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Original Research

Comparative evaluation of effect of denture adhesives on retention of maxillary complete dentures using a digital force gauge-An *in vivo* study

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ABSTRACT:
Successful rehabilitation of a completely edentulous patient using removable complete denture prosthesis depends on an array of factors ; retention being the most important among them. Although most patients having favourable clinical factors are believed to be rehabilitated successfully but at the same time there are some patients especially the geriatric ones and those with associated debilitating diseases where adequate retention is not achievable .In such situations ,denture adhesives are recommended. In the present study a comparative evaluation was done to study the effect of two commonly available denture adhesives (Fixon powder and Fittydent paste) on the retention of maxillary denture bases. The study was conducted on 10 completely edentulous subjects . Maxillary denture base was fabricated for each patient employing the conventional methods of fabrication and a hook was attached to the same for engagement of the measuring device. A DIGITAL FORCE GAUGE (Lutron) was used as the measuring apparatus. Force at which denture base dislodged was recorded and was considered as retentive value. Data obtained were tabulated and subjected to statistical analysed. Intragroup comparison was done using paired *t*-test. Intergroup comparison was done using analysis of variance (ANOVA) .p value <0.05 was considered as statistically significant. Results show that the retention force value of the paste group was the maximum, followed by powder group, and the least retention force value was observed with control group employing no adhesive at all. Within the limitations of the study it can be concluded that the paste form of denture adhesive has the best retentive property compared to the powder.
Keywords: Dental adhesives, digital force gauge, maxillary denture base, retention, complete denture.

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INTRODUCTION

Complete denture fabrication has to satisfy certain basic principles about stress distribution and optimum tissue preservation[1]. Sears[2] clearly stated that these principles are the important factors for justification of what we do and the way we do it. Good retention, stability, and support are the prime requisite for a well-fitting prosthesis[3]. Among them, adequate retention constitutes an elementary tool for satisfying the patient with the complete dentures[4] (Al- Abdulla & Khamas).The Glossary of Prosthodontic terms defines denture retention as ‘‘The resistance of a denture to dislodgement”[5].The retention of complete dentures may be influenced by a number of variables classified by Hardy and Kapur (1958) as physical, physiological, psychological, mechanical, and surgical factors[6]. Patients seeking a prosthetic therapy demand retentive prosthesis irrespective of their oral conditions, which is sometimes difficult to achieve with conventional complete denture therapy [7]. However, protocols for treating completely edentulous patients have improved with time. Overdenture and implant-supported prosthesis are a part of such improvements, which provides patient with more retentive and stable prosthesis[8,9]. But the cost and time requirements for such treatment

protocols are more as compared with conventional complete denture, thus, limiting their use. So, the conventional denture remains the main stay treatment for majority of completely edentulous patients; hence, the problem of poor retention of dentures is prevalent especially in patients where conventional therapy does not suffice the needs. So, many complete denture-wearer patients resort to other means to improve retention such as using denture adhesives, which are available freely over the counter, cheap, easy to use[10]and have the capacity to enhance treatment outcome[11].

''Denture adhesive'' is a commercially available, non toxic, soluble material of sticky nature that can be applied over tissue surface of the denture in order to enhance the quality of denture retention and thereby improving quality of denture stability too[12].They are available in different forms such as powder, paste/cream, foam and strips/wafer[1]. They enhance retention through optimizing interfacial forces by (a) increasing adhesive/cohesive properties and viscosity of the medium lying between denture and supporting tissues and (b) by eliminating voids occurring in the interfacial space[13-16].Use of denture adhesives is recommended for enhancing the quality of retention in conditions such as immediate dentures, single complete denture, maxillofacial prosthesis like obturators and in patient's having poor neuromuscular control, poor ridge anatomy, dry mouth, and jaw relations. It may also be indicated in difficult and demanding patients with poor denture adaptation, and in socially active people such as public attorneys, actors and politicians[1,17]. Many in vivo and in vitro studies, have evaluated specifically the retentive ability and efficacy of different types of denture adhesives both subjectively and objectively, but with varying results[1,17-23]. Of all, objective methods have been proven to be reliable[24] .Though a no of devices have been used in past[1,11,23,25-28] to measure the efficacy of adhesives but most of them are complex and difficult to use.

Therefore, this study aims to evaluate and compare the retentive ability of two denture adhesives, which are commercially and easily available to the patients using a simplified device called digital force gauge.(Fig 1) It is a spring-loaded device that engages onto the hook of the heat polymerized trial denture base and is easy to use and portable. The null hypothesis of this study is there is no effect of any of the 2 types of denture adhesives on the retention of maxillary denture bases.

MATERIALS & METHODS

This study was conducted on 10 completely edentulous subjects in the age group of 50 -60yrs reporting to the outpatient Department of Prosthodontics, crown and bridge, Government dental college, Srinagar. The benefits and drawbacks of the study were explained to the patients and upon signing an informed consent the patients were recruited for the study after fulfilling inclusion and exclusion criteria. Inclusion criteria for the study were - completely edentulous patients, having well-formed ridges, without any undercut requiring surgical correction, with no history of craniomandibular dysfunction or medical condition , healthy mucosa and exclusion criteria included patients with— xerostomia, flabby ridges, poor neuromuscular conditions, palatal defects, unco-operative patients). Permission from the Institutional Ethics Committee, was obtained.

Two denture adhesives (a powder one, and a paste one)were used in the study. In this study, a digital force gauge was used for recording the retentive values of different adhesives which works on the basic principle stated by Skinner and Chung[25], and is easy to use, and portable device. It was planned to check retentive force on maxillary denture bases for each patient utilising single base for recording the retentive value of both adhesives. Routine materials and standard techniques were used for the fabrication of denture bases used in this study. Preliminary and final impressions were made for the selected subjects used in this study and casts were fabricated. Prefabricated stainless steel hooks(1.5cm in dia)(Fig 2) were attached to anterior palatal region of the waxed up bases approximately corresponding to a line joining the distal surfaces of cuspids. The casts with waxed-up bases were flasked, and processed in a curing unit. After they had been processed, the denture bases were carefully finished and polished. The denture bases was stored in water at room temperature before testing for retention. Before testing the denture base for retention, the patients were trained to tell, when the denture base gets loose. Cephalostat was used for the stabilization of Patient's head. Following two denture adhesives were used in the study, Fixon supergrip powder (ICPA, Mumbai); Fittydent paste (Dr. Reddy's Lab. Ltd., Hyde. The denture base without any adhesive was the control group, same denture base with Fixon powder was group I, & group II was denture base with Fittydent paste .Each group was tested in 10 patients by placing the denture base in the mouth for 3 min, respectively, after which the dislodgement of the denture base was tested . A digital force gauge (graduated up to 5000gm) was used to record the retentive values in each group. The hook of the gauge engaged the wire loop & a vertical downward force was applied to dislodge each trial denture base. (Fig 3,4)The value at which dislodgement of denture base took place was considered as retentive value. The retention values of the control group and the two test groups of all the subjects were tabulated and subjected to statistical analysis.

For the powder form, denture base was wetted and Fixon powder was sprinkled over the impression surface of the denture base, for the paste form, the denture base was dried and bead size of Fittydent paste was applied on the incisor, molar and mid-

palatine region .Both the denture adhesives were tested for retention on the same day.

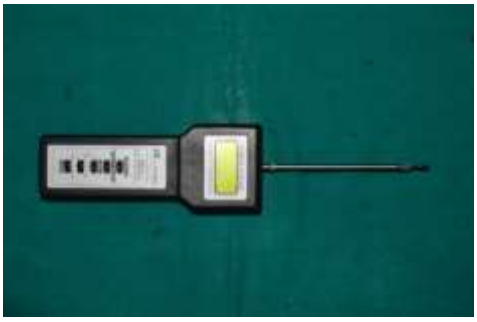


Fig 1

Fig 2

Fig 3

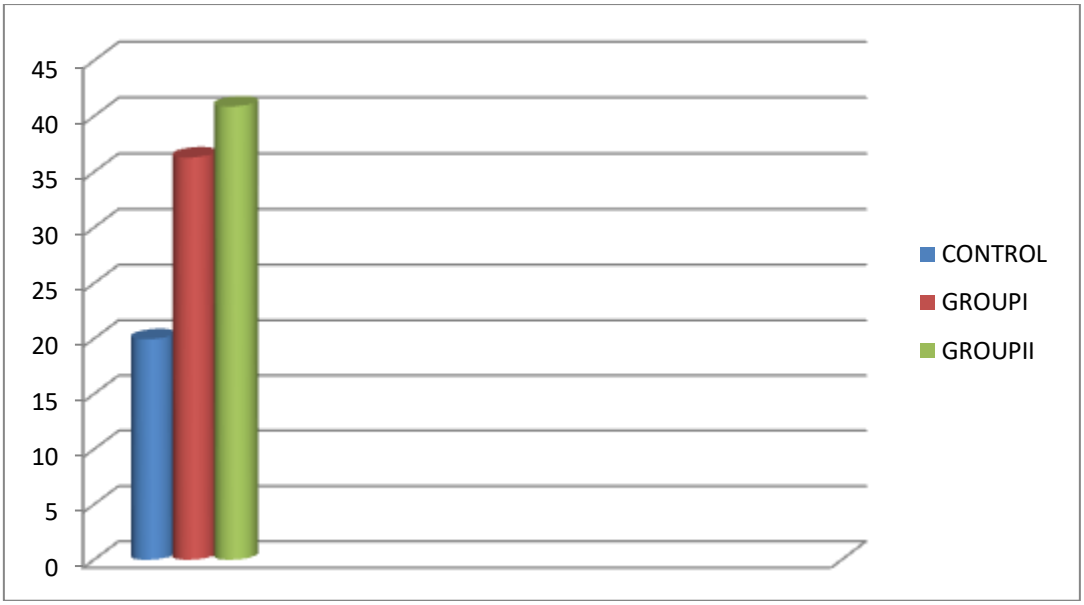
Fig 4

RESULTS

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Data was presented as Mean±SD. The data was explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests of normality. The data showed a normal distribution and hence analysis of variance (ANOVA) was employed for comparing various groups. Graphically the data was presented by bar diagram. A P-value of less than 0.05 was considered statistically significant. Table 1 shows descriptive statistics of all the groups in which the mean retention force for control group was 19.96N, Group I was 36.31N,& Group II was40.89N. Table 2 shows the one way ANOVA statistics in which a highly statistical significance among all the groups($p < 0.00001$) was found. Graph 1 shows the comparison between all the groups in which Group II (paste form) shows the highest mean retention force value and the control group shows the lowest mean retention force value.

TABLE 1: Descriptive Statistics

GROUPS	N	Mean(Newtons)	SD	Min	Max
CONTROL Group(denture base without adhesive)	10	19.96	2.514	16.6	25.6
Group I(denture base with fixon powder)	10	36.31	2.534	32.5	39
Group II(denture base with fittydent paste)	10	40.89	1.614	37.5	42.5



GRAPH 1

	TABLE 2: Summary statistics of one way ANOVA				
Source of variation	**Sum of squares**	**df**	**Mean square**	**F value**	**P value**
Between groups	2421.2127	2	1210.6063	236.5458	<0.00001
Within group	138.182	27	5.1179		
Total	2559.3947	29			

DISCUSSION

Successful rehabilitation of edentulous patient depends upon a well-fitting prosthesis, which not only provides function and esthetics, but also instils psychological confidence to the patient[28]. These goals can be achieved by thorough understanding of the patient, through clinical examination, meticulous planning with preparation of patient and executing perfect craftsmanship[1].Situations like severely resorbed alveolar ridge covered by abused tissues pose a serious threat of inadequate retention, and thus demands the use of an alternative mechanism to encounter such adverse situations. Search in literature has revealed the use of mechanical devices viz. Wires, Springs, Suction discs, Suction chambers, use of Magnets and Undercuts for providing required retention to prosthesis. These devices increases the retention but further complicate the situation by causing damage to the tissues of the foundation[23].

Denture adhesives also known as fixatives or adherents are commercially available products, which have been used as an aid for the improvement of retention and stability of complete dentures[28] and serve as acceptable solution to meet the challenges of retention in such patients[1]. The main components of denture adhesives are either vegetable gum or synthetic polymer as carboxymethyl cellulose and polyvinyl methyl ether maleate. As the adhesive absorbs water and the carboxymethyl cellulose comes in contact with the saliva, the hydrate material (free carboxyl groups) is formed and swells greater than their original volume, thereby excluding air between denture bases and bearing tissue. The hydrate material sticks to the fitting surface of the denture and oral mucosa and increases the viscosity of the saliva. These actions increase the retention of complete dentures[29]. With so many choices of denture adhesives available, selection of adhesive is based on certain attributes like it should have longer duration of action and should be non-toxic, odor free, tasteless, easy to use, economic, biocompatible, and easily available[8,9,30].

Two denture adhesives were investigated in present study out of which one were in powder form (Fixon Supergrip), and one were in paste form Fittydent). The reason of choice was easy availability, cost effectiveness, biocompatibility, and ease of use. Numerous studies have been done to evaluate retention objectively, subjectively or by combination of both, but advantage of objective study is that it is free from influence of patient's perception. Also, in vivo study has an advantage over in vitro study for being clinically more relevant[28]. Hence, present in vivo study was designed to evaluate the retention objectively in the form of force required to dislodge the denture using testing apparatus based on the

principle given by Skinner and Chung[25]. Digital force gauge (Lutron FG 5000 A) with 3 types of display units: gram, Newton and ounce was used in this study. It had a measure capacity of 5000 g/176.40 oz. /49.03 Newton and overload capacity of 7000 g, high resolution, & high accuracy.

In the present study, the retention of well-fitting maxillary denture bases was evaluated . Kumar & Thombare[1] and Pachore et al[23] also used only the denture bases for evaluation of retentive ability of the denture adhesives. However Kapur and Salman [31] used complete dentures. Uniformity of the thickness of the denture bases was achieved by using one sheet thickness of baseplate wax and the monomer: polymer ratio was taken as per manufacturer's instructions, overnight bench curing was done, processed using long curing cycle, overnight bench cooling was done before retrieval of the denture bases. Denture bases for all the patients were constructed using heat-cure acrylic resin hence, material of the denture bases were same for all patients. Force was applied at the anterior region of palate .The reason for this alteration was that a more anterior positioning would ensure a force that was directed perpendicular to the denture base as opposed to oblique forces generated when the geometrical center was used for attachment of loop. This was to ensure adherence to the principles/definition of retention.[32] In the present study the mean retention force value was the maximum in group II—40.89N followed by group I 36.31N. Least retention force was observed with the control group -19.96 N.Results of the present study revealed that both forms of denre adhesives (powder and paste) showed improved retention values in comparison to that of without adhesives This is in accordance with Kumar and Thombare[1] , Chowdhry et al[17],Salman and Ibrahim[18,] Pachore[23] et al, Chhabra[28] et al, Panagiotouni et al[33] & Ghani and Picton[34]. The paste form (Fittydent) of denture adhesive enjoys superiority over the powder form as reflected by the higher values of retention by almost double as observed in this study. It is in confirmation with earlier research conducted by Chew[35] . In vivo study conducted by Kumar and Thombare[1] ,Pachore[23] etal also found that the paste form is more retentive compared to the powder form of denture adhesives which is also seen in the present study. Intergroup analysis showed that there was a statistically significant difference in retentive ability of all denture adhesives ($p < 0.05$). This is in accordance studies done by Kumar and Thombare[1], Chowdhry et al[17,] Pachore [23]et al, and Berg et al[36] where paste form of denture adhesives performed better compared with the powder form as the powder form dissolves in saliva and loses its effectiveness with time while paste form has an oily medium, which does not dissolve easily in saliva. Results were in contrary to Salman and Ibrahim[18],& Chhabra etal[28] who showed that there was no statistically significant difference in retentive ability of all denture adhesives at all time intervals.

Variation in the results of present study from other studies may be due to difference in testing apparatus, study design, difference in brands of denture adhesives used. Thus, from the present study, it is suggested that denture adhesives can be prescribed to the patients to enhance denture retention irrespective of their form. However the patients must be warned about the 'use and misuse', and 'do's and don'ts' related with the applications of denture adhesives to enjoy best possible results without threatening the health of oral tissues.

CONCLUSION

The value of retention obtained with adhesives was more than double as compared to dentures used without adhesives. The paste form have established its superiority over powder form of denture adhesives . The reason for the paste form being more retentive can be due to its viscosity.

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