

EVALUATION OF DENTURE ADHESIVE VERSUS SINGLE IMPLANT ON COMPLETE DENTURE RETENTION AND PATIENT SATISFACTION

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ABSTRACT

Purpose: Evaluate the effect of denture adhesive versus single implant on complete denture retention and patient satisfaction.

Materials and Methods: Fourteen completely edentulous male patients participated in a crossover study. Acrylic complete denture was constructed for each patient and after 30 days of the adaptation period, retention of lower denture was measured without using denture adhesive. Patients were instructed to use Protefix paste denture adhesive for 6 months. After 3 months of denture insertion with the use of denture adhesive, for each patient a single implant (**3.5*13mm Anyone Two– piece dental implant, Mega Gen Implant System, Korea**) was placed at the anterior midline region to retain mandibular denture and patients were permitted to continue using their complete dentures using denture adhesive for an additional three months to ensure implant osseointegration. After 3 months of implant osseointegration, patients were recalled and abutments were attached to implant fixtures and attachments were then placed. Patients were then informed to avoid the use of denture adhesive. Retention of the mandibular denture and patient satisfaction were evaluated before using denture adhesives and at 1, 3, and 6 months after using denture adhesive and at 1, 3, and 6 months after implant placement without using denture adhesive. Data were statistically analysed by t student test.

Results: Retention of mandibular denture and patient satisfaction were increased in both groups with no significance difference between them.

Conclusions: Within the limitations of study, denture adhesive and a single implant can increase mandibular denture retention and patient satisfaction in completely edentulous patients.

KEYWORDS: Denture Adhesives, Single implant, Implant overdenture, Retention.

This study was conducted at faculty of dentistry, Tanta University, Egypt after the approval of the Ethics committee of the faculty

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INTRODUCTION

Despite the declining occurrence of total edentulism as a result of the development of implant-supported prostheses, there are still a number of edentulous patients who believe complete dentures to be aesthetic and inexpensive¹. Achieving the desired degree of retention and stability is one of the most important factors in the success of complete denture treatment^{2,3}.

Complete denture retention was decreased over time as a result of ridge resorption especially for mandibular complete dentures resulting in pain and difficulties with aesthetics, chewing, and biting. These issues might result in overall dissatisfaction with the mandibular prosthesis, causing the patient to ask new dentures⁴.

Although there are scenarios in which optimal denture retention may be difficult to achieve, prosthodontists tend to overlook the benefits of denture adhesives, believing that their usage is a symptom of poor denture retention, which in turn indicates incorrect denture manufacturing. Therefore, the use of denture adhesive by a patient is viewed as a negative annotation on the dentist's professional competence. In contrast to this unfavourable view regarding the usage of adhesives, data currently suggests that these products might be advantageous for denture maintenance⁵.

Certain situations need the usage of denture adhesives, such as with a demanding patient, extensive maxillofacial deformities, dry mouth, severely atrophic edentulous ridges, abused or hypertrophied ridges, impaired neuromuscular control as well as in public individuals. In addition, alveolar bone loss causes denture's retention to loosen with time; thus, relining or new denture constructions are the only solution. Denture adhesives closing gaps produced by bone resorption and provide short relief from denture loosening^{6,7}.

It has been shown that adhesives minimise three-dimensional and rotational denture motions and

chewing durations in both old and new dentures, hence enhancing denture retention, the function of chewing and patient satisfaction⁷⁻¹⁰. Also, adhesive material expands in the presence of water by 50 to 150 per cent by volume, therefore closing gaps between the prosthesis and underlying tissues. Modern adhesives, on the other hand, provide strong bio adhesive and cohesive forces via carboxyl groups that establish electrovalent connections, producing stickiness and preventing gaps between denture base and underlying tissue¹¹.

A variety of soluble and insoluble adhesive formulations are commercially available. The soluble group consists of creams, powders, and pastes, whereas the insoluble group comprises wafers and lozenges¹².

Some drawbacks, such as irritation of the oral mucosa, alterations in occlusal relationships, increased vertical dimension and increased alveolar bone loss have been found with the use of denture adhesives particularly insoluble adhesives¹³. However, implant-retained dentures have been the usual therapy for these individuals in recent years.

Two or more implant-assisted mandibular overdentures can improve function and increase success rates in comparison to traditional complete dentures¹⁴⁻¹⁶. However, no proofs about the optimum implant numbers are present for mandibular overdenture retention¹⁷⁻¹⁹.

Single implant-retained overdenture offers an additional alternative for older populations particularly in underdeveloped nations in an effort to decrease treatment costs and duration and also the biomechanical effects and patient satisfaction were found equivalent to those reported with a mandibular two-implant retained overdenture²⁰⁻²².

Patients in good general health are ideal candidates for implant therapy; however, because single implant-assisted overdenture is a simplified and less invasive approach, it is a more viable option for elderly and/or disabled patients with health

restrictions or systemic conditions that increase the risk of extensive implant surgical procedures. If any systemic illness or condition, such as diabetes or hypertension, is present, it must be addressed as part of the treatment plan and during surgical interventions²³⁻²⁷.

Although denture adhesives and single implant-assisted overdentures are viable alternatives for impaired edentulous individuals, a lack of research has hindered their applications. This study's aim of the work was to compare denture adhesive to a single implant on complete denture retention and patient satisfaction.

MATERIAL AND METHODS

Fourteen completely edentulous male patients with a mean age of 50 participated in a crossover study. Using a comprehensive medical history, the patient's overall health was examined. Laboratory tests included the Glycosylated Haemoglobin Test (HbA1c Test) to check that all chosen patients had glucose levels between 6.5 and 7%²⁸ and were clear of any other systemic disorders that might affect implant osseointegration.

This study excluded patients with HbA1c levels above 7%, alcoholism, drug misuse, and poor oral hygiene.

Cone Beam CT was performed on all patients to reveal the height and width of bone as well as the bone density in the mandibular anterior midline region, as well as to detect any clinically undetected disease or bone anomaly. Before beginning therapy, each patient signed an informed consent form that had been authorised by the ethics committee following a discussion of the proposed treatment plan.

An acrylic complete denture was fabricated for each patient with the conventional technique using semi-anatomic acrylic teeth set on semi-adjustable articulator. Mandibular acrylic dentures were duplicated using clear autopolymerized acrylic

resin to produce surgical templates to aid in implant placement in the anterior midline area.

After 30 days of the adaptation period, retention of lower denture was measured without using denture adhesive and then patients were instructed to use Protefix paste denture adhesive according to manufacturer's instructions for 6 months.

After 3 months of denture insertion with the use of Protefix paste denture adhesive, for each patient single implant (**3.5*13mm Anyone Two-piece dental implant, Mega Gen Implant System, Korea**) was placed at the anterior midline region using flapless technique.

Patients were permitted to continue using their complete dentures using Protefix paste denture adhesive for an additional three months to ensure optimal implant osseointegration. After 3 months; patients were recalled and implant osseointegration was evaluated, abutments were attached to implant fixtures after minimal surgical exposure of implant fixtures and each mandibular denture was relieved at the implant location, the plastic cap was placed on the implant abutment ensuring that the denture was securely seated, and the implant head was covered with a shim to prevent excess acrylic from engaging any implant undercuts. The relieved region of the fitting surface of the mandibular denture was filled with autopolymerized acrylic resin, the dentures were installed, and patients were asked to bite softly during the setting of the acrylic resin. After the resin had cured, the dentures were removed, the plastic cap inside the mandibular denture was inspected, and any extra resin was cut. Patients were then informed on how to clean the denture and avoid the use of denture adhesive, and were instructed to return the next day for an examination of the denture-bearing region to look for symptoms of tissue irritation (Figure 1).

Evaluation of denture retention

Geometric centre of the lower denture was determined as follows:

All undercuts in the denture's fitting surface were filled with base plate wax, the fitting surface was poured with a plaster mixture, and another mixture was used to make the base. On the denture's polished surface, retro molar pads and midline centres were identified, and a cardboard triangle was cut and put on the plaster base to fill the area between the three marks (retro molar pads and midline centres). On the cardboard, three lines were then drawn bisecting the triangle's three angles. The junction of the three lines constituted the geometric centre of the denture. A pin was pushed through the geometric centre of the cardboard to indicate a point on the plaster base. Wire was then attached to the base at the designated spot and hung upward in order to maintain the geometric centre location. On the mandibular denture's polished surface, three "V"-shaped grooves were formed. One was produced on the lingual surface of the central incisors in the midline region just below the central incisal edge. The last two grooves were created in the retro molar pad region immediately distal to the second molars on both sides. 1 mm wrought wire was bent at its centre and adjusted to avoid the tongue space and 2 cm above both sides' retro molar pad grooves. A second 1 mm wrought wire was modified to run 2 cm above the lingual flange groove, and the two wires were then bent to meet at the determined geometric centre. One end of the second wire was fitted into

the groove made right below the central incisors, while the other end was formed into a C-shaped loop around the first wire. The free ends of the two wires were then affixed to the lower denture's polished surface with cold-cured acrylic resin. Excess acrylic resin was then removed, and the denture's surface was refinished and polished (Figures 2&3).

Retention of mandibular dentures was assessed as follows: Each patient was asked to sit comfortably with his head on the headrest and the occlusal plane is parallel to the floor. Retention force was measured by digital force gauge (HP-5 Digital Force Gauge, Beijing Lanetech Instruments Co., Ltd). Before each retention measurement, the force meter's display was made at zero. The force measuring unite is adjusted to be in newton. Digital force gauge's metallic hook was attached to the loop positioned at mandibular dentures for each group. Vertical pull was applied until denture dislodgement resulted and the peak load value was recorded. Measuring procedure was repeated three times and the average was calculated (Figure 4).

The same measuring procedure was repeated for mandibular dentures before using denture adhesives and at 1, 3, and 6 months after using denture adhesive and at 1, 3, and 6 months after single implant placement without using denture adhesive.



Fig. (1) Anterior midline single implant inserted in the mandibular edentulous arch.

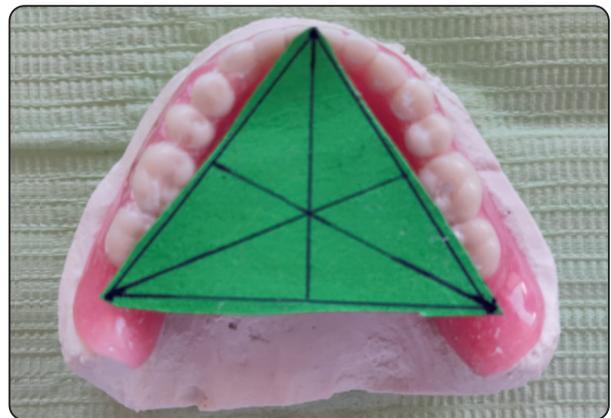


Fig. (2) Determination of geometric center of lower denture



Fig. (3) Wires joined at geometric center of the denture



Fig. (4): Patient during the retention evaluation

Patient satisfaction:

Patients answered the same questionnaire before using denture adhesive and at 1, 3, and 6 months after using denture adhesive and at 1, 3, and 6 months after single implant placement without using denture adhesive including the following items:

- Are you pleased with your lower denture's retention?
- Are you pleased with your denture's retention when using denture adhesive?
- Did denture adhesive impair your mandibular denture retention?
- For how long did the denture adhesive keep your mandibular denture in place?
- Was your ability to chew affected by the usage of denture adhesive?
- Did the usage of denture adhesive produce any side effects while you were not chewing?
- Was it difficult to clean your dentures after applying denture adhesive?
- Was it difficult to clean your gums after applying the denture adhesive?
- Did the usage of denture adhesive affect the state of your mouth, as evidenced by clinical symptoms or complaints?

The same questions are repeated for each patient with the single implant retained mandibular denture.

The answers to each question and respective scores were as unsatisfactory (0), regular (1), and good (2). The overall results for denture satisfaction were calculated by summing the scores of each question, ranging from 0 to 18 for each patient²⁹.

Statistical analysis

For retention force value and patient satisfaction, statistical analysis was performed using IBM SPSS 20 (Statistical Package for Scientific Studies) and Microsoft Office XP (Excel) for Windows. The t student test analysis was used to compare between the two groups at 0.05 significance level.

RESULTS

Table (1) lists the results of the t student test analysis for retention values at different follow up periods.

After 1 month from prosthesis insertion, mean \pm standard deviation (SD) of retention values of group I patients was (1.235 \pm 0.355), while mean \pm standard deviation (SD) of retention values of group II patients was (1.401 \pm 0.434).

Retention values for group II were better than that for group I and non-statistical significant

increase of the retention values between the two groups were found during the follow up periods ($P > 0.05$), while within each group there were a significant increase of the retention values between 1 month and 3 months and 1 month and 6 months ($P < 0.05$). Also, within each group there were a non-significant increase of the retention values between 3 months and 6 months ($P > 0.05$).

Table (2) lists the results of the t student test analysis for patient satisfaction values at different follow up periods.

Generally, there were no statistically significant

differences for patient satisfaction values between the two groups at 1 months, 3 months and 6 months ($P > 0.05$).

Patient satisfaction values for group II were better than that for group I and non-statistical significant increase of the patient satisfaction values between the two groups were found during the follow up periods ($P > 0.05$), while within each group; a significant increase of the patient satisfaction values between 1 month and 3 months, 1 month and 6 months and between 3 months and 6 months were found ($P < 0.05$).

Table (1): Results of t Student test for retention values at different follow up periods.

Period of follow up		Group I	Group II	t	p
<i>After 1 month:</i>					
Mean \pm S.D.		1.235 \pm 0.355	1.401 \pm 0.434	1.342	0.432
<i>After 3 months:</i>					
Mean \pm S.D.		2.011 \pm 0.546	2.145 \pm 0.476	1.223	0.571
<i>After 6 months:</i>					
Mean \pm S.D.		2.441 \pm 0.599	2.540 \pm 0.664	1.565	0.223
Differences		0.776 \pm 0.191	0.744 \pm 0.042		
A1M- A3M	Paired Test	t	0.685	0.856	
		P	<0.001*	<0.001*	
Differences		1.206 \pm 0.244	1.139 \pm 0.23		
A1M- A6M	Paired Test	t	0.442	0.657	
		p	<0.001*	<0.001*	
Differences		0.43 \pm 0.053	0.395 \pm 0.188		
A3M- A6M	Paired Test	t	0.148	1.251	
		p	0.548	0.412	

*Significance: $P < 0.05$

Table (2): Comparison between patient satisfaction values of the two groups at different observation periods.

Patient satisfaction		Group I	Group II	t	p
<i>After 1 month:</i>					
Mean ± S.D.		12.754±0.566	13.000±0.776	1.543	0.332
<i>After 3 months:</i>					
Mean ± S.D.		13.324±0.665	13.564±0.788	1.648	0.421
<i>After 6 months:</i>					
Mean ± S.D.		14.102±0.779	14.220±0.875	1.257	0.246
A1M-A3M	Differences	0.57±0.099	0.564±0.012		
	Paired Test	t	0.679	0.884	
		p	<0.001*	<0.001*	
A1M-A6M	Differences	1.348±0.213	1.220±0.099		
	Paired Test	t	0.653	0.690	
		p	<0.001*	<0.001*	
A3M-A6M	Differences	0.778±0.114	0.656±0.087		
	Paired Test	t	0.351	0.645	
		p	<0.001*	<0.001*	

*Significance: $P < 0.05$

DISCUSSION

The study was conducted on mandibular dentures since the majority of edentulous patients have retention difficulties with mandibular dentures³⁰.

Successful complete denture therapy depends on excellent prosthesis construction and effective patient management; however, even the most skilled practitioners may find it difficult to meet the patient's expectations for denture stability and retention, and it is often deemed appropriate to prescribe a denture adhesive to these patients. Denture adhesives benefit edentulous individuals, and a number of studies indicate that their usage greatly reduces the displacement of mandibular and maxillary dentures during different functions³⁰⁻³³.

The perfect denture adhesive must be odourless, tasteless and simple to apply and remove from the denture's fitting surface. Various adhesive types

are present in the market, but paste was favoured over powder because it is less likely to be washed away by oral fluids and its impact lasts longer after insertion³⁴.

In this study, denture adhesive significantly increases mandibular denture retention at all observation periods ($P < 0.05$), and this is in agreement with Ibrahim and Salman³⁵ and Ibraheem and El-sisy³⁶.

Variation in the morphology of the mandibular ridge across patients may account for differences in retention before and one month after using dentures, and patients had not yet habituated to their dentures. Numerous studies^{37,38} have focused on the significance of time in the development of mandibular denture retention. In agreement with Pradies et al.,³⁸ who did a research to examine the effectiveness of two denture adhesives in

edentulous patients wearing complete dentures, there were significant variances within the same group. Their research proved the anticipated and predicted increase in the stability and retention of complete dentures (CDs) when adhesives were used as an aid. There is no consensus in the literature on which adhesive is superior to others^{39,40}. According to self-perception studies, wearing dentures with adhesive increases comfort and satisfaction. Numerous studies have demonstrated that CD adhesives (CDAs) prescribed by a dentist enhance the retention and stability of CDs. Additionally, the usage of CDAs will improve the patients' quality of life, overall health and satisfaction⁴⁰⁻⁴².

There are numerous implant treatment options for edentulous patients with good aesthetic and functional results, resulting in a higher quality of life but in some cases, a conventional complete denture is indicated, such as in the case of elderly multimedicated patients with tumoral diseases^{43,44}. With xerostomia, individuals with hormonal and neurotransmitter abnormalities and illnesses that impact muscle tension, such as Parkinson disease, myasthenia gravis, muscular dystrophy, and buccolinguofacial dyskinesia are affected⁴⁵⁻⁴⁷.

Denture adhesives contain either a vegetable gum or a synthetic polymer, such as carboxymethyl cellulose and polyvinyl methyl ether maleate. As the adhesive absorbs water and the carboxymethyl cellulose interacts with saliva, the hydrate material (free carboxyl groups) is generated and expands to a higher extent than their initial volume, producing electrovalent interactions that cause stickiness or strong bio adhesive forces. The hydrate substance adheres to the denture and oral mucosa while increasing the viscosity of the saliva. These measures enhance the retention of CDs. Thus, the use of CDAs reduced the movement of CDs, resulting in improved function and masticatory efficiency, which corresponds to greater patient satisfaction⁴⁸⁻⁵¹.

It is commonly acknowledged that two implant-supported mandibular overdentures should be advised for edentulous individuals, despite the fact that single implant-retained overdentures also have considerable clinical and practical promise²⁰⁻²².

Implants were put in the mandible's anterior region. This region is the optimum location for a single implant-retained overdenture for the following reasons: thicker cortical bone, reduced surgical risk by avoiding the inferior alveolar nerve and blood vessels and a wider tissue-supporting area to minimise implant overloading. Although there was some worry about the potential risk of mandibular fracture due to the anatomical structure⁵², there was minimal difference between the expected risk of overdentures retained by one implant and those retained by two implants⁵³.

The results of this research were in agreement with those of earlier prospective studies⁵⁴⁻⁵⁶. Tavakolizadeh et al.⁵⁵ found that patients with mandibular overdentures (MODs) supported by one or two implants were more satisfied after six and twelve months when compared to those with traditional CDs. The attachment technique for implant-retained overdentures may potentially affect patient satisfaction with their dentures⁵⁷. In this study, the attachment system consisted of a metallic ball abutment and O-ring attachment system and the majority of studies showed sustained high levels of patient satisfaction utilised a ball attachment for implant-retained prostheses⁵⁴⁻⁵⁸.

In this study, MODs supported by a single implant resulted in greater patient satisfaction when compared to treatment with CDAs. These results are consistent with other investigation showed an improvement in the masticatory function and patient satisfaction of patients treated with MOD supported by a single implant throughout the first six months of treatment⁵⁹. Harder et al.⁶⁰ and Cheng et al.⁶¹ showed similar outcomes after four weeks and immediately after attachment insertion.

Results of this investigation are consistent with study done by Krennmair and Ulm⁶². They employed nine patients who got a single implant retained mandibular prosthesis and self-administered questionnaires to evaluate subjective levels of satisfaction. From their research, they determined that a single symphyseal implant retained mandibular overdenture significantly enhanced the retention and function of the prosthesis, as well as patient satisfaction. Also, the results are similarly consistent with numerous additional studies⁶³⁻⁶⁷ and those of Heydecke et al⁶⁸ who evaluated the influence of implant overdentures on quality of life in older adults who used either a mandibular implant retained overdenture or a conventional CD and they discovered that the outcomes were much better in the single implant retained overdenture. Our results are also in accordance with Wolfart et al⁶⁹ who reported that a single central implant in the front mandible and a connecting ball attachment in the current denture can improve the patient satisfaction.

The lack of a statistically significant difference between the two groups for denture retention and patient satisfaction may be attributable to the lower resistance of MOD supported by a single implant to horizontal movement, which may result in less denture stability during chewing and diminished masticatory performance. The possible rotating motion of overdentures supported by a single implant during mastication is another possibility. One of the primary difficulties for overdentures supported by a single implant is prosthesis rotation along the central axis⁷⁰. According to Krennmair and Ulm⁶², the development of sagittal, transverse, and vertical rotational axes and implant location, are drawbacks of overdentures supported by a single implant. In addition, the use of CDAs reduced the movement of CDs, resulting in improved function and masticatory efficiency, which corresponds to greater patient satisfaction and also patients found that the use of CDAs minimised the problems

caused by food particles introduced below during mastication, producing irritation and discomfort in the mucosa owing to friction, which can occur with MODs supported by a single implant⁴⁸⁻⁵¹.

Overall, the results indicate a significant improvement in patient satisfaction, despite the fact that several patients complained about denture adhesive paste altering the flavour of their meal. Meleşcanu-Imre et al⁷¹ discovered that there is a fair amount of diversity in the effects of denture adhesives on smell and taste alterations that cause patients discomfort, which is consistent with the findings of the current study. While El-Mekawy and Habib's⁷² investigations revealed that the majority of patients reported a nice taste with Protefix paste, powder, and cushion, while patients reported an average or poor taste with Super Corega paste and powder. This can be due to the inclusion of menthol, azorubin, and P-hydroxy-benzoic acid methyl ester in the formulation of Protefix paste type and menthol in the composition of Protefix powder type, although neither Super Corega paste nor powder include these substances²⁶.

Due to the limitations of this study and the small sample size, the ability to demonstrate statistically significant differences between the two groups may have been compromised. In addition, a longer assessment period may be required to compare the success of a single anterior median implant retained denture versus a complete denture with adhesive.

CONCLUSION

Denture adhesive and a single anterior median implant can increase mandibular denture retention and patient satisfaction in completely edentulous patients, within the constraints of this study regarding assessment length and sample size.

Conflict of interest

The Author declares no conflict of interest and has full control of all primary data.

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