10.5005/jp-journals-10024-1195

ORIGINAL RESEARCH


# Effect of Denture Cleanser on Weight, Surface Roughness and Tensile Bond Strength of Two Resilient Denture Liners

**Dayanand Ashok Huddar, MN Hombesh, B Sandhyarani, GS Chandu, Girish Shankar Nanjannawar, Rohit Shetty**

## ABSTRACT

**Aim:** Evaluating effects of a denture cleanser on weight, surface roughness and tensile bond strength on two resilient lining materials.

**Materials and methods:** Specimens of heat cure acrylic resin were prepared to verify weight change, surface roughness and tensile bond strength. Specimens were divided into four groups: Relined with resilient liner Visco-gel, soft liner immersed in Clinsodent denture cleanser and water and evaluated immediately, 24 hours, 7 and 15 days. Weight changes, roughness and tensile bond strength were determined and data submitted to statistical analysis.

**Results:** Visco-gel specimens immersed in water (group 1) have shown significant increased surface roughness than those immersed in Clinsodent (group 3) during 24 hours, 7 and 15 days. The soft liner specimens immersed in water (group 2) have shown increased surface roughness than those immersed in Clinsodent (group 4) during 24 hours and 7 days. Visco-gel specimens immersed in water have shown significant increased tensile bond strength during 7 and 15 days than those immersed in Clinsodent. The soft liner specimens immersed in water have shown increased tensile bond strength than those immersed in Clinsodent during immediately, 24 hours and 7 days.

**Conclusion:** Within limitations of this study, specimens immersed in Clinsodent demonstrated increased weight changes compared with water. Specimens immersed in water demonstrated lesser surface roughness and tensile bond strength compared with specimens immersed in Clinsodent.

**Clinical significance:** Resilient denture liners and denture cleansers are most commonly used materials in prosthodontics. Caution should be taken while selecting the materials which cause the detrimental changes on properties of the materials.

**Keywords:** Resilient liners, Denture cleanser, Denture-base resins, Temporary denture liners.

**How to cite this article:** Huddar DA, Hombesh MN, Sandhyarani B, Chandu GS, Nanjannawar GS, Shetty R. Effect of Denture Cleanser on Weight, Surface Roughness and Tensile Bond Strength of Two Resilient Denture Liners. J Contemp Dent Pract 2012;13(5):607-611.

**Source of support:** Nil

**Conflict of interest:** None declared

## INTRODUCTION

Prosthodontic management of edentulous patients is greatly concerned with the preservation and maintaining optimum health of supporting structures under function. Though most of the denture base materials are tolerated well by the denture bearing areas, in clinical situations where underlying tissues become sore and the need for resilient liners arises. The use of resilient liners in the prevention and treatment of chronic tissue irritation from denture is an excellent alternative to the use of hard resins and is beneficial in preserving the health of the supporting tissues.[1] Resilient lining materials, like tissue conditioners, soft liners, are commonly used.[2] These materials are used for functional impressions, immediate dentures or obturators, where there are underlying healing areas.[3] Soft denture liners have certain limitations, like hardening due to loss of plasticizers, colonization of *Candida albicans* and other microorganisms, porosity, poor tear strength and bond failure to denture base. The effectiveness of temporary resilient liner is for 4 to 8 weeks. Thus, it requires frequent replacement, as they lose its plasticity and becomes rigid and harbors microorganisms and food debris, so it becomes important to maintain the hygiene of underlying tissues by keeping the tissue surface clean.[4] Caution should be exercised in cleaning soft liners. Studies have shown that commercially available denture cleansers cause detrimental changes in resilient liners within relatively short period.[5] A roughened surface facilitates colonization by microorganisms. Therefore, denture cleansers used for plaque control of tissue conditioners should reduce microbiological contamination and have a minimum effect on the physical properties of the liner.[5] In this present study, the effect of commonly used denture cleanser on properties of temporary resilient liner is evaluated.

## MATERIALS AND METHODS

The objective of the study was to evaluate the effects of denture cleanser on weight, surface roughness and tensile bond strength of two resilient liners and to compare them cleaning with normal water. The materials used are DPI heat cure denture base resin, chemically cured resilient liners Visco-gel and soft liner, Clinsodent denture cleanser and artificial saliva (0220 gm/l of calcium chloride, 1.07 gm/l sodium phosphate, 1.68 gm/l sodium bicarbonate, 2 gm/l sodium azide and 0.2% $NaN_3$).

### Preparation of Metal Dies (Table 1)

**Table 1:** Shape, size and quantity of metal dies

| *S. No.* | *Shape* | *Size* | *Quantity* |
|---|---|---|---|
| 1 | Disk | Diameter 30 mm<br>Thickness 4 mm | 4 |
| 2 | Disk | Diameter 30 mm<br>Thickness 6 mm | 4 |
| 3 | Cuboidal | Length 40 mm<br>Width 10 mm<br>Height 10 mm | 6 |
| 4 | Cuboidal | Length 70 mm<br>Width 3 mm<br>Height 10 mm | 1 |

### Preparation of Specimens

Forty specimens of heat cure acrylic resin (DPI) were prepared using No. 1 metal dies (Fig. 1). Processed specimens were carefully retrieved and smoothened using sand paper (Fig. 2). Moulds were prepared with metal dies No. 2 (6 mm) then moulds were used to assemble the acrylic disk coated with resilient liner (Fig. 3). The acrylic disks prepared with metal dies No. 1 were first placed in the mould cavity and the liner was coated on it. The dental flask was closed carefully till the material is set. Specimens were removed carefully. The specimens of 4 mm thickness resin disks with a layer of 2 mm resilient liner were thus obtained (Fig. 4). By following above-mentioned method, 20 specimens of Visco-gel and 20 specimens of soft liner were prepared, which were used for evaluation of weight changes and surface roughness.

The acrylic resin block specimens for tensile bond strength were prepared by using metal dies No. 3 (Fig. 1). Total of 384 heat cure acrylic resin blocks were prepared. The gloss surfaces of the blocks were removed using sand paper. The metal dies No. 3 were again flasked with two dies facing each other interposed with metal die No. 4 placed horizontally to get uniform thickness of 3 mm resilient lining material. Elastomeric impression material of putty consistency (Aquasil, Dentsply) was applied along the sides of all the metal dies before flasking for easy removal of the specimens and for repeated preparation of specimens (Fig. 3). Total of 192 specimens were prepared for evaluation of tensile bond strength.

**Fig. 2:** Heat cure acrylic specimens

**Fig. 1:** Molds created for preparation of acrylic specimens

**Fig. 3:** Molds prepared to provide space for resilient liners

### Weight Changes, Surface Roughness and Tensile Bond Strength

When samples were not being treated or tested, they were stored in artificial saliva. The specimens were divided into four groups as follows.

- *Group 1:* Specimens of Visco-gel were immersed in water after every 24 hours for 15 days (control group).
- *Group 2:* Specimens of soft liner were immersed in water after every 24 hours for 15 days (control group).
- *Group 3:* Specimens of Visco-gel were immersed in Clinsodent denture cleanser after every 24 hours for 15 days (test group).
- *Group 4:* Specimens of soft liner were immersed in with Clinsodent denture cleanser after every 24 hours for 15 days (test group).

The weight and surface roughness and tensile bond strength were tested for all the specimens, for the following period of time: Immediately (T0), 24 hours (T1), 7 days (T2) and 15 days (T3).

The specimens of resilient liners were dried with absorbent paper and immediately weighed (T0) by analytical balance (Afcoset, E R 120A) with $10^{-4}$ precision. The surface roughness was measured in micrometers of each specimen by use of a surface roughness tester (S J-201, Mututoyo, Japan). To ensure that measurements were made in the same area of each time for all the specimens, the area was marked with a pencil on each specimen. After evaluation, the specimens were stored in artificial saliva at 37ºC. The artificial saliva was changed everyday. For each immersion, fresh solution of the denture cleanser was prepared according to manufacturer's recommendations. All the specimens were immersed for a period of 5 minutes in denture cleansing solution. The artificial saliva was changed daily. The roughness data for each period of time and the weight difference T0-T1, T1-T2 and T2-T3 were recorded. The data was tabulated for statistical analysis. The tensile bond strength was evaluated by a universal testing machine (Unitek 9450PC), at a cross speed of 5 mm/min with a 500 Kg load cell. The specimens were placed under tension until bond failure occurs. The load at which bond failure occurred was recorded. The type of failure was observed by use of stereomicroscopy at original magnification ×10. Types of failures were recorded as cohesive, adhesive/cohesive and adhesive (Graph 1).

## RESULTS

The results were obtained for weight, surface roughness and tensile bond strength. The data were recorded as mean difference between the control group and test group at specific interval of time. Mean standard deviation, student's unpaired t-test and students paired t-test are used for statistical analysis. p-value < 0.05 was considered significant, and the results were interpreted as follows.

Visco-gel specimens immersed in Clinsodent (group 3) have shown significant ($p < 0.05$) decrease in weight than those immersed in water (group 1) during 7 days and 15 days. The soft liner specimens immersed in Clinsodent (group 4) have shown decrease in weight than those immersed in water (group 2) during 24 hours, 7 and 15 days.

Visco-gel specimens immersed in water (group 1) have shown significant ($p < 0.05$) increase in surface roughness than those immersed in Clinsodent (group 3) during 24 hours, 7 and 15 days. The soft liner specimens immersed in water (group 2) have shown increase in surface roughness than those immersed in Clinsodent (group 4) during 24 hours and 7 days (Table 2).

Visco-gel specimens immersed in water (group 1) have shown significant ($p < 0.05$) increase tensile bond strength

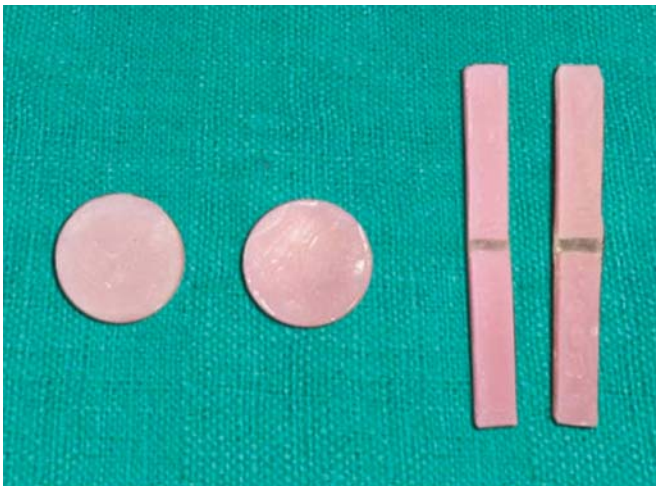
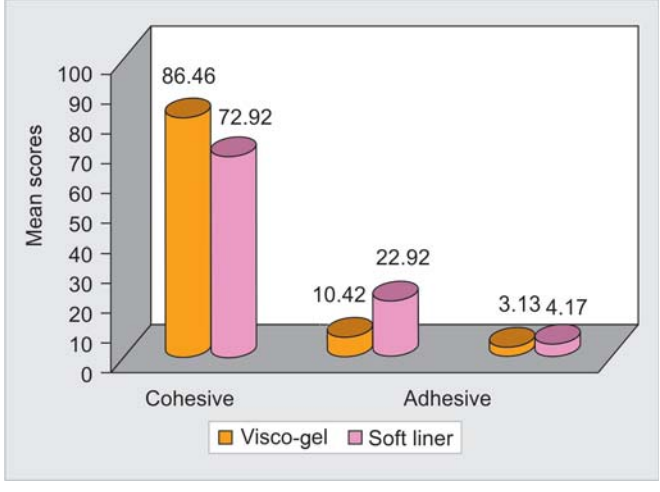


**Fig. 4:** Prepared specimens for evaluation




**Graph 1:** Type of bond failure (%) between Visco-gel and soft lines and heat cure acrylic resin

during 7 days and 15 days than those immersed in Clinsodent (group 3). The soft liner specimens immersed in water (group 2) have shown increase in tensile bond strength than those immersed in Clinsodent (group 4) during immediately, 24 hours and 7 days (Table 3).

## DISCUSSION

In the present study, the effects of a denture cleanser on weight, surface roughness and tensile bond strength of resilient liners Visco-gel and soft liner were evaluated at different intervals of time. When treated with Clinsodent, Visco-gel has shown significant decrease in weight during T3 and T4. The soft liner has shown significant decrease in weight during T2 and T3, than immersed in water. Goll, Smith and Plein[4] reported a decrease in the weight of resilient lining material, after storage in water and after daily immersion in denture cleanser for 30 days. Rodrigues Garcia, Leon, Olivera[6] in their studies concluded that weight changes were greater, when resilient liners were immersed in denture cleanser than when immersed in water. Two resilient liners tested in the present study showed that soft liner has more weight changes than Visco-gel. The soft liner polymer may have plasticizers of lower molecular weight than that of Visco-gel, allowing the leaching out of plasticizers in the highest quantity during T1 and T2, T2 and T3.[6]

The Visco-gel has shown significantly increase in surface roughness at T0, T0 and T1, T1 and T2 and T2 and T3 in the specimens treated with water than the specimens treated with Clinsodent denture cleanser. The soft liner has shown significantly increase in surface roughness during T1 and T2 in the specimens treated with water, than treated with Clinsodent denture cleanser. According to the study by Zissis, Polyzois, Harrison,[6-8] the roughness data obtained is comparable with the values given in study, 3.2 µm which is for autopolymerized resilient liners. When specimens were immersed in denture cleanser, the loss of soluble components, such as plasticizer may have occurred leaving empty spaces or bubbles,[6] these bubbles are responsible for roughness, increase in size resulting in craters.[9] The crater in the boundaries probably diminish when compared with those of the bubbles and the specimens become smooth.[8]

The Visco-gel has shown significantly different increase in tensile bond strength during T1 and T2, T2 and T3 in the specimens treated with water, when compared with the specimens treated with Clinsodent denture cleanser. The soft liner has shown significant increase in tensile bond strength during T1 and T2, T3 and T4 specimens treated with water than specimens treated with Clinsodent denture cleanser. In present study, it is observed that tensile bond strength increased with time for both resilient liners treated with water and Clinsodent denture cleanser. These results are in agreement with Craig and Gibbons[10,11] who reported increased bond strength with time when resilient lining materials were stored in water. This may occurred as a result of leaching out of plasticizer resulting in increase in stiffness.[13,14] In addition, soft liner bond strength was higher than Visco-gel, when specimens were immersed in water. Soft liner may probably have plasticizer of low molecular weight as compared to Visco-gel.[6,7] The absorption or loss of soluble components may cause failure in bond strength between the resilient liner and acrylic resin of the denture base. Most of failures were cohesive (Graph 1) so these results can be explained by mechanical bonding and chemical adhesion. According to Craig and Gibbons,[11,12] the mechanical bonding occurred because of the sand paper treatment of acrylic resin surface, which consequently may have increased surface area and mechanical retention. Chemical adhesion may be explained by the similar chemical composition of acrylic resin and resilient liners.[13]

**Table 2:** Comparison of Visco-gel and soft liner with respect to surface roughness in test group

| Periods | Visco-gel | | Soft liner | | t-value | p-value | Sig. |
|---|---|---|---|---|---|---|---|
| | Mean | Std. dev. | Mean | Std. dev. | | | |
| Immediate | 2.7520 | 0.1326 | 3.6920 | 1.1224 | – 2.6302 | 0.0170 | S |
| 24 hours | 2.7210 | 0.1923 | 3.3570 | 0.5042 | – 3.7272 | 0.0015 | S |
| 7 days | 3.1360 | 0.4364 | 3.6100 | 0.3298 | – 2.7401 | 0.0135 | S |
| 15 days | 4.4705 | 0.6694 | 4.0090 | 0.2580 | 2.0343 | 0.0569 | S |

S: Significant

**Table 3:** Comparison of Visco-gel and soft liner with respect to tensile bond strength in test group

| Periods | Visco-gel | | Soft liner | | t-value | p-value | Sig. |
|---|---|---|---|---|---|---|---|
| | Mean | Std. dev. | Mean | Std. dev. | | | |
| Immediate | 2.8267 | 0.2037 | 3.5325 | 0.5319 | – 5.0227 | 0.0000 | S |
| 24 hours | 2.7617 | 0.3286 | 3.5067 | 0.3773 | – 3.5487 | 0.0018 | S |
| 7 days | 3.4283 | 0.2806 | 4.4383 | 0.2937 | – 4.1434 | 0.0004 | S |
| 15 days | 4.4650 | 0.1216 | 4.7600 | 0.6636 | 0.9435 | 0.3557 | NS |

S: Significant; NS: Not significant

When considering plaque control on resilient lining material,[14] the choice of denture depends on many factors including composition and time of use. These denture cleansers can cause significant deterioration on resilient liners. Compatibility between resilient liners and cleanser should be considered to avoid or minimize alteration of properties.

## CONCLUSION

The two resilient liners Visco-gel and soft liner treated with Clinsodent were shown greater weight changes as compared to the treatment with tap water. Compared with the Visco-gel and soft liner treated with tap water, the resilient liners treated with Clinsodent have shown decreased surface roughness and tensile bond strength. The soft liner has shown more changes in weight and tensile bond strength compared with Visco-gel. Above-mentioned conclusions are with in the limitations of this study and further research is required.

## REFERENCES

1. Winkler S. Essentials of complete denture. Prosthodontics 1996;2:427.
2. Craig RG, John MP. Restorative dental materials (10th ed). 534.
3. Steven MK, James LL. Effects of common agents on intermediary temporary soft lining materials. J Prosthet Dent 1973:30:749-55.
4. Goll G, Smith DE, Plein JB. The effect of denture cleansers on temporary soft liners. J Prosthet Dent 1983:50:466-72.
5. Nikawa H, Iwanga H, Hamada T, Yuhta S. Effect of denture cleansers on direct soft lining material. J Prosthet Dent 1994:72: 657-62.
6. Gercia RM, Leon BT, Olievera VB, Del Bel Cury AA. Effect of denture cleanser on weight, surface roughness, and tensile bond strength of two resilient liners. J Prosthet Dent 2003:89: 489-94.
7. Zissis AJ, Polyzois GL, Yannikakis SA, Harrison A. Roughness of denture materials: A comparative study. Int J Prosthodont 2000:13:136-40.
8. Reza D, Amir A, Khaledi, Mehro V, Mohammad AO. The effect of two denture cleanser on surface roughness and hardness of a silicone soft liner. J Mash dent Sch 2009;33:33-40.
9. Ural C, Sanal FA, Sengiz S. Effect of different denture cleansers on surface roughness of denture base materials. Clin Dent Res 2011:35:14-20.
10. Jones, Hall, Sutow. Chemical molecular weight analysis of prosthodontic soft polymers. J Dent Res 1991;70:874-79.
11. Craig RG, Gibbsons P. Properties of resilient liners, Ann Arbor Mich. J Am Dent Assoc 1961:63:382-90.
12. Mese A, Guzel KG, Usyal E. Effect of storage duration on tensile bond strength of acrylic or silicone based soft denture liners to a processed denture base polymer. Acta Odontol scand 2005:63: 31-35.
13. Kawano F, Dootz ER, Koran A, Craig RG. Comparison of bond strength of six soft denture liners to denture base resin. J Prosthet Dent 1992:68:368-71.
14. Guzel KG, Mese A. Effect of storage duration on hardness on and tensile bond strength of silicone and acrylic based resilient denture liners to a processed denture base liners. J Prosthet Dent 2008;99:153-59.

## ABOUT THE AUTHORS

### Dayanand Ashok Huddar (Corresponding Author)

Associate Professor, Department of Prosthodontics, Bharati Vidyapeeth University Dental College, Sangli, Maharashtra, India
e-mail: sandhyadayahuddar@gmail.com

### MN Hombesh

Associate Professor, Department of Prosthodontics, SJM Dental College, Chitradurga, Karnataka, India

### B Sandhyarani

Assistant Professor, Department of Pediatric and Preventive Dentistry Bharati Vidyapeeth University Dental College and Hospital, Sangli Maharashtra, India

### GS Chandu

Professor, Department of Prosthodontics, Mansarovar Dental College Bhopal, Madhya Pradesh, India

### Girish Shankar Nanjannawar

Assistant Professor, Department of Conservative Dentistry and Endodontics, Bharati Vidyapeeth University Dental College, Navi Mumbai, Maharashtra, India

### Rohit Shetty

Professor, Department of Prosthodontics, KLE Society's Institute of Dental Sciences, Bengaluru, Karnataka, India