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The Efficiency of Various Denture Adhesive Materials in the Retention of Mandibular Dentures: An In-Vivo Study

[1]Dr. Rajeev Srivastava,[2]Dr. Naman Agarwal,[3]Dr. Vandana Sharma,
[4]Dr. Sonu Solanki, [5]Dr. Prashanthi Reddy
[1]Director PG Studies Professor and Head,[3,5]Reader,[4]Postgraduate Student,
[1]Department of Prosthodontics, Crown &Bridge and Implantology,
Index institute of dental sciences, Indore, Madhya Pradesh, India,
[2]Modern Dental College and Research Centre,
[3]Darshan Dental College and Hospital Loyara, Rajasthan,
[4]Index Institute of Dental Sciences, Indore,
[5]Government College of Dentistry, Indore

***Corresponding Author:**
Dr. Rajeev Srivastava
Index Institute Of Dental Sciences, Indore, Madhya Pradesh, India

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Abstract

Background: The study was intended to compare and assess the amount of retention of mandibular dentures with the three commonly used adhesives and without adhesive.

Materials and Methodology: 25 edentulous patients got treated with a complete denture utilizing a standard protocol. The dislodgement resistances of mandibular dentures were measured in simulated functional motions using a Digitalized weighing machine. Following consecutive periods of 2 weeks of use of a randomly assigned denture. The outcome metrics were originally evaluated without the adhesive and then retention evaluated with three different adhesives used in the study which are available in the form of cream and with different formulations in all the three cases: A) Fixon (ICPA health products Ltd) B) Denofit (Global Dent Aids Pvt Ltd New Delhi) C) Secure (Group pharmaceuticals Ltd Mumbai) available denture adhesives.

Outcome:24 patients (aged: 58 years) have been included in this study. The result of the gnathometer showed a major differences between the non-adhesive group and the two experimental (P = .008) and the control adhesive groups (P = .021). Differences among the two adhesive groups were not significant (P = .161).

The outcome of dynamometer showed a very significant difference among the maxillary and mandibular dentures in the non-adhesive group and the two adhesive groups ($P \leq .0001$). Similarly, major differences were noted when one of the adhesive groups was compared to the non-adhesive group (P = .0001). Subjective assessment of patients was very favorable for both adhesives.

Conclusions: This study confirms the expected and anticipated improvement in the stability and retention of well-adjusted complete prosthesis with application of auxiliary adhesives. The observed and documented improvements in new adhesive as compared to the conventional adhesives were not statistically significant.

Keywords: Retention, mandibular denture, Denture adhesive, digitalized weighing scale

INTRODUCTION

Retention and stability are the most important factors which decide the final result of the complete denture treatment. As the primary problem posed through complete dentures is retention and stability of the mandibular dentures. To resolve this problem, dentists and the dental enterprise for a long time have

tried to improve the adhesion of the denture through growing an extensive variety of "glues" of different compositions and efficacy.

Denture prosthetic Adhesives are generally composed of rubber, pectins, methylcellulose, hydroxyl-methylcellulose, carboxyl methylcellulose, sodium-cellulose, and synthetic polymers that improve the denture guide each through mechanical and physicochemical mechanisms. Additional compounds of their composition may also encompass antimicrobial agents, additives, colorings, and preservatives. They were advertised in numerous paperwork consisting of powders, pastes, creams, strips, as well as so-called adhesive cushions. (1)

Their mechanism of action is involves increasing the contact between the tissues and the denture and forming a retentive pressure among the oral mucosa and the denture through an intermediary film composed of a combination of the adhesive, saliva, and other oral fluids. (2)

A survey of elderly patients confirmed that 66% were disillusioned with their complete dentures. The main cause for dissatisfaction turned into discomfort, bad fit, retention, soreness, and pain, especially with mandibular dentures. (3)

Numerous literatures describe the use of various sophisticated methodology for testing the persistent contribution of adhesives to denture stability. (4)

Majority shows improvements with maxillary dentures. (4), (5), (6), (7) however mandibular ones lack similar information. Moreover, the latter subject ought to additionally be assessed because it has a profound effect on superior residual ridge reduction in long-established mandibular edentulism.

The in vivo clinical study assesses the efficacy of different denture adhesives used for enhancing retention of the mandibular, and are they truly effective and capable of increasing the adhesion of the prosthesis on the mucosa protecting the edentulous alveolar ridge. Retention turned into measured with the assist of the digitalized measuring device and a statistical evaluation was done to figure out which of three commercial complete denture adhesives offer the best retention.

Aim

To assess efficacy of different denture adhesive materials in the retention of complete dentures

Objective

To evaluate retention of conventional complete mandibular denture

To evaluate the retention of mandibular complete denture using Fixon, Denofit, and Secure denture adhesive.

To determine which of the three commercially available products offers the best retention.

Materials And Methodology

Twenty- five patients with mandibular dentures were selected from among those who wished to receive prosthodontic treatment in the Department of Prosthodontics and that fulfilled the inclusion standards of the study. The criteria to be included were as follows: (1) completely edentulous in each arch for at least 1-year before the study's initiation, (2) no preceding records of using denture adhesives, (3) demonstrating appropriate recognition of complete denture treatment after a standard period of adaptation and adjustment, (4) absence of systemic health issues that would prevent attendance at clinical trial appointments, (5) no history of allergic sensitiveness to any component of the adhesive material, and (6) complete compliance with study protocol and objectives, as approved by an ethical committee for informed consent.

Prior to the commencing the study, each patient had a new set of complete dentures manufactured under the same protocol. This protocol consists of the making of anatomic and final impressions by following principles of impression making. The Jaw relation was recorded with a face bow and transferred to a semi-adjustable articulator (Hanau- Vue 183) with an individualized adjustment and a bilateral balanced occlusal scheme was established. The denture was fabricated by following the steps for denture fabrication. Once manufactured, the dentures had been examined on the patients for precision and adjustment. Patients were asked to wear them for 4 weeks to enable the dentures to get adjusted and achieve a proper fit. After this period and once the foresight of any lesion or injury in the mucosa was ruled out and then patients were enrolled in the experimental portion of the study.

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Three commercially available denture adhesives used in the study were provided as cream and with different formulations in all three cases: A) Fixon (ICPA health products Ltd) B) Denofit (Global Dent Aids Pvt Ltd New Delhi) C) Secure (Group pharmaceuticals Ltd Mumbai). (Fig.1)

Quantification of adhesive-free retention has also been carried out as the control. For each patient reading for retention were recorded without adhesive and with all three adhesives. A device was made for checking the retention, consisting of two rods of stainless steel with a vertical arm measuring about 4feet 9 inches, and a horizontal arm was attached to it measuring 1 foot 9 inches. Two small pulleys were attached to the horizontal arm one in the anterior and posterior region respectively. A digitalized weighing machine was attached to the posterior part of the horizontal rod with a wire passing over the pulley. (Fig 2)

On the anterior end, the wire was attached to the patient's lower denture to U shaped hook that was attached to the middle of the mandibular denture using self-cured acrylic resin. (Fig 3).

DIGITALIZED WEIGHING MACHINE the dentures had been then placed into the mouth and finger pressure was applied on the lower denture for one minute. Once this retention force (in grams) has been recorded by pulling the digitalized weighing machine. (Fig 4). This process has been repeated thrice for each product, with no additional quantities of adhesive added and one minute following each measurement. The same quantity of adhesive was used in every test, distributing the material in three equivalent portions in the anterior and lateral zones, in compliance with the instructions of the manufacturers (Fig. 5). After completing the study with each adhesive, the dentures were thoroughly cleaned using the means recommended by the manufacturers, to eliminate any accumulated effects between materials. The same process was subsequently repeated with the following product. Thus, every patient was subdued to three measurements of retention strength without adhesive (control values), and again with adhesive in the same patient.

Result

The enrolled patients (n= 25) had attended all visits and the retention was recorded. Arithmetic averages of the three retention force measurements (in grams) corresponding to each adhesive (Fixon, Denofit, Secure) and without adhesive (control values) were calculated. Comparison for retention was done between the selected adhesives, and the effects of the implementation sequence was assessed.

The statistical significance has been acknowledged for $p<0.00$, shows the mean retention forces and standard deviation (in grams) for all four series of measurements (Fixon, Denofit, Secure, and control).

Retention obtained without any adhesive was found to be less (396.80 ±260.188 g), while the highest value was observed with Secure (1038.40±440.281 g). Table 1

The nonparametric Wilcoxon test for repeated measures was applied to determine whether the retentions obtained with each commercial adhesive were superior to those recorded in the absence of adhesive. The results showed that all the adhesives, regardless of the commercial brand involved, significantly improved retention versus the control values. Table 2

One-way ANOVA was used for repeated measurements (since the data showed a normal distribution), taking into account the brand and order of application. The mean retention values recorded for each commercial adhesive were considered to be independent of the adhesive application order, i.e., no order or sequencing was observed. The adhesive performances of the three commercial products were seen to differ significantly ($p<0.00$) and the best retention was achieved with Secure followed by Denofit and Fixon.

Discussion

The properly designed and well fabricated complete denture satisfies the request for aesthetics, phonetics, and function. These goals can be achieved by understanding the need of the patient, through clinical examination, meticulous planning. To provide desired optimal retention, it is necessary to have a maximally stable denture and incomplete denture physical factors attribute for adequate retention of the prosthesis. Zarb GA (1990)(1) discussed several factors that account for retention for complete dentures, including the adhesion,

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interfacial surface tension, capillary action, atmospheric tension, and oral-facial musculature. All these factors do not act at the same time instead some act only when needed to meet or resist a certain dislodging force. These factors along with appropriate fabrication of complete dentures combine to retain the denture. Boucher CO (1) had also emphasized the factors suggested by Brill N (1967) which should be incorporated while making of impression: (I) Maximum area of coverage, (ii) Intimacy of contacts of denture base with the tissue, and iii) Eliminating the effect of fulcrum by way of providing relief at the center of the palate but in severely resorbed alveolar ridges there's a problem with inadequate retention, and thus demands the use of an alternative mechanism to encounter such adverse situations. Many methods have been described in the literature for enhancing retention-use of mechanical devices Wires, Springs Suction discs, and Suction chambers, use of Magnets and Undercuts for providing required retention to prosthesis. The above devices increase the retention but complicate the situation by causing further damage to the tissues of the foundation. Therefore, denture adhesives being commercially available which are non-toxic, soluble material of sticky nature and having the ability to hold a denture in position has emerged as an acceptable solution to meet the challenges of retention in such patients (8).

Commercial denture adhesives are the products that can improve the outcome of treatment and have advantages for the patients when are used correctly and are available in various forms like powder adhesives, adhesive paste, and strips adhesive. Kalra P et al reported that the paste type of denture adhesives was the most effective in improving incisal force, followed by powder and strip adhesives. (9), (10) so, therefore in this study we have used the different paste adhesives for evaluating the retention. However, the major components of paste denture adhesive are carboxymethylcellulose and a polyvinyl group. The carboxymethylcellulose starts its effect immediately after the application of the denture adhesive. Over time, the long-acting polyvinyl group hydrates and increases adherence and viscosity as well show the molecular cross-linking leading to a measurable increase in adhesive behavior. There are many studies considering both the ridges and just the maxillary ridge for recording retention. (4), (6), (5), (7), (8), (11), (12). Nevertheless, only a few studies have considered mandibular ridges.

(13), (14) and as mandibular ridge shows more resorption with time and there is the problem of inadequate retention seen with it. (3) Therefore, in this study the mandibular prostheses were used because usually the greatest retention issues arise. Patients were included regardless of duration during which the dentures were worn, or of their quality since the study protocol envisaged repeated measurements in one same patient and involving the same dentures.

Psillakis J J. et al in (2004) (7) carried out a mixed study using a gnathometer to measure the force required for detachment of the dentures, and administering a subjective patient questionnaire to evaluate chewing, comfort and confidence. Manes et al in 2001 (13) have done a similar study but have used spring scale for recording retention and Koronis et al (14) have evaluated retention values in questionnaire form but the present study has recorded retention values with the help of digitalized weighing scale which gives more accurate values and hasn't used by any of the studies.

Retention obtained in the absence of adhesive was found to be less (396.80 ±260.188 g), while the highest value was observed with Secure (1038.40±440.281 g). Papadiochou et al (9) summarized a similar result stating denture adhesives increase retention. The nonparametric Wilcoxon test for repeated measurements was applied to determine whether the retentions obtained with each commercial adhesive were higher than those recorded in the absence of adhesive. We recorded a 3- fold increase in retention strength with adhesive. The findings showed that all the adhesives, regardless of the trade mark involved, significantly improved retention over control values. One-way Analysis of Variance was used for repeated measurements (since the data showed a normal distribution), that considered the brand and order of application. The average retention values recorded for each commercial adhesive were considered to be independent of the order of adhesive application, that is, no order or sequential effect was observed. All three trade products showed significant differences ($p<0.00$) and most effective retention was achieved with Secure followed by Denofit and Fixon. It can be

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expected that this retention strength will diminish over time as the saliva gradually dissolves the adhesive material. (13) A significant increase in retentive strength was seen after implementing the denture adhesive.

Conclusion

According to the terms of this study, the following conclusions can be drawn:

Substantially increased retention of prostheses was seen with the application of denture adhesives cream in the complete mandibular prosthesis.

Of the three commercially available denture adhesives used as part of this study, best retention monitored with Secure follow-up by Denofit, and finally Fixon.

As a prosthodontist, it is our responsibility to be knowledgeable and caring enough to assist each patient in adapting to the dental prosthesis. It is through knowledge of the attributes and limitations of this product that the dental profession can better guide patients in the management of their prostheses.

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Tables

Table 1: Shows the values of retention and standard deviation (in grams) for all 4 ranges of readings (Fixon, Denofit, Secure, and control).

Denture adhesives	N	Mean±± SD	Friedman ANOVA test
Without adhesive	25	396.80 ±260.188	P= 0.00
Fixon	25	581.60± 317.906	
Denofit	25	718.00± 344.275	
Secure	25	1038.40±440.281	

Table 2: Depicts the p- value of the groups by applying the wilcoxon test.

Denture adhesive	N	Wilcoxon Test
Fixon - Control	25	P= 0.00
Denofit - Control	25	
Secure - Fixon	25	
Secure - Denofit	25	

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Figure 1: Denture adhesives used in the study

Figure 2: Position of the patient for recording retention

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Figure 3: The maximum retention force being registered by the Digitalized Weighing Machine

Figure 4: shows the placement of hook attached to denture.

Figure 5: The same amount of adhesive was used in all tests.

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