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A Clinical Study to Compare the Efficacy of Isabgol as a Denture Adhesive When Compared with two Commercially Available Denture Adhesives in Complete Dentures

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ABSTRACT:

Objective: This study was conducted to determine the effect of isabgol as a denture adhesives on the bite force and retention of complete denture wearers and to compare it with two different types of commercially available denture adhesives.

Materials /Methodology: 30 edentulous patients with resorbed ridge were included in the study. isabgol, fixon powder and fittydent powder denture adhesives formed the different variables of the study. Incisal bite force was measured using flexi force sensor whereas retention force was measured using digital force gauge respectively.

Conclusion: The results showed that both the commercially available adhesives and isabgol, significantly improved retention and incisal bite force versus the control values. The mean retention and incisal bite force was significantly more among fitty Dent Powder and isabgol in comparison to fixon.

Key words : isabgol, denture adhesives, incisal bite force, retention

INTRODUCTION

Denture adhesives occupy a very important place in conventional Prosthodontics. Although, they are commonly used and easily available over the counter products, clinicians hesitate to recommend denture adhesives in routine dental practice.

Denture adhesives are classified according to manufacturing types i.e powder, paste, strips, tapes etc. 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.[1,2] Denture adhesives used with ill-fitting dentures reduce mucosal irritation, compression ulcers and patchy inflammation.[3] Improvements have also been reported in chewing efficiency and bite force, resulting in a greater distribution of occlusal forces over the denture bearing tissues, reducing local pressure points.[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.

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Retention in complete dentures is and has always been the most important issue as far as the success of complete dentures is concerned. The situation worsens with advancing age as resorption of residual tissues worsens with age. The role of denture adhesives and their efficacy has been well documented in literature however the problems associated with them have also come into light. Especially, the presence of zinc in denture adhesives has been associated with hyperzincemia which is further characterized by elevation of serum zinc levels and depression of serum copper. The low serum copper levels are further associated with bone marrow depression and widespread sensory and motor neuropathies. Although zinc free formulations are also available however an attempt was made in the present study to evaluate and compare the retentive ability of a commercially available and commonly prescribed laxative (isabgol) versus commercially available denture adhesives.

This study was conducted to determine the effect of isabgol as a denture adhesives on the bite force and retention of complete denture wearers using flexi force sensor and digital force measurement gauge respectively, and to compare it with two different types of commercially available denture adhesives.

MATERIALS AND METHOD

This clinical study was conducted in Department of Prosthodontics, SGT Dental College Gurgaon. A total of 30 completely edentulous patients within the age group of 45-60 years following the inclusion criteria; edentulous patients since last 6 months with no previous denture experience, class 1 jaw relation, resorbed mandibular ridge (low well rounded or depressed i.e order 5 and 6 according to atwoods classification[8]) were selected to participate in the study. Patients suffering from any systemic disorders, patients having class 2 and class 3 jaw relationship, neuromuscular incoordination, tmj disorders were excluded from the study. Each subject received a written and oral description of the experimental procedures, need of follow up visits, time required and written informed consent was obtained prior to enrolment into the study.

ISABGOL, FIXON powder and FITTYDENT powder denture adhesives formed the different variables of the study. As isabgol is available in powder form so for the purpose of standardization only powder type of commercially available denture adhesive were selected and used in the study.

For all the patients included in the study new set of complete denture was fabricated in heat cured acrylic resin (travelon, dentsply india, Mumbai, india) using the conventional technique. Dentures were inserted in the patient's mouth with proper border extensions and the occlusion was verified. All patients were instructed to use the dentures for 4-6 weeks prior to the start of the study, which allowed them to get used to the dentures. At the end of follow up period of 6 weeks, the patients were recalled and the dentures reevaluated for any of the post insertionproblems.

To measure the retention of dentures, the method used by Burns et al. [9] using digital force measurement gauge (Figure :1) (digital force gauge device model 47544, Extech Instruments Corporation) was used in this study, whereas to measure the bite force a custom made occlusal force

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meter (Figure : 2) was constructed based on the concept of flexiforce sensors that consisted of piezoresistive foil layers. The standard sensor consisted of two thin, flexible polyester sheets which had electrically conductive electrodes deposited in varying patterns. The basic transaction method is the change of an element's resistance due to applied pressure. This change can be measured with configuration like a Wheatstone bridge. The element in the most cases is a strain gauge sensor which deflects under loading and strains. 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 flexiforce sensor was connected to a digital meter which showed the reading of force when patient bites. The readings were shown in pounds.

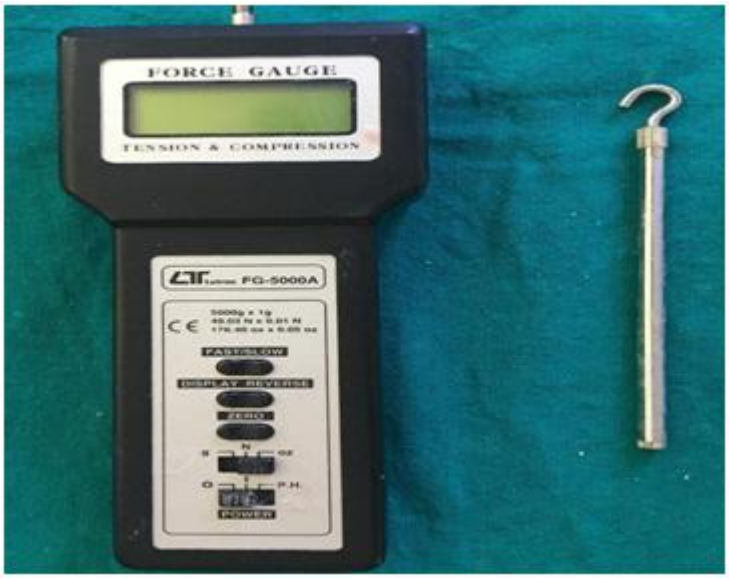

Figure 1 : Digital force measurement gauge

Figure 2 : Custom made occlusal force meter

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Measurement of retention and incisal bite force without denture adhesives (control group): The patient was seated in the dental chair in an upright position with the head resting firmly against the headrest. Patients were made to rinse his/her mouth with water. Dentures were inserted and patient were made to close in centric occlusion for 5 sec. and left in position for 2 min. Patient was asked to rest his tongue passively in the floor of the mouth with its tip adjacent to the anterior denture teeth. A wire loop (0.9mmin diameter) was placed on the geometrical center of the polished lingual surface to which the pull end of the digital force meter (graduated up to 196 N) was attached. (Figure :3) This force was measured in Newton and recorded as the denture's retention. Readings were recorded and the collected data was tabulated to evaluate and compare retention of the dentures.

Figure :3 Hook of the device is engaged in the hook attached to mandibular denture

For the measurement of the bite force, patients were asked to wear the complete dentures without applying denture adhesives and bite in centric occlusion for 15 minutes. The flexiforce sensor assembly was covered with disposable polythene sheets for the purpose of infection control. Patients were asked to bite on the sensor in the anterior region (Figure: 4) until the mandibular denture was dislodged and the maximum reading shown by the occlusal force meter

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was recorded. The procedure was repeated five times and average of these five values was taken as final reading for the bite force.

Figure 4 : Patient asked to bite on the sensor in the anterior region

Standardization for powder and cream denture adhesive:

In order to measure the suitable amount of powder and cream denture adhesive for each case a pilot study was done. The retention force with a definite amount of adhesive was measured, then the amount of adhesive was increased or decreased until the desired retention is achieved and also with minimum amount of denture adhesive.

Measurement of retention force and incisal bite force with denture adhesives:

Patient was seated comfortably, made to rinse his mouth and the denture adhesives (isabgol, fixon powder, and fittydent powder) was applied respectively on the denture (according to the manufacturer instruction) on three successive days and each type of adhesive on separate day and in the standardized amount. Readings were taken for retention force using digital force measurement gauge and for bite force using flexiforce sensor for each type of denture adhesives.

The dentures were cleaned very carefully after each experiment with an aqueous solution of detergent. They were thoroughly washed with distilled water to remove all traces of the adhesive material and then dried with clean absorbent tissue, so that the procedure would be free of any effects between the treatments. Three readings were taken and the average of these was considered as final reading. The order of application of the adhesives was randomized, and all measurements were made by the same investigator.

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Thus, each patient was subjected to four measurements of retention strength and bite force without adhesive (control values), together with three measurements involving each of the two commercial adhesives and isabgol.

RESULTS

In this study, retention capacity and bite force of two commercial adhesives and isabgol were measured. Calculations were made of the arithmetic means of the three retention force and incisal bite force measurements (in pounds) corresponding to each adhesive (isabgol, fittydent and fixon in random sequence) and without adhesive (control values).

The adhesive and bite force performances of the different products were compared. Statistical significance was accepted for $p<0.05$. (Table 1 & 3) shows the mean retention forces (in poundss) and incisal bite force (in pounds) for all four series of measurements (isabgol, fittydent, fixon, and control). Retention and incisal bite force was markedly low in the absence of adhesive (20.07 & 14.93), while the highest values corresponded to fittydent (38.13 & 58.12). The existence of differences among the two commercial adhesives and isabgol was evaluated by analysis of variance (ANOVA) for repeated measures, the retention and incisal bite force of the two commercial products i.e fixon and fittydent were seen to differ significantly ($p<0.001$). Whereas the difference was non significant in relation to retention force and incisal bite force when fittydent and isabgol were compared. Specifically, the best adhesive performance corresponded to fittydent , followed by isabgol and finally fixon.

The nonparametric post hoc bonferroni test for repeated measures was applied (table 2&4) to determine whether the retention and incisal bite force obtained with each commercial adhesive were superior to those recorded in the absence of adhesive. The results showed that both the commercially available adhesives and isabgol, significantly improved retention and incisal bite force versus the control values. The mean retention and incisal bite force was significantly more among fitty Dent Powder and isabgol in comparison to fixon which was significantly more than Control group.

Table 1: Comparative evaluation of mean incisal bite force (Pounds) in mandibular complete denture without using any adhesive, fittydent, fixon and isabgol

	Bite Force				
	Number	Mean	Std. Deviation	F-value	p-value
Control	30	14.93	0.66	2,181.719	< 0.001*
Fitty Dent Powder	30	38.13	1.03		

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Isabgol	30	36.20	0.88		
Fixon	30	27.00	1.98		

One-way ANOVA test *** Significant difference**

Table 2: The inter-group comparison of mean Bite Force was done between Control, Fitty Dent Powder, Isabgol and Fixon using the post-hoc bonferroni test

		Bite Force	
		Mean Difference	p-value
Control	Fitty Dent Powder	-23.20	< 0.001*
Control	Isabgol	-21.27	< 0.001*
Control	Fixon	-12.08	< 0.001*
Fitty Dent Powder	Isabgol	1.93	0.080
Fitty Dent Powder	Fixon	11.13	< 0.001*
Isabgol	Fixon	9.19	< 0.001*

Post-hoc bonferroni test *** Significant difference**

Table 3: Comparative evaluation of mean retention force in mandibular complete denture without using any adhesive (control) , fittydent, fixon and isabgol

	Force Gauze				
	Number	Mean	Std. Deviation	F-value	p-value
Control	30	20.07 N	0.78	414.344	< 0.001*
Fitty Dent Powder	30	58.12 N	1.13		
Isabgol	30	55.59 N	9.57		
Fixon	30	34.07 N	1.38		

One-way ANOVA test *** Significant difference**

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Table 4: The inter-group comparison of mean retention force was done between Control, Fitty Dent Powder, Isabgol and Fixon using the post-hoc bonferroni test

		Force Gauze	
		Mean Difference	p-value
Control	Fitty Dent Powder	-38.05	< 0.001*
Control	Isabgol	-35.52	< 0.001*
Control	Fixon	-14.00	< 0.001*
Fitty Dent Powder	Isabgol	2.54	0.280
Fitty Dent Powder	Fixon	24.05	< 0.001*
Isabgol	Fixon	21.52	< 0.001*

Post-hoc bonferroni test *** Significant difference**

DISCUSSION

The use of dental adhesives began in the XVIII century [10]. These products were prepared by pharmacists who mixed plant gums to produce a material that could absorb the humidity of saliva and swell to form a mucilaginous layer adhering to the oral mucosa and dentures. Dental adhesives are used in prosthodontics to provide a binding layer on the surface of removable complete dentures[10], thus allowing the latter to adhere to the supporting tissues of the edentulous patient. Basically denture adhesives act by increasing the viscosity of saliva and of the interface between the dentures and mucosa, thus facilitating peripheral sealing[11].

Denture adhesives are commercially available nontoxic, soluble materials that when applied to the tissue surface of dentures enhance their retention, stability and performance[10]. Denture adhesives are associated with reduction in movement of complete dentures, improve the fit, comfort and chewing ability of the patients and it is well documented in the literature[10, 11]. Nonretentive, unstable mandibular dentures are generally the most common complaint of denture patients[14]. The possible explanation for this observation could be that the maxillary denture has a larger surface area, and often the ridges were less resorbed when compared with the highly resorbed alveolar ridges in the mandible. Keeping this fact in mind mandibular dentures were used to evaluate the retention and the incisal bite force in the present study.

Denture adhesives are available in powder, paste or strip form. Most commonly it is available in powder form, the adavantage of powdered adhesive is that they are easier to clean and do not ooze. Powder forms were particularly tested in the present study as they were seen to be more readily available over the counter materials and also they were found to be less expensive and more commonly used by denture wearers. Abdulla and Khamas[12] in their study revealed that there is a significant improvement in the retention of mandibular complete denture for flat ridge after using three types' denture adhesives. Denture adhesives start their action immediately and decreased with time. Powder was the most effective denture adhesives than

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cushion and cream

Isabgol or otherwise known as psyllium husk is the portion of the seed of the plant called plantago ovate. Isabgol has a prominent space in ayurveda. It is known for its gentle laxative, cooling and diuretic properties. Also it helps in weight loss, prevention of heart diseases, relieves acidity, promotes digestion and controls diabetes. Isabgol has no taste an odor of its own. It has natural gelatinous substance (mucilage and gelatin) so when it is soaked in water, it swells forming an emollient gel which increases the adhesive and cohesive properties and also eliminates the voids between the denture base and the basal seat which will hold the denture in place.

According to Shay[13] the denture adhesive material swells 50 to 150 percent by volume in the presence of water, filling in spaces between the prosthesis and the tissues. The physical forces are based on a principle derived by Stefan over a century ago, which states that the force required to pull two disks or plates apart is directly proportional to the viscosity of the liquid between them. Saliva increases the viscosity of the adhesive, thereby increasing the force required to separate the prosthesis from the oral surface. Modern adhesives provide strong bio adhesive and cohesive forces via carboxyl groups. Sodium carboxymethylcellulose, or CMC, a naturally derived adhesive ingredient, also is commonly used because of its carboxyl groups.

Although it provides a strong initial hold when used alone, CMC quickly dissolves due to its high level of solubility. Manufacturers introduced products that combined PVM-MA zinc and calcium salts with CMC. These materials provided even greater cohesive strength for longer durations because of the stronger covalent bond that develops via the divalent zinc cation.

The use of denture adhesives is highly recommended with patients seeking for extra retention demands that can't be achieved by the routine protocol of complete denture construction. Denture retention and stability were significantly improved with the use of denture adhesives due to the bond created between the denture base and the underlying supporting tissues.[14]

According to the results obtained in the present study there was a statistically significant increase in the incisal bite force and retentive force of the complete denture after the application of denture adhesives as well as the test material used in the study i.e isabgol (table 2,4) when compared with control group. Tarbet et al in 1981[15] reported the biting force of denture wearers as measured by radio telemetry and gnathodynamometry.[15] The results were similar to the present study i.e when adhesives were used, the patients achieved biting forces similar to those achieved by patients with more satisfactory support tissues. Psillakis et al[6]. and Ozcan et al[7] also investigated the effect of a denture adhesive on maximum bite force until denture dislodgment after adhesive; they also found a significant improvement in bite force until denture dislodgment when adhesive was used..

Fittydent powder was found to be most effective in increasing retentive and bite force when compared with fixon powder and isabgol (table 1 and table 3). The increased effectiveness of Fittydent powder can be explained by the fact that it consists of a sticky material, polyvinylacetate. Fittydent powder showed a almost statistically significant increase in mean

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retentive and bite force when compared with fixon powder (table 2.4) but the difference was not statistically significant when compared with isabgol (table 2,4). When the mean retentive and bite force of isabgol as a adhesive was compared with fittydent and fixon powder it was seen that the values were less than fittydent powder but more than fixon powder and the difference was not statistically significant when compared with fittydent whereas the difference was statistically significant when compared with fixon (table 2, 4). So it can be inferred from the results that isabgol showed excellent retention force and also improved the bite force in complete dentures and can be used as a natural alternative to commercially available denture adhesives. Several disadvantages of commercially available denture adhesive such as bad taste, ingestion of adhesive and zinc toxicity, increased cost and availability will be solved if isabgol is used as a denture adhesive as isabgol is tasteless and odorless, zinc free and is available readily at a very low cost. Also the elderly population is very well versed with the numerous advantages of isabgol and it will be easy for the dentist to convince them to use it as a denture adhesive.

As the life span of population is increasing and many elderly edentulous patients are suffering from systemic diseases such as diabetes, obesity, constipation, blood pressure. Also majority of the patients 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, isabgol as denture adhesives would be highly beneficial and should be recommended to the patients.

Conclusion:

Within the limitation of the study it was concluded that the use of denture adhesive was found to be significantly effective in improving the incisal bite force and retention of complete dentures. Fittydent powder adhesive was found to be the most effective in improving the incisal bite force in comparison to that of fixon powder and isabgol. The mean retentive force in incisal bite force with isabgol was less than fittydent powder but more than fixon powder. So isabgol can be recommended as a denture adhesive in elderly population.

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