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Investigate the effect of three types of denture adhesives on the retention of a poorly fitting maxillary complete denture (Clinical Study)

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Abstract

Background: In this study the forces required to dislodge poorly fitting maxillary complete denture where compared with saliva alone and at different time intervals with the use of three types of denture adhesives, one paste type (Fittydent) and two cream types (Protefix and Incydent).

Materials and Methods: Ten subjects with age range between 47-65 years Who wore a maxillary and mandibular complete dentures were selected for this study with their maxillary dentures are lacked sufficient retention(poorly fitting), the dislodgment forces were measured with the aid of a strain gauge force transducer and strain measuring device. The measurements were performed with saliva alone as a control interface medium and at different time intervals (baseline, 1 hour, and 2 hours) after the application of the adhesives.

Results: Comparing dislodgement forces using t-test show a highly significant difference (P<0.ooo1) in the amount of retention for all adhesives used at different time intervals in comparison to its values with saliva alone. The Fittydent adhesive paste show a highly significant difference in comparison to Protefix and Incydent adhesives cream at different time intervals.

Conclusion: All denture adhesives used were improved the retention of poorly fitting maxillary complete denture but the Fittydent adhesive paste was more effective in increasing the retention than Protefix and Incydent adhesives cream.

Introduction

Sufficient retention constitute a basic and important requirement for the acceptance of complete dentures by the patient.(8) Improving retention and stability of denture is of a considerable interest in prosthetic dentistry .Approaches to the problem over the years have included over dentures , implants and denture adhesives (9).

Denture adhesives as aids to denture retention and stability are marketed in many forms such as powders, pastes creams, semi-viscous liquids, thin sheets and wax impregnated adhesive cloths. However, the powder, paste, and liquid form are the most common formulations used by denture wearer. (10)

Many studies based on information from subjective finding as well as objective measurements of improvements in denture functions have reported the denture adhesive as useful adjunct to denture treatment and denture after care.(10)

Many studies on the use of denture adhesives confirm the improvement in denture stability and retention for both new and experience denture wearer (1,2) .Furthermore , advocates fell that there are many beneficial uses for denture adhesives that include increased stability and retention , reduction in denture mediolateral movement and

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dislodgment , and greater levels of incisal bite force during function.[9,15,16]. Dental professionals have been slow to accept denture adhesives as a means to facilitate clinical procedures, patient acceptance, and patient satisfaction .Denture adhesive can enhance complete denture retention, and stability, as well as function. [17]

The ideal adhesive should provide comfort retention (adhesion, cohesion) and the stability to the denture, ensuring the patients ability to function with security and effectiveness during speech, mastication, yawing and smiling [3].The increased stability and retention allow denture patients to increase the force they can apply during mastication, which result in fewer chewing strokes to reach swallowing stage of deglutition. The use of denture adhesives provides a cushioning effect, reduces the amount of food particles collecting under the denture, inhibit the growth of candida albicans, and assist in distribution of forces of occlusion over the denture bearing regions, thereby minimizing local pressure points [4, 5].

A number of studies [1, 6, 7] have been conducted to evaluate the effectiveness of the denture adhesives and measured either subjectively or by determining the force required to dislodge the denture.

The purpose of this study was undertaken to determine and compare the effect of the use of three types of denture adhesives on the retention of poorly fitting maxillary complete dentures by an in vivo method using a strain gauge force transducer.

Materials and methods

For the purpose of this investigation, retention has been expressed in terms of the force required to dislodge vertically a maxillary complete denture using a strain gauge force transducer and strain measuring device [11].

Ten subjects with age ranges between 47-65 years half of them male and the others are female, who wore an old maxillary and mandibular complete denture and waiting list for the construction of new dentures in department of prosthodontic, college of dentistry .Baghdad university were selected for this study and their existing old maxillary complete dentures lacking sufficient retention (poorly fitting dentures) were used. All of the participants possessed no physical disability which would interfere with the study and all of them were willing to participate and cooperate throughout the entire study. A complete case history with clinical examination of the oral cavity and clinical evaluation of the dentures retention and stability with evaluation of the appearance of the denture bearing area in accordance to the Kapures criteria [1] table (1).Patients should have no undercuts on the maxillary arch .the clinical examination were evaluated by two qualified prosthodontists.The three test adhesives table (1) were one adhesive paste (Super Hold Denture adhesive, Fitty Dent), and two adhesives cream (Protefix adhesive)and (INCYDENT denture fixative). All the three adhesives Fig (1) were in the forming which they could be purchased by the public. The adhesive used was divided equally into three pre –specified spots on the fitting surface of the maxillary complete denture according to the manufactures recommendation. Fig (2)

The denture must be thoroughly cleaned and completely dry, then denture adhesives were applied in a series of dots on a previously prespecified spots on the fitting surface of the maxillary complete denture and

must avoid too close application of the adhesive to the edge of the denture, after that the denture must be inserted into the patient mouth and the patient must be asked to close firmly and hold it in place for few seconds, then wait 15 minutes before starting the adhesive testing. The adhesive used were delivered in measured quantity onto the fitting surface of the maxillary complete denture; its amount varied from 0.15-1gram depends on physical formulation of the adhesive and on the size of the individual denture [14].

A specially designed strain gauge force transducer was used in order to measure the force values that are required to dislodge the poorly fitting maxillary complete denture. The experimental apparatus Fig (3) consist of load application apparatus which included (load application screw, cantilever beam, hook assembly) with the supporting structure or platform. The active element of the transducer was 2 foil strain gauges that bonded to the prepared surfaces of the stainless steel cantilever beam and wired with lead wires to form 2 arms of the Wheatstone bridge circuit. They were connected so as a 1/2 bridge .The tension and compression occur within the 2 strain gauges from the bending of the cantilever beam during the dislodgment of the maxillary dentures will produce a signals that amplified on the strain measuring device which provide reading in voltage unite (milivolt) then by referring to calibration test converted to load in grams.

A string of about 1 inch length was secured on the polished palatal surface of the poorly fitting maxillary complete denture in region relating to the second premolar and first molar teeth (12)with auto polymerizing acrylic resin to serve as a mean of connection for the hook assembly Fig (4). The hook used being light in weight and easy to disinfect by using 70%solution of isopropyl alcohol Fig (5).The patient head was held firmly on the head rest with occlusal plane of the maxillary teeth parallel to the floor. The maxillary complete denture was placed in the patient mouth and directed to a seating force by the operator using manual pressure for five seconds, it was then left in position for 2 minutes before any dislodging force was applied [13].

At the first day of testing , retention of the poorly fitting maxillary complete denture was first recorded after insertion without the use of any denture adhesives(Saliva Alone) .These measurements served as the control to which the experimental measurements of dislodgment when adhesive was applied were compared. Measurements were repeated in the same manner after 15 minutes of the denture adhesive application using the first type of adhesive as baseline measurements, and at 1 and 2 hours time intervals after the first measurement with denture adhesives. A mean of three readings was registered in each step. After that the denture was removed, cleaned and kept in water. All these measurements were repeated in the next day using a second type of adhesive, and the third day using the third type of adhesive. After finishing of the measurements, the string was removed and the denture was polished and returned to the patient.

Results

The mean and standard deviation of measurements of dislodgement forces of a poorly fitted maxillary complete denture with saliva alone and at various time intervals with the use of the denture adhesives table (1) revealed that the mean of dislodgement forces were increased with the use of

the denture adhesives and the denture adhesives showed an increase in the denture retention with increase of the time of the experiment. The fitty dent adhesive has higher dislodgement values when compared with the other adhesives after 2 hours time intervals (Fig1).

Using paired students t-test for the different values of dislodgement forces revealed that there is a highly significant difference $P<0.0001$ in the amount of retention for all types of adhesives in comparison to its values with saliva alone at all time intervals (Table2).

The one way analysis of variance ANOVA test(Table 3) showed that there is a highly significant difference $P<0.0001$ between the dislodgement forces with saliva alone and at three time intervals with the use of denture adhesives.

The one way analysis of variance ANOVA test (Table4) between the dislodgement forces of each type of the denture adhesives at different time intervals show a highly significant difference $P<0.0001$.

Students Paired t-test were used to make a comparison between the dislodgement values of the three types of denture adhesives (Fittydent, Protefix and Incydent) with each other at different time intervals (Table 5) .The results showed that there is a highly significant difference $P<0.0001$ when comparing between Fittydent and Protefix denture adhesives and also between the Fittydent and Incydent denture adhesives while there is a non significant difference $P>0.05$ between the Protefix and Incydent denture adhesives at the base line, 1 hour and 2 hours time intervals .

Discussion

Denture adhesives are used by many edentulous patients to improve the retention and stability of their dentures (9,19,20) , this study measures the improvement in the dislodgement forces of poorly fitting maxillary complete denture with the use of three types of denture adhesive, two cream types (Protefix and Incydent) and one paste type (Fitty dent).

Many clinical methods and techniques have been developed to investigate the phenomenon of denture retention .In present study; the loading apparatus are used to dislodge poorly fitting maxillary complete denture in order to investigate the effect of three types of denture adhesive on its retention.

The dislodging forces were compared with and without the use of denture adhesive for all participating subjects.

The main components of denture adhesive are either vegetable gum or synthetic polymer as carboxymethyl cellulose and polyvinyl methyl ether maleate. So when carboxy methyl cellulose come in contact with saliva , the hydrate material is formed and swell in presence of saliva/ water and flows under pressure , thereby eliminating voids between denture base and bearing tissue. Hydrate material stick readily both the tissue surface of the denture and the mucosal surface of the basal seat, and increases the viscosity of the saliva .These actions markedly increase the retention of complete denture. (18)

In the present study the increase in denture retention are highly significant with using of denture adhesive (Table 4) at all time intervals ($P< 0.0001$) and this is in accordance with the findings of Salman (14).

The three types of denture adhesives used started their action immediately and reached to accepted retention rapidly, their effectiveness increased gradually from base line and maximum retention was achieved at 2

hours time interval. These findings come in agreement with (Grasso etal 9, Ghani etal 10, and Floystrand etal 24). This is due to decrease of salivary flow in the edentulous subjects with increase of the experiment time. As Niedermneir and Kramer (22) have shown that whole saliva produced by the major salivary glands could not flow easily into the well –sealed space between the denture base and mucosa of the palate.

All the three types of denture adhesives used have a positive effect in improving the retention of poorly fitting maxillary complete denture with a difference in dislodgment forces from one adhesive to another.

In this study Fittydent adhesive paste was rated higher dislodging values which was highly significant difference $P<0.0001$ when compared with adhesives cream (Protefix and Incydent) in all time intervals throughout the experiment while both adhesives cream show non significant difference $P>0.05$ when compared with each other at different time intervals (Table5).

The main components of paste denture adhesive are carboxy methyl cellulose and poly vinyl group. The carboxy methyl cellulose start its action immediately after application of the denture adhesive, and with time the long acting polyvinyl group hydrates and increase adherence and viscosity also display molecular cross linking resulting in measurable increase in adhesive behavior.(18)

The oily medium in which the active ingredients of the paste are incorporated delaying the rapid activation of paste denture adhesive, ultimately prolongs its duration of action and maintains the higher level of dislodging forces achieved (25)

The higher values of dislodging forces measured with Fittydent adhesive paste in comparison to lower dislodging values for both Protefix and Incydent adhesive creams may be attributed to the insoluble properties of Fittydent adhesive paste that is not affected by saliva and liquids .This insoluble properties of Fittydent have a direct effect on increasing the bond force and provide a strong bioadhesive and cohesive forces between the polyvinyl group and the carboxy methyl cellulose ,so this combination provide a quick hold through the action of carboxy methyl cellulose and a hold of longer duration through the use of the polyvinyl group, and thereby it increases the retention of the poorly fitting maxillary complete denture.

Also the hydrate material formed by carboxymethyl cellulose stay intact because of the insoluble properties of the Fittydent denture adhesive paste, this action delay the washing away of the polymer by the salivary flow so that the effective life of the polymer during use is increased and thereby it markedly increases the retention of the poorly fitting maxillary complete denture.

The results of this study come in agreement with Chew et al (21), who conducted that the denture adhesives improved the retention of the dentures more so for poorly fitting dentures than well fitting dentures.

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Table (1): Mean dislodgment forces in grams with standard deviation of poorly fitting maxillary complete denture with saliva alone and at various time intervals with the use of denture adhesives.

		Mean	SD	SE	Min	Max	C.V%
Saliva alone		483.1	54.872	17.352	395	577	11.358
Fittydent adhesive paste	Baseline	1024.2	81.194	25.676	918	1177	7.927
	1 hour	1119.3	85.69	27.10	1018	1277	7.656
	2 hours	1207	76.540	24.204	1090	1312	6.341
Protefix adhesive cream	Baseline	825.9	58.847	18.609	723	919	7.125
	1 hour	931.6	48.277	15.266	858	1011	5.182
	2 hours	973.1	48.367	15.295	890	1020	4.970
Incydent adhesive cream	Baseline	810.5	54.195	17.138	736	911	6.686
	1 hour	911.3	47.609	15.05	839	996	5.224
	2 hours	967.3	73.87	23.36	873	1110	7.636

Table 2 -The test adhesives

Trade Name	Type	Ingredients
Super Hold Denture adhesive (Fitty Dent)	Paste	Sodium Carboxymethyl cellulose, Solution of polyvinyl acetate, petrolatum, Hydroxy -propylcellulose.
Protefix adhesive cream	Cream	Mixture of sodium and calcium salts of the copolymer of methylvinylether and maleic acid anhydride 30g, Carboxymethylcellulose 23g, paraffin,Vaselin,Silica<menthol,Azorubin,P-hydroxy-benzoic acid methyl ester
INCY DENT Denture fixative	Cream	Petrolatum,Calicium/SodiumPVM/MAcopolymer, Cellulosegum, Paraffinum liquidum,Aroma, C.I45430:1.

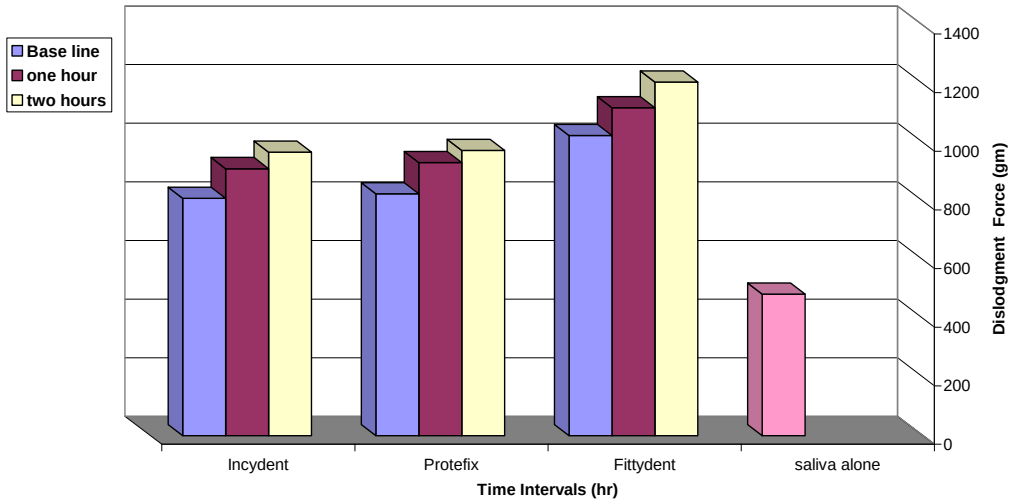

Fig. 1: Mean dislodgment forces of poorly fitting maxillary complete denture with saliva alone and at various time intervals with the use of denture adhesives

Table (2) Comparison of dislodgment forces of poorly fitting maxillary complete denture with saliva alone and with the use of three types of denture adhesives at various time intervals (Students Paired t- test)

	Fittydent		**Protefix**		**Incydent**	
	t-test	P-value	t-test	P-value	t-test	P-value
Immediately	17.46	0.000	13.47	0.000	13.42	0.000
One hour	19.77	0.000	19.41	0.000	18.64	0.000
Two hours	24.31	0.000	21.18	0.000	16.64	0.000

*P<0.0001 High significant

Table(3) : Results of One way analysis of variance (ANOVA) between the dislodgment forces of poorly fitting maxillary complete denture with saliva alone and at various time intervals with the use of three types of denture adhesives.

	F-test	***P-value***	***Sig***
Immediately	125.54	0.000	HS
One hour	193.53	0.000	HS
Two hours	222.17	0.000	HS

*P<0.0001 High significant

Table (4) One way analysis of variance (ANOVA) between the dislodgment forces of each type of denture adhesives at different time intervals.

	F-test	***P-value***	***Sig***
Fittydent	12.67	0.000	HS
Protefix	21.25	0.000	HS
Incydent	17.77	0.000	HS

*P<0.0001 High significant

Table (5) Comparison of effectiveness among the denture adhesives at each time intervals (Students paired t-test)

	Immediately		**One hour**		**Two hours**	
	t-test	P-value	t-test	P-value	t-test	P-value
Fittydent & Protefix	6.25	0.000 HS	6.03	0.000 HS	8.17	0.000 HS
Fittydent & Incydent	6.92	0.000 HS	6.71	0.000 HS	7.13	0.000 HS
Protefix & Incydent	0.61	0.55 NS	0.95	0.36 NS	0.21	0.84 NS

**P<0.0001 High significant*

***P>0.05 Non significant*

Fig. 1 Denture adhesive

Fig. 2 Denture adhesive application

Fig. 3 The experimental apparatus

Fig. 5 Hook disinfectant