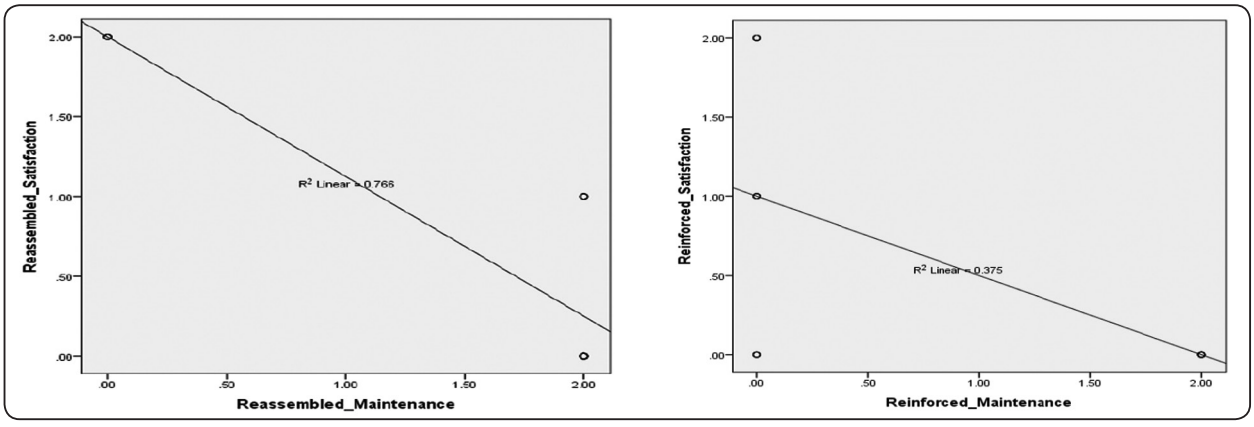

Fig. (3) Correlation between patient satisfaction and maintenance in both groups

overdenture at the day of loading, but a significant decrease in patient satisfaction, accompanied by an increase in the prosthetic maintenance have occurred after 1 year follow up and that is mainly because all repaired dentures lost their strength and fractured again which affected the functional efficiency of the dentures, making patients dissatisfied, and consequently resulted in an increase in the number of visits for adjustment.

In the reinforced group, the metal framework embedded in the fitting surface will not only reduce the incidence of fractures, but will also improve the functional rigidity for occlusal stability and uniformly distribute the stresses to the underlying denture bearing areas, an invitro study carried out by **Gonda et al** [22] have concluded that reinforcement over the top of the attachment will reduce the strain in the midline of the overdenture.

In the present study, it was found that in the reinforced group there was no significant difference in patient satisfaction and prosthetic maintenance after 2 weeks, and 3 month when compared to the single implant retained overdenture at the day of loading, but a major improvement in patient satisfaction together with a decrease in the prosthetic maintenance have been reported after 1 year from reinforcement. That is mainly because the embedded framework within the fitting surface of the denture when initially delivered to the patient, it might have required some adjustments due to the presence of sore spots, pressure areas which have resulted in a decrease in patient satisfaction, with an increase in the number of visits for adjustment after 3 month from repair when compared to the base line values, but after 1 year from repair the patients have outweighed the advantages of having a stronger denture base, with actually no tendency towards repeated fractures, **Weinlander M et al** [23] concluded that a metal reinforced framework will lower the extent of prosthetic maintenance. That would all strongly explain the reason of a significant improvement in patient satisfaction with a decrease in the required prosthetic maintenance in the reinforced group when compared to the re-assembled group after a 1 year follow up from repair.

The prosthetic maintenance required would have an important impact not only on the prosthodontics success but also on the patient satisfaction and cost[24, 25]. The majority of prosthetic maintenance for implant retained overdenture occurs during the first year of service[26] and the most common complication is fracture of the denture base.

Prosthetic maintenance would mainly record the number of visits carried out by the patient for occlusal adjustment, need for relining, selective grinding of the fitting surface due to pressure area and fracture of the denture base or acrylic teeth, presence of mucosities, flabbiness or hypertrophy. While patient satisfaction charts would evaluate and assess many items as; physiological function (chewing and speaking ability), psychological aspects (overall satisfaction, appearance, and improved retention and stability), and social function. Patient satisfaction scores will be affected by the patient's own ability to successfully carry out all oral functions as chewing, speech, swallowing[27], or by personal difference such as age, gender and personality[28].

When trying to correlate the mean patient satisfaction scores and the mean prosthetic maintenance score, a negative correlation was reported in this clinical trial. This negative correlation seems to be very realistic as the number of visits of patient increases for adjustment it will probably result in a decrease in patient satisfaction. The correlation between prosthetic maintenance and patient satisfaction has not been strongly evaluated in the literature very few case reports with a small sample size have addressed such correlation[29] which puts an increase demand for further clinical randomized clinical trial with a large sample size and longer follow up period.

When comparing retention values in newtons between the reinforced and the re-assembled group, there tends to be no significant difference between the two groups, even when compared to the base line values. This is mainly because the retention of the attachment would be mainly influenced by the micro and macro movement between the retentive surfaces of the attachment and their respective nylon cap and metal housing that may result in wear and eventually a decrease in the retentive capacity of the attachment over time[30]. The re-assembled and the reinforced single implant retained denture base would not have any effect on the movement between the male and female part of the attachment in the present study.

CONCLUSION

1- With in the limitation of the present study it can be concluded that for a single retained mandibular overdenture, the use of a metal framework embedded in the fitting surface of the overdenture will improve patient satisfaction and decrease the prosthetic maintenance visits required when compared to the direct re-assembly method of repair.

2- When correlating the patient satisfaction mean score with the prosthetic maintenance mean score there tends to be a negative correlation between them.

3- There tends to be no statistically significant difference in retention values when comparing the re-assemble and the reinforced mandibular single retained overdenture after a 1 year follows up from repair.

Such conclusions will not be very definitive due to the small sample size and short follow up period, the need for a randomized clinical trial with a larger sample size is needed to confirm such conclusions.

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