

An investigation into the effect of denture adhesives on incisal bite force of complete denture wearers using pressure transducers - a clinical study

Pawan Kalra¹, BDS, MDS, Ramesh Nadiger², BDS, MDS, Farhan Khalid Shah^{3*}, BDS, MDS

¹Department of Prosthodontics, Harsarandas Dental College, Ghaziabad, India,

²Department of Prosthodontics, SDM College of Dental Sciences, Dharwad, India,

³Department of Prosthodontics, College of Dentistry, King Khalid University, Abha, Saudi Arabia

PURPOSE. Study was conducted to determine and assess the effect of different type of denture adhesives on the incisal bite force of complete denture wearers until the dislodgement of upper denture, using pressure transducer. **MATERIALS AND METHODS.** 30 patients out of 100 were included in the study. Based on the Kapur's method of scoring denture retention and stability, these patients were divided into 3 groups- Group A - Clinically good dentures; Group B - Clinically fair dentures; and Group C - Clinically poor dentures. A custom made occlusal force meter was constructed based on the load cell type of pressure transducers. Different adhesives (powder, paste and adhesive strips) were used in the study. Complete denture wearers were asked to bite on the load cell and the readings of incisal bite force were recorded. The readings of incisal bite force were subjected to statistical analysis using Repeated measures ANOVA followed by post-hoc bonferroni test. **RESULTS.** The result suggests that denture adhesives improved the incisal bite force of complete denture wearers significantly. The incisal bite force (in kg) in Group A without using adhesives, with powder adhesive, with paste adhesive and with adhesive strips was found to be 2.48 (\pm 0.16), 3.43 (\pm 0.11), 6.01 (\pm 0.11), 3.22 (\pm 0.09) respectively. The incisal bite force (in kg) in Group B without using adhesives, with powder adhesive, with paste adhesive and with adhesive strips was found to be 1.87 (\pm 0.18), 3.35 (\pm 0.14), 5.34 (\pm 0.18), 3.21 (\pm 0.12) respectively. The incisal bite force (in kg) in Group C without using adhesives, with powder adhesive, with paste adhesive and with adhesive strips was found to be 1.00 (\pm 0.17), 3.07 (\pm 0.14), 4.37 (\pm 0.26), 2.99 (\pm 0.14) respectively. **CONCLUSION.** Within the limitations of the study, it was concluded that the use of denture adhesive was found to be significantly effective in improving the incisal bite force of complete dentures until the dislodgement of upper denture. Fittydent paste adhesive was found to be more effective than the powder and strips adhesives. The improvement in incisal bite force was found to be higher in Group C in comparison to that of Group A and Group B. [J Adv Prosthodont 2012;4:97-102]

KEY WORDS: Pressure transducer; Occlusal force meter; Denture adhesive strips; Paste adhesive; Powder adhesive

INTRODUCTION

Residual ridge resorption has been considered a continuous process. The resorption of bone due to complete denture wearing leads to the loosening of the denture in due course of time. Therefore the periodic recall of the patient should be an integral part of the prosthodontic treatment.

Denture adhesives are the products which are easily available over the counter and their usage is very common among the significant number of complete denture patients.

The use of denture adhesives was started in the late 18th century but the dental literature before 19th century shows no ref-

erence to denture adhesives. McKevitt¹ in 1951 mentioned that well-constructed dentures do not require adhesives or any extraneous suction devices. He said that use of denture adhesive indicates our professional shortcomings.

Denture adhesive improves retention, decreases tissue discomfort, prevents strangulation of the mucosal blood supply, and reduces the frequency of adjustments even in a well-fitting denture.^{2,3} Denture adhesives used with ill-fitting dentures reduce mucosal irritation, compression ulcers and patchy inflammation.⁴ Improvements have also been reported in chewing efficiency and bite force, resulting in a greater distribution of occlusal forces over the denture bearing tissues,

Corresponding author: Farhan Khalid Shah

Department of Prosthodontics, College of Dentistry, King Khalid University, Abha, Saudi Arabia

Tel. 966542609929; e-mail, drfarhanshah@yahoo.com

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reducing local pressure points.^{2,4,5} Adhesives provide a cushioning and lubricating effect that reduces friction and mucosal irritation.⁵ Patients with deficits in muscle control, such as hormonal/neurotransmitter changes, myasthenia gravis, muscular dystrophy, dyskinesia, parkinsonian syndromes, or Alzheimer's disease may realize a substantial benefit using denture adhesives.³

Psillakis *et al.*⁶ and Ozcan *et al.*⁷ investigated the effect of a denture adhesive on maximum bite force until denture dislodgment after adhesive application using a disposable gnathometer with a 1-10 scale. They found a significant improvement in bite force until denture dislodgment when adhesive was used.

Earlier studies used the gnathometer to measure the incisal bite force but the units obtained with gnathometers could not be interpreted in terms of Newton or kg, and hence in those studies significant quantification of force could not be done and therefore a direct correlation with previous studies could not be made. Grasso *et al.*⁸ measured the incisal bite force in Newton but they have not considered the effect of different types of adhesives on the incisal bite force. Also the different types of adhesives have not been compared with each other in improving the incisal bite of complete denture. The literature is lacking in clinical studies that enquire into common effects of different type of adhesive along with sufficient quantification of force.

This study was conducted to determine the effect of denture adhesives on incisal bite force until the dislodgement of upper denture of complete denture wearers using pressure transducer, and, to also assess three different types of denture adhesives.

MATERIALS AND METHODS

A custom made occlusal force meter was constructed based on the pressure transducer. The pressure transducer is an instrument which converts the mechanical energy into electrical energy. Load cell type of pressure transducer was used. A load cell is a transducer that converts load acting on it into an analog electrical signal. This conversion is achieved by the physical deformation of strain gauges which are bonded into the load



Fig. 1. Button type of load cell.

cell beam and wired into a Wheatstone bridge configuration. Button type of load cell was used (Fig. 1). Strain gauge is a sensor whose resistance varies with applied force. It converts force, pressure, tension, weight, etc., into a change in electrical resistance which can then be measured. When weight is applied, the strain changes the electrical resistance of the gauges in proportion to the load. The load cell was connected to a digital meter which showed the reading of force when patient bites on the load cell. The readings were shown in kilograms with a resolution of 100 grams.

Materials and Armamentarium used for construction of biting jig

- Self cure acrylic resin (DPI-RR cold cure, Denture base polymer resin)
- Porcelain jar
- Wax knife
- Bard Parker knife
- Bioline White Petroleum jelly

The subjects were recruited conveniently from among the patients wearing complete dentures, who attended the

Table 1. Denture adhesives used in the study

Number	Trade name	Type of denture adhesive	Manufacturer	Composition	Lot number
1	Fixon	Powder	ICPA Health Products	Carboxymethylcellulose Polyvinylmethyl ether	C 07005
2	Fittydent	Paste	Dr Reddy Laboratories	Sodium Carboxymethylcellulose, Polyvinylacetate, Petrolatum	40411
3	Poligrip ComfiSeal Strips	Strips	Stafford-Miller Ltd	PEG-90M, Cera Microcrystallina, Polybutene, Cellulose Gum	633801

Prosthodontic Clinic at SDM College of Dental Sciences and Hospital, Dharwad during the year 2005 - 2007. A total of 100 complete denture wearers participated in the study. The study population was selected based on the inclusion and exclusion criteria of the study. Completely edentulous patients with class I jaw relationship were selected from the patients undergoing complete denture treatment in the department of prosthodontics, SDM College of dental Sciences. All experimental procedures were approved by the Ethical Committee of SDM dental college, Dharwad. Patients with medically compromised conditions, any physical disability, class II and class III jaw relationship were excluded from the study. A total of 100 complete denture patients treated in the department of prosthodontics were screened for the present study. Out of 100 patients, 55 patients were excluded from the study on the basis of exclusion criteria and a total of 45 patients of class I jaw relationship were categorized into 3 groups on the basis of kapur's method for scoring denture retention and stability (Table 4): clinically good denture (11), clinically fair dentures (14), and clinically poor dentures (20). Finally, 10 patients per group (total-30) were included in the study for the purpose of standardization. The powder, paste and strip type of denture adhesives formed the different variables of the study (Table 1). Each subject received a written and oral description of the experimental procedures, and informed consent was obtained prior to enrolment into the study. Prior to the study, study protocol was submitted to the SDM College of Dental Sciences & Hospital, Dharwad. Ethical clearance was thus obtained for the present study. Newly made dentures were rated according to Kapur's method⁹ for scoring denture retention and stability as listed in Table 2 and 3.

The maxillary and mandibular dentures were scored separately for their stability and retention. The sum score of stability and retention of a set of denture determined its clinical rating.

The biting jig, extending from distal surface of lateral incisor of one side of upper denture to that of other side, was constructed with self cure acrylic resin. It was constructed by using dough method. The thickness and width of



Fig. 2. Thickness and width of biting jig were 2 mm and 8 mm respectively.

biting jig were 2 mm and 8 mm respectively (Fig. 2). Patients were asked to wear the complete dentures without applying denture adhesives and bite in centric occlusion for 15 minutes. Then the biting jig was attached to the incisor teeth of upper denture in the mouth of the patient. The load cell was attached to one squarish wooden base at its lower end to prevent damage of sensor. Then the whole assembly was covered with disposable polythene sheets for the purpose of infection control. Patients were asked to bite on the load cell until the upper denture gets dislodged. The maximum reading shown by the occlusal force meter was recorded. The procedure was repeated five times and average of these five values was taken as final reading. Three

Table 4. Clinical rating of dentures based on Kapur's score

Kapur's score	Group	Number of patients
Less than 6	Clinically poor dentures	10
6 - 8	Clinically fair dentures	10
More than 8	Clinically good dentures	10

Table 2. Retention score

Score	Retention	Criteria
0	No retention	When denture is seated in its place, it displaces itself
1	Minimum retention	When a denture offers slight resistance to vertical pull, and little or no resistance to lateral force
2	Moderate retention	When a denture offers moderate resistance to vertical pull, and little or no resistance to lateral force
3	Good retention	When a denture offers maximum resistance to vertical pull, and sufficient resistance to lateral force

Table 3. Stability score

Score	Stability	Criteria
0	No stability	When a denture base demonstrates extreme rocking on its supporting structures under pressure
1	Some stability	When a denture base demonstrates moderate rocking on its supporting structures under pressure
2	Sufficient stability	When a denture base demonstrates slight or no rocking on its supporting structures under pressure

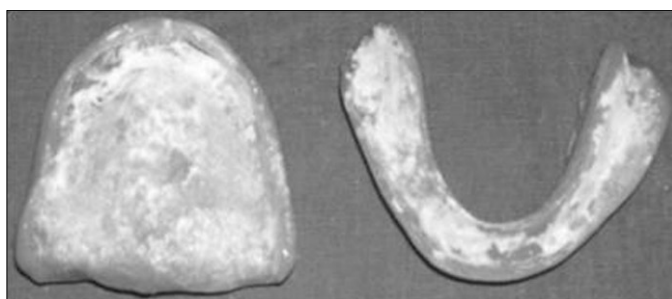


Fig. 3. Application of powder type of denture adhesive.



Fig. 5. Application of adhesive strips on denture surface.

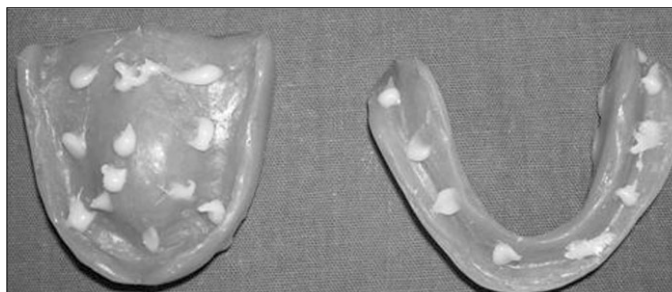


Fig. 4. Application of adhesive paste on denture surface.



Fig. 6. Patient biting on the load cell of pressure transducer system.

types of denture adhesives were used in the study. These were powder, paste and strips types. The powder type of denture adhesive was applied to dentures by sprinkling it on the wet tissue surface of denture as recommended by the manufacturer (Fig. 3). Patients were asked to wear the dentures and to bite in centric occlusion for 15 minutes. Then the load cell of pressure transducer system was placed between the upper and lower incisor teeth and patients were asked to bite on it until the upper denture gets dislodged. The maximum reading shown by the occlusal force meter was recorded. Five readings were taken and the average of these was considered as final reading. The paste and adhesive strips were also applied to dentures as per manufacturer recommendation (Figs. 4, 5) and readings were taken in a similar manner (Fig. 6).

For the inter-group comparison of the final mean of incisal bite force, repeated measures of one way analysis of variance (ANOVA) test was used to evaluate the statistically significant difference among the three different groups with respect to different types of adhesives. For all of the above tests, the level of significance was set at 0.1% ($P < .001$).

RESULTS

The total number of 30 patients were divided into three groups (Group A, B, C) as shown in Table 5 and Fig. 7.

Table 5. Distribution of total number of 30 study subjects between different groups

Study group	Clinical rating	Number of subjects
Group A	Clinically good denture	10
Group B	Clinically fair denture	10
Group C	Clinically poor denture	10
Total		30

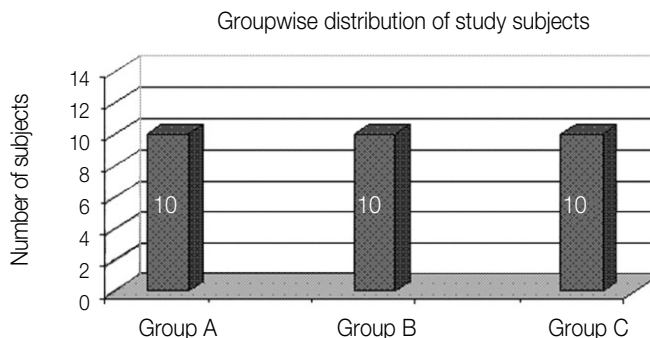


Fig. 7. Groupwise distribution of study subjects.

Mean and Standard deviations of recorded incisal bite force (in kg) of different groups (without using denture adhesives and with application of different types of adhesives) are shown in Table 6 and Fig. 8. From statistical analysis a significant difference was found among the complete denture wearers in different groups without application of adhesives and with application of different types of adhesives (using repeated measures of Anova test followed by post-hoc bonferroni test). Fittydent paste was found to be more effective than powder and adhesive strips in all the three groups.

There was statistically significant difference in the mean incisal bite forces in 4 materials among clinically good, clinically fair and clinically poor denture groups. The mean was significantly higher for paste adhesive followed by powder adhesive, adhesive strips and without adhesive (Similar trend was seen in group A, B, C).

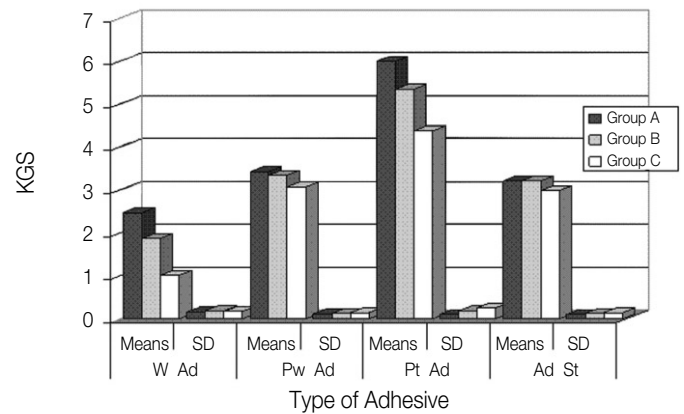


Fig. 8. Comparative representation of means and standard deviations of incisal bite force of different groups with different adhesives (n = 10 in each group, W Ad: without adhesive, Pw Ad: powder adhesive, Pt Ad: paste adhesive, Ad St: adhesive strips, SD: standard deviation)

Table 6. Means and standard deviations of incisal bite force of different groups with different adhesives

Clinical rating		Mean	SD	n	P value	Post-hoc test
Clinically fair denture	Without adhesive (1)	1.87	0.18	10	<.001	3 > 2 > 4 > 1
	Powder adhesive (2)	3.35	0.14	10		
	Paste adhesive (3)	5.34	0.18	10		
	Adhesive strips (4)	3.21	0.12	10		
Clinically good denture	Without adhesive (1)	2.48	0.16	10	<.001	3 > 2 > 4 > 1
	Powder adhesive (2)	3.43	0.12	10		
	Paste adhesive (3)	6.01	0.11	10		
	Adhesive strips (4)	3.22	0.09	10		
Clinically poor denture	Without adhesive (1)	1.01	0.17	10	<.001	3 > 2 > 4 > 1
	Powder adhesive (2)	3.07	0.14	10		
	Paste adhesive (3)	4.37	0.26	10		
	Adhesive strips (4)	2.99	0.14	10		

Repeated measures ANOVA followed by post-hoc bonferroni test.

DISCUSSION

The denture adhesives are mainly used to improve fit, comfort, chewing ability and confidence of the patient. The availability of different types of adhesives necessitates their quantitative and *in vivo* assessments, to aid in the selection of adhesive. The present study showed a statistically significant increase in incisal bite force of the complete denture patients after the application of denture adhesives. Denture adhesives were more effective in improving the incisal bite force of complete denture patients with clinically poor and fair dentures in comparison to that of patients with clinically good dentures. Fittydent paste adhesive was found to be more effective than powder and strips type of adhesive and also, the powder type of denture adhesives were found to be more

effective than strips type of adhesive. The increased effectiveness of Fittydent paste can be explained by the fact that it consists of a sticky material, polyvinylacetate.¹⁰

The adhesive strips were found to be the least effective in improving the incisal bite force of complete dentures in the present study. This finding could be easily explained by the fact that the adhesive strips were recommended to be applied locally by the manufacturers in comparison to the other types of adhesives applied all over the tissue surface of denture base as per their manufacturers recommendation. Fittydent paste adhesive was found to be more effective than powder and strips type of adhesive and also, the powder type of denture adhesives were found to be more effective than strips type of adhesive. These findings are in accordance with the studies by Uysal *et al.*¹¹ and Kulak *et al.*¹²

If all of the clinical and laboratory procedures will be followed properly for the fabrication of the dentures, then there will be no need of denture adhesives, especially in cases of edentulous patients with ideal situations such as high and well formed residual ridges, and repeatable jaw relation. However, the life span of population is increasing and many edentulous patients are suffering from systemic diseases and are not able to reassess the denture treatment immediately. There are many patients who do not have ideal intraoral conditions of good ridges and jaw relations but they expect the degree of retention, which is often not possible to attain, even with accurate denture fabrication procedures. In such conditions, denture adhesives should be recommended to the patients.

There is a possibility of misuse of denture adhesives if the patients continue to wear ill-fitting prosthesis with the adhesives, for a long time. The prolonged use of ill-fitting dentures not only causes trauma to soft tissues, but also accelerates alveolar ridge resorption. Due to neuromuscular adaptation, the prolonged use of ill-fitting dentures is also possible, even without the use of adhesives, wherein the ill-fitting dentures without adhesives can cause more damage to the oral tissues. Hence, the denture adhesives can be an effective adjunct to the complete denture therapy provided that it is prescribed by the dental surgeon along with the proper education of the patient and can become a beneficial part of oral health care for the edentulous patients.

CONCLUSION

Within the limitations of the study, it was concluded that the use of denture adhesive was found to be significantly effective in improving the incisal bite force of complete dentures until the dislodgement of upper denture. Fittydent paste adhesive was found to be the most effective in improving the incisal bite force in comparison to that of fixon powder and Super Poli-Grip adhesive strips. Fixon powder adhesive was found to be more effective

than the Super Poli-Grip adhesive strips. The increase in incisal bite force until denture dislodgment of complete denture with the use of denture adhesive in the clinically Poor denture was found to be higher than that of clinically fair and clinically good dentures. The increase in incisal bite force until denture dislodgment of complete denture with the use of denture adhesive in the clinically fair denture was also found to be higher than that in the clinically good dentures.

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