

A Comparative Evaluation of the Retentive Effect of Four Different Forms of Denture Adhesives on Maxillary Dentures an in vivo Study

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Abstract

Statement of the problem: Improving retention of complete dentures is of considerable interest in the field of prosthetic dentistry. With the loss of the natural dentition, edentulousness poses numerous problems associated with the complete dentures in terms of its retention and resulting efficacy. With the advent of new generation denture adhesives, the retention may well be enhanced but the effectiveness over other materials remains to be studied.

The objective of the study was to compare the retentive effect offered by different forms of denture adhesives to maxillary dentures.

Four types of denture adhesives - powder, paste, liquid and pads were evaluated for their retentive effect on maxillary dentures. A custom-made pulley unit was fabricated in which weights were added to test the retentive effect of all four forms of adhesives.

Mean values for pair 3 in Test A&B [346.15] and Test B&C[38.46] were significantly higher than pair 1[158.46][5.38], pair 2[204.61][18.46] and pair 4[302.31][25.38] in both Test A&B and B&C.

Within the limitations of this study, it has been concluded that Liquid adhesive was superior to all other forms of adhesives in their performance, which can be considered as the material of choice for more retention. Powder adhesive was least effective in improving retention.

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Introduction

Denture adhesives are commonly used by denture wearers to increase the retention and stability of complete dentures, to improve masticatory and phonetics. This improves stability and psychologically support the patient to make complete denture more acceptable. Sufficient retention constitutes a basic and important requirement for the acceptance of complete dentures by the patients. Denture adhesive refers to a commercially available, nontoxic, soluble material that is applied to the tissue surface of the denture to enhance retention, stability, and function.¹

There are occasional situations in which it is not possible to obtain the desirable optimal retention. In these instances the use of

adhesives play a vital role in enhancing retention of the dentures.^{2,3} Denture adhesives augment the same retentive mechanisms already operating when a denture is worn. The absorption of water and saliva by the denture adhesives eliminates the voids and fills the space between the denture base and the basal mucosa accounting for stickiness that leads to an increase in retention. Denture adhesives may also be used to enhance retention in the following situations².

As an aid in retention during clinical procedures such as jaw records and try-in stages.

In maxillofacial prosthetic rehabilitations where there are physical limitations to the degree of retention.

As a vehicle to aid in application of drugs to the oral mucosa and

To enhance retention in complete denture patients experiencing hormonal and neurotransmitter disorders where muscle control is affected. E.g., Dyskinesias, Parkinson's and Alzheimer's disease.

Much light has not been thrown in the dental literature regarding the properties of

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denture adhesives. Furthermore the little information that is available about relative span of effectiveness of denture adhesives, influence of physical forms, composition, quantities and the performance of these materials, rely mostly upon patient judgment.⁴

As the adhesives are available in various physical forms such as powder, paste, liquid and pad, it is necessary to analyse their individual effect on denture retention objectively to help us make the choice.

Materials and methods

Thirteen edentulous subjects between ages of 40 and 65yrs, who wore complete dentures, were selected for this study. Samples of denture adhesives [Fig.1] selected in this study were adhesive powder [fittydent], adhesive paste [fittydent], adhesive liquid [super Korega] and adhesive pad [Protifix]. The main components of adhesives, the manufacturer and the consistency of the adhesive material used in this study are listed in the table I.



Figure 1. Samples of denture adhesives.

Name	Form	Manufacturer	Composition
Fittydent	Powder	Altwithr, Gmbh 4950 altheim, Austria	Calcium sodium poly [vinyl methyl ether maleate], sodium carboxy methyl cellulose and pectin
Fittydent	Paste	Altwithr, Gmbh 4950 altheim, Austria	Polyvinyl acetate, sodium carboxy methyl cellulose and petroleum jelly
Super Korega	Liquid	Stafford miller, Dungarvan co. Waterford, Ireland	Paraffin liquidum, cellulose gum, PEG-90M, polyethylene, propyl paraben, birabolol and aroma
Protifix	Pad	Queisser pharma, 24914 Flesnburg, Germany	Paraffin liquidum, cellulose gum, PEG-90M, polyethylene, propyl paraben, birabolol and aroma

Table 1. Denture adhesives selected for the

study.

The testing device included two pulley units with first pulley non-adjustable and second pulley assembled in a vertical rod that was adjustable and clamped on to the table [fig.2].



Figure 2. Two pulley units.

The adjustable vertical rod was fixed at the same level as the subject's occlusal plane, which was kept parallel to the floor. A nylon tension free thread was passed over the pulleys with one end tied to a loading pan and other end engaging a hook, attached to the maxillary denture by self-polymerizing resin [Fig.3].

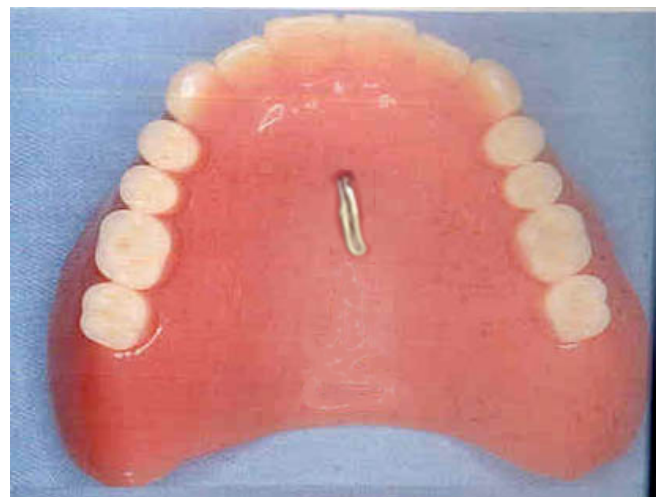


Figure 3. Maxillary denture by self-polymerizing resin.

The hook was attached at the center of the palatal surface of the maxillary denture, determined by a transverse line between the premolar and molar regions of each side, bisected by a midline. [Fig.4]

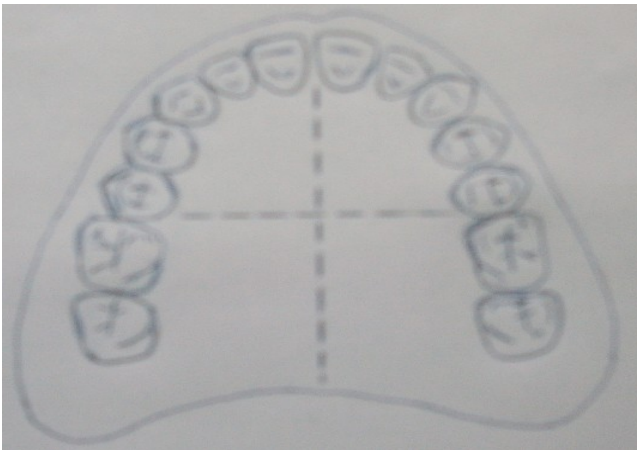


Figure 4. transverse line between the premolar and molar regions of each side, bisected by a vertical midline.

Retention criteria	Stability criteria
No retention- when a denture is seated it gets dislodged by its own weight	No stability- Denture base demonstrates extreme rocking on its supporting structures under pressure
Minimum retention- Denture offers slight resistance to vertical pull.	Some stability- Denture base demonstrates moderate rocking on its supporting structure under pressure
Moderate retention- Denture offers moderate resistance to vertical pull	Sufficient stability- Denture base demonstrates slight or no rocking on its supporting structure under pressure
Good retention- Denture offers maximum resistance to vertical pull	

Table 2. Criteria to determine denture retention and stability.

NO	Interval	Mean	Standard Deviation	t	p
PAIR 1	Test 'A'	158.46	83.55	6.838	<0.000*
	Test 'B' POWDER				
PAIR 2	Test 'A'	204.61	100.30	7.35	<0.000*
	Test 'B' PASTE				
PAIR 3	Test 'A'	346.15	168.45	7.409	<0.000*
	Test 'B' LIQUID				
PAIR 4	Test 'A'	302.31	159.70	6.825	<0.000*
	Test 'B' PAD				

Table 3. Mean and Standard deviation of Test 'A'

and Test 'B'.

All complete denture wearers selected for this study were clinically checked for their denture base fit and occlusal relationship. The subjects whose denture had moderate retention with sufficient stability were selected as per the requirements [Table II]. The major criteria used for selection of the subjects are

1. The subjects should possess no physical disability, which would interfere with the study.
2. The subjects should not have used adhesives previously, and were willing to participate and cooperate throughout the entire study.

The dentures worn by the subjects should not be an inadequate prosthesis, such as, relined dentures, faulty occlusion and repaired dentures. The testing of denture adhesives for each subject were conducted in the following order

Test 'A'- Dislodgement of the maxillary denture without adhesive.

Test 'B'- Immediately after applications of the measured quantity of adhesive.

Test 'C'- One hour after the use of adhesive.

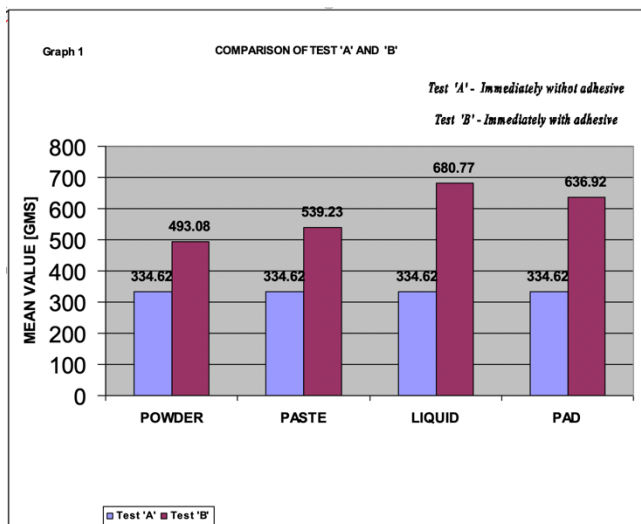
In each test sequence the subjects were comfortably seated under cephalostat in order to stabilize head position and occlusal plane. Weights were added in increments of 10 grams and waited for 30 seconds interval for dislodgement. The weight at which the denture dislodged was recorded for all the three tests. All the three tests for each subject was repeated three times consequently for three days and mean was taken for evaluation. Adhesives were applied as per the instructions given by the manufacturer. Dentures were inserted and held firmly by hand pressure for 5 to 10 seconds. Mandibular dentures were removed since it may disturb the testing procedures.

1. Test 'A'- Initially without applying adhesive. The subjects were asked to wet the palate with their tongue before inserting the maxillary denture.
2. Test 'B'- Immediately after insertion of the denture with adhesive.
3. Test 'C'- Conducted one hour after insertion of the denture with adhesive.

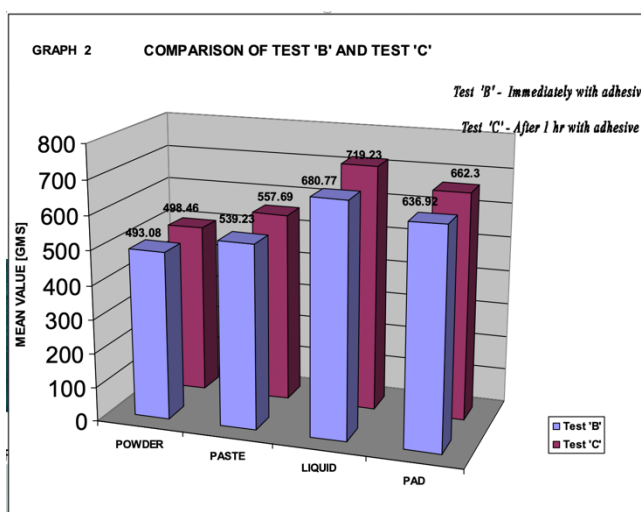
Results

In this study retention values of various

physical forms of denture adhesives were clinically evaluated for powder, paste, liquid and pad. The data in table III illustrate that retention values of test 'B' was significantly higher than test 'A'. The results showed that super korega liquid effected in more retention followed by Protefix pad, fittydent and fittydent powder [Graph 1]. The data in table IV also illustrates that retention value of test 'C' increased slightly when compared with the retention values of test 'B'. The results showed that super korega liquid effected in more retention followed by protefix pad, fittydent paste and fittydent powder [Graph 2]. As per the result it was found that liquid showed increased retention values, which remained maximum for the one-hour study period followed by pad, paste and powder.



Graph 1. The retention results comparison of test A and B.



Graph 2. The retention results comparison of test

B and C.

NO	Interval	Mean	Standard Deviation	t	p
PAIR 1	Test 'B' POWDER	5.38	24.70	0.786	>0.447
	Test 'C' POWDER				
PAIR 2	Test 'B' PASTE	18.46	12.81	5.196	<0.000*
	Test 'C' PASTE				
PAIR 3	Test 'B' LIQUID	38.46	24.44	5.674	<0.000*
	Test 'C' LIQUID				
PAIR 4	Test 'B' PAD	25.38	20.66	4.430	<0.001*
	Test 'C' PAD				

Table 4. Mean and Standard deviation of Test 'B' and Test 'C'.

Discussion

An in vivo investigation to study the efficiency of four physical forms of denture adhesives in maxillary denture retention was undertaken. Reports by Adisman Jagger and Harrison showed that denture adhesives should not be used in ill-fitting dentures^{2, 5}. So dentures that were grossly inadequate in fit and function were not considered for the study. The testing device used in this study was very effective in measuring the retentive values. Ow and Bearn reported that the force used to seat the dentures directly, affect the retention values⁶. Therefore, prior to the testing procedure, the dentures were inserted and held firmly for 5 to 10 seconds.³

The test for retention of dentures was restricted to, immediately and after one hour of the application of the adhesives and not over a period of time, as, the aim of this study was only to evaluate and compare the adhesive property of the material used, and not the changes in retention over a period of time. Mirza et al have reported retention values increase and remain maximum up to a period of one hour after application of adhesives⁷. The retention values of all the adhesives were substantially higher than that of saliva. Previous studies by Mirza, Ow, Koppang, Panagiotouni showed that there was substantial increase in the retention values of adhesives when they were used in combination with saliva⁶⁻⁹.

Good adaptation and intimate contact to

the underlying soft tissue is essential to attain maximum retention. Stan Stamoulis stated that perfect adaptation of denture base to underlying soft tissue is impossible¹⁰. Among the four forms of adhesives used, the retention value was superior in liquid form followed by pad, paste and powder in their order. This can be attributed to the consistency of the liquid, which favored maximum wetting of the denture base and its cohesiveness. Also studies by Usman JA et al showed Vinyl poly siloxane has good dimensional stability when compared with PVS and polyether¹¹. The pad form was 10% less retentive than the liquid form. The pad form does not readily spread to wet the denture base like the liquid form. The pad adheres due to inherent adhesive and cohesive properties of the components.

Paste form was 30% less effective than the liquid form. The uniformity of film thickness obtained is questionable with a high possibility of void formation, resulting in moderate performance. Powder form was least effective among the four forms. This may be because of difficulty to sprinkle uniformly, especially in flange areas, water-soluble ingredients and the physical form, which gets washed off soon in border areas. All the adhesives used in this study improved the retention. But the physical form of the adhesives did play a significant role in their individual performance. Use of denture adhesives improved the retentive strength of complete denture¹². Cream-type denture adhesives have lower initial viscosity and higher adhesive strength than powder type adhesives, which may offer better manipulation properties and greater efficacy during application. These actions markedly increase the retention of complete denture^{13, 14}. The addition of antifungal gel to denture adhesives has been tried but it reduces retentive bond strength of denture adhesives to denture acrylics. However, if an antifungal gel has to be used, then a denture adhesive cushion soft plastic liner may provide a better retentive option than denture adhesive cream¹⁵. Abdulla et al concluded that autopolymerising bis-acrylic material demonstrated significantly improved marginal integrity when compared to PMMA auto polymerizing resin and polyvinyl-ethyl methacrylate resin¹⁶. Elis crystal et al compared pressure absorbability between three type of denture base materials where Biotone was found to be significantly higher in pressure absorbability

compared to TCS and PMMA denture base¹⁷.

Clinical observations: Patients tested in the study were comfortable and were accustomed to the test. Subjects were satisfied with the improvement of retention and preferred to use them after the study. The taste and ease of application of four forms were well accepted by the subjects. The subjects complained about the adherence of the adhesives to the denture base and oral tissues, also difficulty in cleaning liquid and pad adhesives but rated them most effective for retention of dentures.

Clinical implications: Denture adhesives can be advised to patients who need enhanced retention and psychological safety. Adhesive manufacturers should be transparent in their product compositions since the active ingredients like sodium causes hypertension and karaya gum can lead to decalcification of enamel, which predisposes to dental caries.

Conclusions

This study was conducted to assess the efficiency of four physical forms of denture adhesives. The effectiveness of retention was tested initially without adhesives on the maxillary denture, immediately after application of the adhesives and 1 hour after the application of adhesives. Three readings were recorded for each test and the mean values were considered for evaluation. On the basis of analysis and data collected from the study, the following conclusions were made,

1. All the four forms of denture adhesives remarkably improved the denture retention.
2. Liquid adhesive was superior to all other forms of adhesives in their performance, which can be considered as the material of choice for more retention.
3. Pad adhesive was good but less effective than liquid.
4. Paste adhesive rendered moderate improvement in retention.
5. Powder adhesive was least effective in improving retention.

Denture patients should use denture adhesive on the advice of their dentists. They should be educated about its proper use. The manufacturers of denture adhesives should be encouraged to develop more effective adhesives with enhanced denture retention,

easier application, acceptable appearance, non detrimental to taste and conducive to the hygienic care of the denture and underlying tissues.

Declaration of Interest

The authors report no conflict of interest.

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