

## An Evaluation Of The Retention Property Between Cream Type And Strip Type Denture Adhesive With And Without Salivary Substitutes: An In Vitro Study

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**Abstract:** Background: Patients with xerostomia complain of not only dryness of mouth but also discomfort during routine normal oral functions like speaking and swallowing. These complain is worse in individuals wearing removable intraoral dental prosthesis. In such situations, when salivary flow decreases, denture adhesives and salivary substitutes are recommended; which aid in denture retention and improve patient comfort. Material & Method: A total 150 samples were prepared using heat-cure acrylic resin of 30mm×30mm×5mm. All samples were equally divided in A,B,C,D,E groups, wherein Group A was control group with salivary substitutes. Group B was denture adhesive cream without salivary substitutes. Group C was denture adhesive cream with salivary substitutes. Group D was denture adhesive strips without salivary substitutes. Group E was denture adhesive strips with salivary substitutes. The retentive force was measured for all samples using universal testing machine. Results: Data was collected and statistical analysis was done by one-way ANOVA test followed by post hoc test. The significant difference was found between the retentive forces of cream type and strip type denture adhesives with or without salivary substitutes. Conclusion: From this study, it is concluded that denture adhesive will definitely increases the denture retention. The cream type denture adhesive with salivary substitutes has the most retention than among all groups. [Shah D Natl J Integr Res Med, 2020; 12(1):62-67]

**Key Words:** xerostomia, denture adhesive, salivary substitutes.

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**Introduction:** In older individuals, xerostomia is very common condition. Patients with xerostomia complain of not only mouth dryness but also discomfort during routine oral functions like speaking, swallowing and chewing along with mucosal irritation.<sup>1</sup>

In older individuals, the factors that predispose to xerostomia are medications for hypertension, diabetes, etc., radiation therapy for head and neck surgery, salivary gland diseases and improper nutrition and diet.

Problems are compounded for the patient who are wearing removable intraoral dental prosthesis (removable complete denture, removable partial denture, obturator). Xerostomia can cause various difficulties like denture induced oral ulcers, inadequate retention of denture and delayed healing of oral mucous membrane.

The saliva is important for various physical factors of retention. Retention of denture is affected by a thin layer of saliva between the denture base and denture foundation area.

When the salivary flow is decreased, a salivary substitute is often recommended with denture adhesive.<sup>2</sup> The denture adhesives may be soluble and insoluble. The insoluble adhesives include strips and wafers. The soluble adhesives include cream and powder.<sup>3</sup> Denture adhesives are recommended for improving the quality of retention in conditions like immediate dentures, single denture, maxillofacial prosthesis like obturators. Other conditions like poor neuromuscular control, poor ridge anatomy and dry mouth also require denture adhesives.<sup>4</sup>

Denture adhesives are used to increase the retention of the removable prosthesis, that will improve the chewing and masticatory ability and provide psychological comfort to the patient.

Artificial saliva is recommended in patient with xerostomia as it act by humidifying and lubricating the dehydrated oral mucosa. Salivary substitutes mainly consist of aqueous solutions containing the similar mineral salts as those found in human saliva.<sup>4</sup>

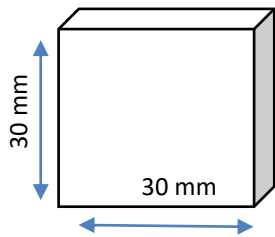
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In dental practice, sometimes patients who wearing removable prosthesis may complaint about dryness of mouth. For such patients' treatment with salivary substitutes for dryness is recommended.

**Materials And Methods: Materials:** Modelling wax (Y'DENT, India).Dental plaster (type II) (Kalabhai, India).Separating medium (Ashvin, India).Heat cure acrylic resin (Ashvin, India). Salivary substitutes (Gel Form by GC, Japan). Denture adhesive strips (Poligrip, Japan). Denture adhesive cream (Poligrip, Japan). Flask and clamp (JABBAR, India). Sand (aluminium oxide, 110 $\mu$ ) & Sand blaster (TISSidental, Italy). Universal testing machine (Intron 33R 4467, U.S.)

The aim of this study was to evaluate the effect on retention of denture adhesives along with or without salivary substitutes.

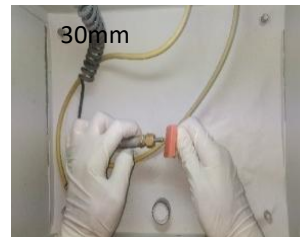
**Methods:** This study was conducted in department of prosthodontics, crown & bridge at karnavati school of dentistry. A total 150 samples were prepared using heat cure acrylic resin with dimensions of 30mm×30mm×5mm (Figure 1). The handle was attached perpendicular to the samples with the size of 30mm×10mm×5mm for easy handling (Figure 2). All acrylic blocks were sand blasted with aluminium oxide (110 $\mu$ ) from 2 cm distance, at 2 bar pressure and 90° angulations approximately for 1 min on top surface to mimic tissue surface roughness. (Figure 3)<sup>5</sup>.



(Figure 1)



(Figure 2)



(Figure 3)



(Figure 4)

All samples were divided in 5 groups with 30 samples for each group. Group A: Control group with salivary substitutes. Group B: Denture adhesive cream without salivary substitutes. Group C: Denture adhesive cream with salivary substitutes. Group D: Denture adhesive strips without salivary substitutes. Group E: Denture adhesive strips with salivary substitutes. For simulating moderate dry mouth condition, samples were exposed to water for one minute only. (1) After that, the testing materials were applied on the samples respectively. Figure 4 shows application of

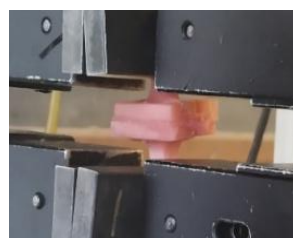
salivary substitutes gel. Figure 5 shows application of denture adhesive cream (0.4ml). Figure 6 shows application of denture adhesive strip with dimensions of 1.5mm×0.7mm×0.05mm. Then each sample was placed on the universal testing machine. The occlusal load was simulated by applying 9.8±0.2 N compressive force with a 5mm/min cross-head speed on each sample (Figure 7). (1)After that, pull out force was applied with the cross head speed of 10mm/min to measure the retentive force for each sample. (Figure 8).



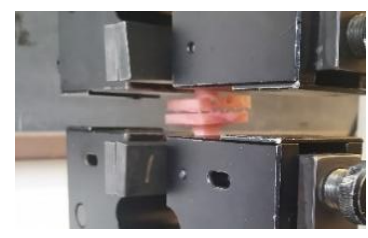
(Figure 5)



(Figure 6)



(Figure 7)



(Figure 8)

The retentive force of the control group and the four other test groups were tabulated and subjected to statistical analysis.

**Results:** Table 1 shows retentive force of all groups. Table 2 shows descriptive statistics of all the five groups. The mean retentive force for

group A was 748.27 N/mm<sup>2</sup>, group B was 1028.55 N/mm<sup>2</sup>, group C was 1225.16 N/mm<sup>2</sup>, group D was 592.64 N/mm<sup>2</sup> and group E was 971.84 N/mm<sup>2</sup>. Table 3 shows the one-way ANOVA test in which a highly statistical significance among all the five groups (p = 0.000).

**Table-1: Data Shows Retentive Force Of All Groups (N/mm 2)**

Sr. No.	Group A	Group B	Group C	Group D	Group E	Sr. No.	Group A	Group B	Group C	Group D	Group E
1	598.81	743.36	850.7	540.58	816.16	16	838.19	1132.41	1121.28	617.54	1122.09
2	842.6	743.17	851.12	539.28	792.67	17	615.46	981.73	1443.33	592.46	1053.77
3	829.47	742.89	977.83	551.58	840.45	18	729.06	1011.23	1551.07	583.55	1084.95
4	895.33	743.36	996.06	576.89	864.28	19	792.15	973.59	1381.58	569.15	993.54
5	712.23	742.67	1010.89	596.64	935	20	692.15	1017.24	981.57	597.22	945.85
6	696.85	884.14	1267.38	582.28	896.15	21	841.45	1121.5	1031.44	623.33	969.82
7	706.02	1057.15	1357.14	562.78	866.64	22	681.9	1152.19	1004.67	557.12	1103.93
8	682.19	1174.04	1536.5	570.42	914.69	23	752.55	1147.07	1292.73	596.75	1095.53
9	721.88	1173.13	1494.51	569.31	965.3	24	826.36	1189.63	1363.27	581.82	893.21
10	711.49	1167.15	1562.43	566.53	1092.86	25	881.49	1174.27	1005.54	539.57	937.85
11	600.19	952.45	1120.73	521.45	981.71	26	819.19	1193.38	1091.71	572.85	1082.08
12	750.6	1021.29	1229.25	573.25	832.53	27	732.28	1104.43	1239.31	607.91	1017.27
13	847.89	921.37	1361.89	603.19	889.03	28	741.54	1156.23	1462.3	629.75	1066.85
14	630.22	1121.09	1345.3	832.63	97337	29	802.15	1162.02	1477.58	663.41	1078.11
15	715.39	1095.81	1093.71	671.81	1021.23	30	761.2	1056.78	1252.04	588.23	1028.51

**Table 2: Shows Mean Differences And Standard Deviation Of Retentive Force Of Five Group**

Groups	Number	Mean (N/mm2)	Std. Deviation (N/mm2)
Group A	30	748.2760	81.99973
Group B	30	1028.5590	154.27601
Group C	30	1225.1620	215.64421
Group D	30	592.6427	56.66105
Group E	30	971.8477	96.69501

**Table 3: Shows Comparisons Of The Mean Retentive Force Between The Groups And Within The Group Using One-Way ANOVA**

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7320732.581	4	1830183.14	102.145	.000
Within Groups	2598048.146	145	17917.573		
Total	9918780.726	149			

**Table 4: Multiple Comparisons Of The Mean Retentive Force Within Groups Using Post-Hoc Tukey HSD Analysis:**

Primary Group	Compared Group	Mean Difference	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Group A	Group B	-280.28300*	34.56161	.000	-375.7562	-184.8098
	Group C	-476.88600*	34.56161	.000	-572.3592	-381.4128
	Group D	155.63333*	34.56161	.000	60.1601	251.1065
	Group E	-223.57167*	34.56161	.000	-319.0449	-128.0985
Group B	Group C	-196.60300*	34.56161	.000	-292.0762	-101.1298
	Group D	435.91633*	34.56161	.000	340.4431	531.3895
	Group E	56.71133	34.56161	.474	-38.7619	152.1845

Group C	Group D	632.51933*	34.56161	.000	537.0461	727.9925
	Group E	253.31433*	34.56161	.000	157.8411	348.7875
Group D	Group E	-379.20500*	34.56161	.000	-474.6782	-283.7318

\*. The mean difference is significant at the 0.05 level.

**Graph 1: Shows Comparison Of The Mean Retentive Force Of All Groups:**

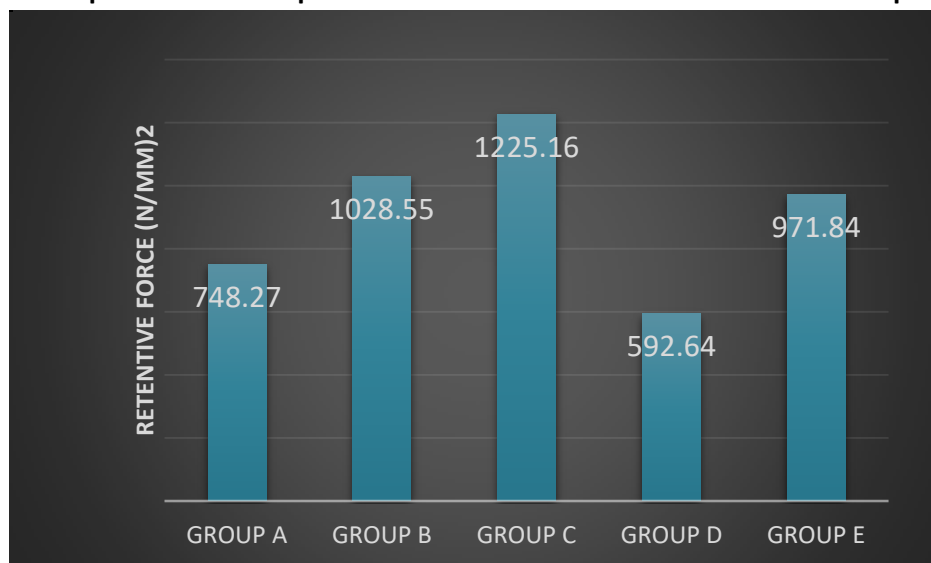


Table 4 shows multiple comparisons of the mean retentive force within groups using Post-hoc Tukey HSD analysis. Comparison of group A (Control group) with group B it gives a mean difference of -280.28. It suggests that group B has high retentive force than group A. When group A was compared with group C it gives a mean difference of -476.88. It suggests that group C has high retentive force than group A.

When group A was compared with group D it gives a mean difference of 155.63. It suggests that group A has high retentive force than group D. When group A was compared with group E it gives a mean difference of -233.57. It suggests that group E has high retentive force than group A.

When group B was compared with group C it gives a mean difference of -196.60. It suggests that group C has high retentive force than group B. When group B was compared with group D it gives a mean difference of 435.91.

It suggests that group B has high retentive force than group D. When group B was compared with group E it gives a mean difference of 56.71. It suggests that group B shows not significant to group E (p=0.47).

When group C was compared with group D it gives a mean difference of 632.51. It suggests

that group C has high retentive force than group D. When group C was compared with group E it gives a mean difference of 253.31. It suggests that group C has high retentive force than group E.

When group D was compared with group E it gives a mean difference of -379.20. It suggests that group E has high retentive force than group D.

According to statistical analysis, the cream adhesive with salivary substitutes (group C) gives maximum values for retentive force while the strip adhesive without salivary substitutes (group D) gives minimum values for retentive force.

Graph 1 shows comparison of the mean retentive force for each group in which cream type adhesive with salivary substitutes (group C) shows the maximum mean retentive force. The strip type adhesive without salivary substitutes (group D) shows the minimum mean retentive force.

**Discussion:** As the life span of individuals increase, proportion of people affected by xerostomia is also expected to increase. Risk factors for xerostomia are age, radiation of head and neck, Sjögren’s syndrome, salivary gland diseases, improper diet and nutrition in geriatrics, general medical conditions such as dehydration,

diabetes mellitus and side effects of certain medications.<sup>1</sup>

Dry mouth can create noticeable problems and have a significant impact on individual life. It can produce serious undesirable effects on the patient's quality of life by affecting dietary habits, nutritional status, speech, taste, acceptance to dental prosthesis and increasing the risk of oral infection. Many factors affect denture retention, such as size, shape and material of denture base. Others are age and health of patient; character of the mucosa; quality and quantity of saliva; time of day and seating of the denture in the mouth.<sup>6</sup> The psychological status, such as anxiety and depression are also predominant for xerostomia.<sup>7</sup> Patients with xerostomia have troubles with denture retention along with mucosal pain and oral ulcers. Studies shows that the use of denture adhesive and salivary substitutes reduced tissue irritation, compression ulcers, inflammation of oral mucosa in denture wearers<sup>8,9</sup> and increase retention of denture.<sup>6</sup>

In xerostomic patients, the fabrication of salivary reservoir dentures have been reported. However, these are different types of dentures and are technique sensitive. Other options to treat xerostomia include asking the patient to drink sip water frequently, chewing sugar free candies, using salivary substitutes in liquid or gel form.

Salivary substitutes should be comforting, pleasantly flavoured, biocompatible and cost effective and must have satisfactory wetting ability of tissue surface of the denture. Artificial salivary substitutes should be developed containing thickeners which increase the stability of liquid for long lasting relief and increased moistening of the oral surfaces.<sup>8</sup>

Denture adhesives are frequently used by denture wearers to increase the retention of the complete denture, improve the chewing and masticating ability and psychologically support the patient to make the complete denture more acceptable.<sup>6</sup>

The problem associated with the loss of denture retention due to xerostomia, can be overcome by using salivary substitutes and an appropriate adhesive in powder, cream or strip form. Denture adhesives are formulated with a mixture of short and long acting synthetic polymers. In additions, the increased viscosity of hydrated adhesive

helps to optimize interfacial forces that aid in denture retention. The long acting polymers improve cohesive forces within the adhesive through molecular cross-linking.<sup>10</sup>

The choice between cream and powder is very subjective. Functioning of adhesive powder is rapid, but the effect is shorter than adhesive cream. The amount of adhesive powder used for denture retention is less as compared to adhesive cream. It is also comparatively easier to clean the denture after using the powder than cream. The cream is commonly recommended as it has low tendency to be leached by the liquid in the mouth, providing strong and long term effect.<sup>8</sup>

Adhesive strip lacks the ability to flow, but its application/ use seems to be easy. In present study, after the statistical analysis significant difference was found between cream type and strip type adhesive ( $p < 0.001$ ). Also we can see that the salivary substitutes used with denture adhesive improves the retention.

This study suggests that the adhesive strength of poligrip cream adhesive with salivary substitutes was significantly greater than that of the other materials in the moderate dry mouth model (water exposure for 1 min).<sup>1</sup> The lowest values were measured with strip type denture adhesive without salivary substitutes. The cream type adhesive without salivary substitutes (group B) was not significant to strip type adhesive with salivary substitutes (group E). It suggests that retentive force for both groups were not different.

The saliva is an important factor for various physical factors of retention like adhesive, cohesion, interfacial surface tension, capillary attraction. To produce adhesion of denture to the supporting tissues, saliva must freely over the entire surface to ensure wetting of the adherend surface. Studies had been done on artificial saliva to check wettability. They evaluated contact angles of water, human saliva and different artificial saliva on polished human enamel and on human mucosa. They found that salivary substitutes exhibit contact angles between 56.7°-61.2°. This suggests that use of artificial saliva decreases the contact angle. So, in present study when denture adhesive is used with salivary substitutes, it increases retention of dentures due to increased wettability.<sup>11</sup>

Cream adhesive shows increases adhesive strength and resistance to washout due to the chemistry of the long-acting adhesive polymer in this formulation. The difference between the cream and the strip product is likely due to the fact that strips do not contain a long-acting synthetic polymer.<sup>10</sup> The cream adhesive with salivary substitutes gives more retentive force due to its viscosity. Strip adhesive is less retentive as compared to others due to its thickness and lack of flow.<sup>6</sup>

**Limitation Of The Study:** It is an in vitro study design, so effects of salivary substitutes and denture adhesives on the mastication capability of patients could not be evaluated. The accuracy will be more when performed in patients. So, the detailed study may be required on patients to draw definitive conclusion.

**Conclusion:** Within the limitation of this study, following conclusions could be drawn: The findings of this study revealed that denture adhesive along with salivary substitutes offers adequate retentive forces in a slightly moist environment (moderate dry mouth). The cream adhesive along with salivary substitutes provides more retention. So, the patient with xerostomia may get more comfort after using denture adhesive and salivary substitutes.

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