



## EFFECT OF DENTURE CUSHION ADHESIVES AND A LINER ON RETENTION AND MASTICATORY EFFICIENCY IN COMPLETE DENTURE WEARERS

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### ABSTRACT

**Objective:** The aim of this study is to evaluate three denture adhesives in retention and masticatory efficiency in edentulous patients wearing complete maxillary and mandibular dentures. **Subjects and Methods:** Thirteen completely edentulous patients were selected from the Outpatient Clinic of the Prosthodontic Department; Faculty of Dental medicine, Al Azhar University. Three complete denture adhesive types (Fitty dent cushion, Protefix cream and Mucopren liner) were used. A digital force meter was used to objectively measure retention strength afforded in grams. Chewing efficiency measured by chewing gum. **Results:** measurement showed significant difference in dentures retention. Improvement of the chewing ability was observed by the using of different adhesive types and there was significant difference between the different adhesives. The direct measurement of dentures retention showed that a significant improvement in dentures retention was observed when the cream type, liner type, or cushion type denture adhesive was used. And that Protefix cream offers the best retention performance, followed by Fitty dent cushion, and finally Mucopren liner offers the lowest retention performance. **Conclusion:** The clinical value of a denture adhesive relates to improvement of function and its effect on the underlying tissue health. There is sufficient information to support the use of denture adhesives to increase denture retention, stability, and incisive ability for ill, fair, and well-fitting prostheses. Also, the use of adhesive creams significantly increased the denture retention.

**KEYWORDS:** Retention; complete dentures; dentures adhesives; masticatory efficiency

### INTRODUCTION

One of the major issues in dentistry is the rehabilitation of individuals who are entirely edentulous. Despite the increased use of implants, the most well-known method of treating edentulousness remains the use of a traditional complete denture <sup>(1)</sup>.

Unfortunately, studies have revealed that edentulism and traditional full denture therapy have

a detrimental influence on dental health quality of life. Poor fit dentures are one of the most aggravating aspects of full dentures. Despite the fact that highly advanced prosthodontics procedures have been proposed to address this issue, individuals with impaired physiological and/or anatomical retention factors continue to pose a barrier to traditional full dentures <sup>(2)</sup>.

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Dentists and the dentistry industry have tried for a long time to enhance denture adherence by producing a variety of prosthetic denture adhesives with widely varying compositions and effectiveness<sup>(3)</sup>.

They can be successfully used as a simple, convenient alternative approach to implant assisted prosthesis due to their positive impact on denture retention and stability. Simply put, they can help the patient retain his or her quality of life. Denture wearers who use adhesives masticate in a comparable way to those who have real teeth, according to research<sup>(4)</sup>.

Denture adhesives bridge gaps created by bone shrinkage and provide temporary comfort from loosening dentures. Added to that, the use of denture adhesives becomes compulsory for the improvement of function in other situations such as severely atrophic edentulous ridges, abused or hypertrophied tissue covering the denture foundation, changes in saliva quality or quantity due to medications or age and patients having lack of neuromuscular control as in stroke and Parkinsonism<sup>(5)</sup>.

Denture adhesive is a commercially available substance that is used to attach a denture to the oral mucosa, improving retention and stability while preventing food entrapment. Adhesive agents such as carboxymethyl cellulose (CMC) and polyvinyl methyl ether/maleic acid (PVM-MA), antimicrobial agents, and plasticizing or flavoring agents are all common components in denture adhesives<sup>(6)</sup>.

There are two types of denture adhesives: soluble and insoluble denture adhesives. Soluble denture adhesives come in a variety of forms, including cream, paste, gel, and powder. The active components are polymer salts, which may expand and become viscous in the presence of water or saliva<sup>(7)</sup>.

Because of its cushioning effect and capacity to disperse masticatory pressures transferred to the denture bearing region, denture soft liners play an important role in removable prosthodontics<sup>(8)</sup>.

Several research has been carried out to see how effective denture adhesives are in improving denture retention and masticatory effectiveness.

A research looked at the clinical effects of four denture adhesives on retention, retention length, chewing ability, and other oral functions<sup>(9)</sup>. In 194 individuals, the function of maxillary dentures was tested with and without denture adhesive. They tested the impact of denture adhesive on speaking, chewing, fitness, and self-confidence using a basic gnathometer<sup>(10)</sup>.

In a study of 30 edentulous individuals, three kinds of denture adhesive were tested. Some factors were used in their research, including retention, chewing efficiency, self-confidence, denture movement, and compliance<sup>(11)</sup>. Their findings revealed that denture adhesive enhanced denture retention and stability, convenience, and self-confidence, as well as reducing denture movement when chewing<sup>(12)</sup>.

The motivation behind this examination was to assess and look at three different forms of denture adhesives as respects to direct measurement of denture retention and masticatory efficiency.

## **SUBJECTS AND METHODS**

### **Sample Size:**

A sample size of 13 patients in each group were used.

### **Patient selection:**

Thirteen completely edentulous patients, were selected from the Outpatient Clinic of the Prosthodontic Department; Faculty of Dental medicine, Al Azhar University. The patients were educated by all techniques of our study. Only motivated patients who showed co-operation participated in the study and an informed consent will be assigned, also approval of REC (Research Ethic Committee) of the Faculty of Dental Medicine Al Azhar University for Boys obtained under reference 403/116.

### The selection of the patient according to the following criteria:

#### **Inclusion criteria:**

All patients were free from any systemic disease. All patients were physically and psychologically able to tolerate complete denture procedures. All patients had Angle Class I (normal maxillo-mandibular relationship) and normal tongue size. Residual ridges had normal morphology, free from severe bony undercuts or flabby tissue and covered by firm muco-periosteum.

#### **Exclusion criteria:**

Patients with temporomandibular disorders and para-functional habits (bruxing, clenching etc.) were excluded. Patients who had received radiation to the head or neck region during the previous year were also excluded. Patients with any pathological findings in any of the dental arches and those with oral soft tissue diseases were not included. All selected patients were informed of the nature of this research work. Only motivated patients who showed co-operation participated in the study after signing an informed consent.

#### **Patients grouping:**

- Group I: patients without adhesive.
- Group II: application of Protefix adhesive cream.
- Group III: application of Fitty dent cushion.
- Group IV: application of Mucopren soft liner

**Prosthetic procedure:** Construction of conventional complete denture for all selected patients.

Maxillary and mandibular preliminary impressions were made using irreversible hydrocolloid impression material in suitable stock trays and immediately poured into stone plaster to obtain study casts on which maxillary and mandibular acrylic resin special trays were constructed. Border molding was performed by special trays using green stick compound.

Final impression was carried out using Zinc Oxide and Eugenol impression material. The obtained impressions were boxed and poured in dental stone to obtain master casts on which occlusion blocks were constructed. After adjustment of the maxillary occlusion rim and proper orientation of the occlusal plane a maxillary face bow record was made to mount the maxillary cast on mean value articulator.

Centric occluding relation was then recorded using the wax wafer method to mount the mandibular cast. Setting-up of anatomic 33° artificial acrylic resin teeth. Trial dentures were tried in the patients' mouth. Any necessary adjustments were carried out; the dentures were processed in the conventional manner using conventional heat cured acrylic resin.

The finished dentures were then tried in the patients' mouth for extension, stability, retention, aesthetics, phonetics and occlusion.

### Evaluation of denture retention

#### **Digital force meter:**

The retention was measured with a digital force metre. It is made up of universal sensing heads to which various adapters (flat, cone, chisel, and hook) may be connected directly or through an extension. An LCD display also included with the gadget, which shows the readings in grammes, ounces, and Newtons. Fig. (1).



FIG (1) Digital force meter

**Retention measurement procedure:**

The relative geometric center of the lower denture was recognized first. A wrought wire, 1 mm in diameter was bent at its center and adjusted to run 2cm above the occlusal plane from left first molar to right first molar. The lower denture was then inserted inside the patient's mouth to check tongue freedom, loop position and denture stability.

The wired-lower denture was embedded into the patient's mouth. The patients were situated in upright position so that the floor of the mouth corresponding to the floor and his head is well supported. The lower denture's wire hook was attached to the force-meter appliance and connected to the stiff loop, and the dislodging force was applied until the denture rose. When testing adhesives, the same procedure was used. Protefix cream was squeezed out of the tube and applied to evenly spaced places on the intaglio surface of the denture for the paste form of the adhesive.

In the case of paste application, 1.5 grammes is required. The thickness of the layer applied should be minimum in order to enable proper retention, since any extra quantity would impede the product's activity. The paste is placed to the denture in the incisor and molar areas.

The denture is fit in the mouth and pressed by hand for 10 sec., and then the mouth should be opened and shut several times until central occlusion is achieved.

For application of Fitty dent cushion, remove the cover on both sides of cushion before using, then apply cushion inside the fitting surface of denture and press firmly in place, if important, cut cushion with scissors to fit denture.

For application of a liner, Mucopren soft liner applied at the fitting surface. Once the recording of all the retentive force values of the denture with and without denture adhesives was completed, the wire loop was removed from the denture. The denture

was finished, polished, and afterward got back to the patient.

Previous steps were repeated for maxillary denture by placing hook at the central portion of maxillary denture.

**Chewing efficiency evaluation:**

Dentures with adhesives were subjected to the chewing efficiency test using Trident (chewing gums) watermelon (pale red) and spearmint (light green) chewing gum. Patients were sat upstanding and requested to bite the two gums for 5, 10, 20, 30 and 50 chewing cycles respectively.

For each chewing cycles another sample of chewing gum was utilized. A pause of 2-3 seconds was reported between each chewing sequence. The operator counted the chewing cycles. The samples were then spit into clear plastic bags after chewing the gums, which were labelled with corresponding numbers of strokes. After flattening to 1 mm thick 'wafers', all samples were analyzed.

Using Adobe Photoshop Elements, unmixed pixels were counted to measure the ratio of unmixed green color to the total surface by scanning with digital camera the samples from both sides with a fixed resolution (500 dots per inch).

The scanned image was then copied into a fixed pixel image (1175 to 925) and placed in the format of Adobe Photoshop. In each image (area of 4779 pixels), a scanned piece of unmixed gum has been copied as a reference scale. To select the unmixed green sections of the picture, the 'magic wand' tool was used (tolerance 20,25,30). On each hand, the numbers of selected pixels were registered from the histogram, and each tolerance was then determined as the mean of those figures. Subsequently a ratio was computed for the unmixed fraction (UF) using the following formula:

$$UF = \frac{(\text{Pixels green side a} + \text{Pixels green side b}) - 2 \times \text{Pixels of scale}}{2 \times \text{Pixels all}}$$

**RESULTS**

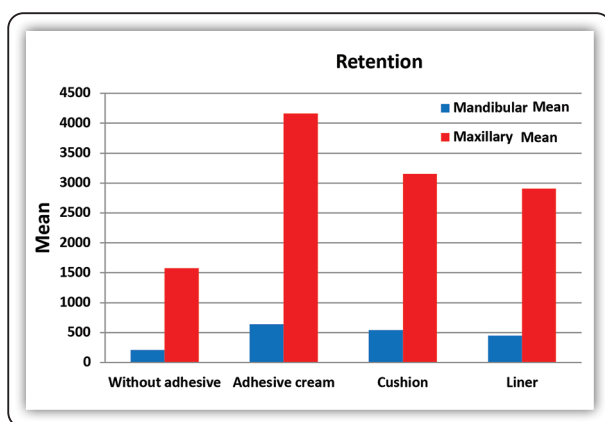
**Retention:**

Comparison between all groups regarding retention of mandibular arch was performed by using One Way ANOVA test which revealed significant difference between them as  $P < 0.05$ , followed by using Tukey's Post Hoc test for multiple comparisons which revealed significant difference in means with different superscript letters as  $P < 0.05$  (significant difference between all groups) as adhesive cream ( $639 \pm 8.89$ ) was significantly the highest while (without adhesive was significantly the lowest ( $206.67 \pm 6.43$ )).

Comparison between all groups regarding retention of maxillary arch was performed by using One Way ANOVA test which revealed significant difference between them as  $P < 0.05$ , followed by using Tukey's Post Hoc test for multiple comparisons which revealed significant difference in means with different superscript letters as  $P < 0.05$  (significant difference between all groups) as adhesive cream ( $4146.33 \pm 228.82$ ) was significantly the highest while without adhesive was significantly the lowest ( $1575.33 \pm 41.97$ ), as presented in figure (2) and table (1).

**TABLE (1)** Maxillary & mandibular arch of all groups.

Group	N	Maxillary		Mandibular		P value
		M	SD	M	SD	
Without adhesive	13	206.67	6.43	1575.33	41.97	0.001*
Adhesive cream	13	639.00	8.89	4164.33	228.82	0.001*
Cushion	13	541.00	25.51	3152.67	72.15	0.001*
Liner	13	452.33	32.15	2909.00	82.87	0.001*



**FIG (2)** Maxillary arch & mandibular arch retention of all groups

**Masticatory efficiency:**

**Comparison between different groups:**

Comparison between all groups was Performed by using One Way ANOVA test which revealed significant difference between them after 5 strokes & after 50 strokes as  $P < 0.05$ , while there was insignificant difference between them in other strokes as  $P > 0.05$ , then Tukey's Post Hoc test was performed for multiple comparison's between all groups which revealed significant difference in means with different superscript letters as  $P < 0.05$  (cream & others at 5 strokes \ soft liner & others after 50 strokes) while revealed insignificant difference in means with the same superscript letters as  $P > 0.05$  (soft liner & cushion after 5 strokes \ all after 10 & 20 & 30 strokes \ soft liner & cream after 50 strokes), as presented in Figure (3) table (2).

**TABLE (2)** Comparison between all groups regarding mastication efficiency.

	5 strokes		10 strokes		20 strokes		30 strokes		50 strokes	
	M	SD	M	SD	M	SD	M	SD	M	SD
<b>Soft liner</b>	0.043 a	0.007	0.039 a	0.013	0.032 a	0.015	0.045 a	0.019	0.042 a	0.030
<b>Cream</b>	0.040 ab	0.001	0.031 a	0.009	0.035 a	0.002	0.040 a	0.002	0.026 a	0.006
<b>Cushion</b>	0.033 b	0.011	0.030 a	0.007	0.040 a	0.005	0.049 a	0.008	0.052 b	0.024
<b>P value</b>	0.005*		0.06		0.09		0.17		0.01*	

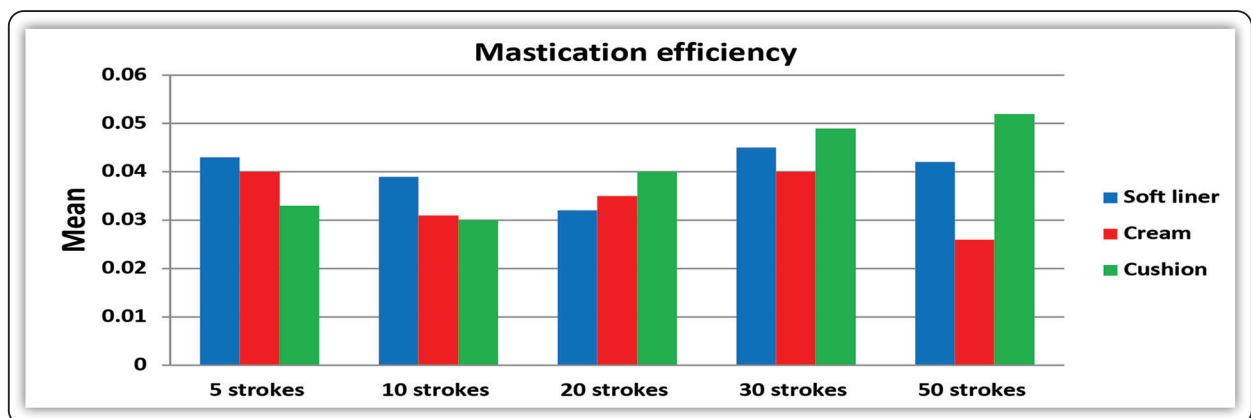


FIG (3) Masticatory efficiency of all groups.

## DISCUSSION

Dentists appear to be sparsely disposed to suggest the utilization of complete denture adhesives. Essentially, the utilization of such items seems to relate more to patient longings for a solution to mobility and retention problems than to dental prescription. This may be due to a lack of confidence in the results obtained, the purported iatrogenic problems of such products, or concern that patients may replace adequate denture maintenance with various commercial adhesives (cream, cushion or powder).

Dentists understand that the success of removable dentures is based on achieving a well-balanced occlusion that provides stability, as well as extending the bases to the fullest extent possible to ensure the key to retention, i.e. proper peripheral sealing. In any event, many doctors are unsure about the real efficacy of these treatments and which

adhesives provide the best retention performance. Some of the advantages of these materials include improved denture adaption, talking, eating, biting forces, maximum incisal force of maxillary denture, and self-confidence<sup>(13)</sup>.

Denture adhesives were developed virtually simultaneously with contemporary denture prosthesis. Despite the fact that denture adhesives are a contentious subject in the dentistry profession, millions of denture wearers continue to purchase and use them<sup>(14)</sup>.

Because the primary components of denture adhesives are either vegetable gum or synthetic polymers such as carboxymethyl cellulose and polyvinyl methyl ether maleate, the prosthetic denture adhesives enhanced the retention of the full denture for the majority of the patients in this research<sup>(15)</sup>.



The hydrate material (free carboxyl groups) is produced and expands larger than their initial volume as the adhesive absorbs water and the carboxymethyl cellulose comes into contact with the saliva, therefore excluding air between the denture bases and bearing tissue. The hydrate substance adheres to the denture's fitting surface and the oral mucosa, increasing saliva viscosity. Complete dentures are more likely to be retained as a result of these activities. When adhesives like methyl cellulose or hydroxyl methyl cellulose are wetted, free carboxyl groups create electrovalent linkages that cause stickiness or high bio-adhesive forces <sup>(16)</sup>.

The retention of complete denture bases was found to be highest in Protefix cream because the hydrate material formed by carboxymethyl cellulose stayed intact due to the insoluble properties of the cream <sup>(17)</sup>.

With the variation in dislodgment forces from one adhesive to the next, all of the evaluated denture adhesives had a positive influence on enhancing the retention of maxillary full denture bases. The findings of this investigation are consistent with those of Manes et al. and Pachore in the past <sup>(18)</sup>.

Denture strips were developed with the goal of decreasing clutter, making adhesive application easier, and lowering the quantity of adhesive required. Adhesive strips were shown to be less efficient than cream in a research by Kalra et al. Goncalves et al. corroborated the findings of this investigation, finding the strips to be less efficient than the cream adhesive in terms of mastication efficacy. They looked at chewing cycle, chewing ability, and chewing performance <sup>(19)</sup>.

Denture adhesives in the forms of paste and powders lost up to 30% to 50% effectiveness in their use after 1-3 hours as shown by Chew <sup>(20)</sup>. The retention effects decreased significantly in three hours and each product in the same study were least effective in the fifth hour of application. He related the decrease in adequacy to the percentage

of loss of adhesive. Obviously, the retention effect is dependent on the adhesive properties of the composition.

When comparing mandibular dentures to maxillary dentures in this study, the satisfaction rate for retention was remained lower for mandibular dentures. This result was in agreement with Kulak et al. <sup>(21)</sup>. They discovered that a non-retentive, unstable mandibular denture is a common complaint among full denture wearers. They ensured that not only the denture adhesive itself, but also the heights of the existing ridges, played a role in mandibular denture retention issues.

From the current study, it is proposed that denture adhesives can be prescribed to the patients to develop denture retention irrespective of their form.

Denture adhesive can improve the efficiency of mastication in denture users. Mastication efficiency is the ability of individuals to break down food in a certain time that can be evaluated. The methods for evaluating mastication efficiency are sieves system, colorimetric method, subjective assessment, image analysis, B-carotene-containing gummy jelly, and chewing gum. Chewing gum is the best method evaluation for elder people to evaluate efficiency mastication <sup>(22)</sup>.

Improvement of the chewing ability may be related to an increased sense of security and added comfort, even though an adhesive is not required for proper denture retention. Denture adhesives give greater stability and retention, allowing denture wearers to apply more force during mastication, requiring fewer chewing strokes to reach deglutition. The chewing ability was evaluated from a bit better to substantially better in this study. Denture adhesives significantly improved mastication ability in patients with poor and fair-fitting dentures, according to Neill and Robert <sup>(23)</sup>.

A study showed that the masticatory efficiency of complete denture base was found to be highest in Protefix cream <sup>(24)</sup>.

## CONCLUSION

The clinical value of a denture adhesive identifies with progress of capacity and its impact on the underlying tissue health. There is adequate data to help the utilization of denture adhesives to increase denture retention, stability, and incisive ability for ill, fair, and well-fitting prostheses. Also, the use of adhesive creams significantly increased the denture retention and masticatory efficiency.

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