Original Research Article
Journal of Pierre Fauchard Academy (India Section), *Vol 36(1), DOI: 10.18311/jpfa/2022/28586, March 2022 p. 16-22*
ISSN (Print) : 0970-2199
ISSN (Online) : 2405-772X

Comparison of Tensile Bond Strength of Permasoft® and GC Reline Soft® Resilient Liners after Denture Base Surface Pretreatment

Fatema Sodawala and Javed Sodawala*

Dental College, Rungta College of Dental Science and Research, Bhilai – 490024, Chhattisgarh, India; drsodawalafatema@gmail.com, drjavedazher@gmail.com

Abstract

Objectives: The surface treatment of intaglio denture base surface by sandblasting followed by Methyl Methacrylate (MMA) monomer might enhance the bond strength of resilient liners. The purpose of this study was to evaluate and compare Tensile Bond Strength (TBS) of two resilient liners after surface treatment of Polymethyl Methacrylate (PMMA) resins by sandblasting and MMA monomer. **Materials and Methods:** One hundred and sixty PMMA resin blocks were randomly divided into eight groups of 20 blocks each based on type of resilient long term liner used (P=PermaSoft and G=GC Reline Soft) and the surface treatment performed (C=untreated Controls, S=Sandblasted, M=MMA monomer treated and SM=Sandblasted and MMA monomer treated: Group PC (PermaSoft untreated Controls), PS (PermaSoft Sandblasted), PM (PermaSoft MMA monomer treated) and PSM (PermaSoft Sandblasted and MMA monomer treated, GC (GC Reline Soft untreated Controls), GS (GC Reline Soft Sandblasted), GM (GC Reline Soft MMA monomer treated) and GSM (GC Reline Soft Sandblasted and MMA monomer treated). Each specimen was prepared by joining two PMMA resin blocks having standard dimensions of 10 × 10 × 40mm with either of the resilient liner of thickness of 10 × 10 × 3mm. The prepared 80 specimens were subjected to testing of TBS by universal testing machine. Also, the types of failure, whether adhesive, cohesive or mixed, were determined by stereomicroscope. One-way ANOVA followed by Tukey post hoc test was used to compare TBS of different surface treatment group with similar resilient liner. Student T-test was used to compare TBS of different resilient liner with similar surface treatment. The level of significance was set at 0.05. **Results:** There was highly significant difference in mean TBS of four surface treatment subgroups within both the groups (P<0.001). The Tukey post hoc test showed significant difference (P<0.05) between group PC=0.837 ± 0.120MPa and PSM=1.104 ± 0.234MPa; and GS=1.304 ± 0.261MPa and GM=2.053 ± 0.784MPa and highly significant difference (P<0.001) between group PS=0.741 ± 0.103 MPa) and PSM=1.104 ± 0.234MPa); and GS=1.304 ± 0.261MPa) and GSM=2.176 ± 0.262MPa. The mean TBS of GC Reline Soft was significantly higher (<0.001) than PermaSoft in various surface treatment groups. The overall modes of failures were predominantly cohesive type (63.75%) followed by mixed type (18.75%) and adhesive type (17.50%). **Conclusions:** All groups tested had mean bond strength values greater than the minimum acceptable standard (0.44MPa) for clinical application. MMA monomer treatment alone or in combination with sandblasting resulted in increase of the mean TBS whereas sandblasting resulted in decrease of the mean TBS of both PermaSoft and GC Reline Soft specimens.

Keywords: Denture Liners, Mode of Bond Failure, Surface Pretreatment, Tensile Bond Strength

(**Article chronicle:** **Received:** 07-09-2021; **Revised:** 29-12-2021; **Accepted:** 30-01-2022)

1. Introduction

US National Library of Medicine has defined denture liners as "material applied to the tissue side of a denture to provide a soft lining to the parts of a denture coming in contact with soft tissue. It cushions contact of the denture with the tissues." The use of resilient lining materials is helpful in fabricating removable complete and partial dentures because of their ability to alleviate inflamed mucosa resulting in a more equal distribution of functional load on the denture-bearing tissues and improving the intaglio denture surface and retention of the prosthesis[1]. The application of a resilient liners is also intended to increase the comfort of denture wearers and to support prosthetic treatment, either as a temporary or permanent line of treatment[2].

*Author for correspondence

Long-term resilient liners are usually either a plasticized acrylic resin or a silicone. Plasticized acrylic resin polymers are supplied in powdered forms and are subsequently mixed with liquids containing 60–80% plasticizer like dibutyl phthalate. Although plasticizers impart flexibility, these may be leached out of resilient liners. As this occurs, resilient liners become progressively more rigid. Silicone rubbers have become more popular as resilient liners. These materials are not dependent on leachable plasticizers; therefore, they retain their elastic properties for prolong periods[3].

There are disadvantages like various degrees of softness or poor tear strength with resilient liners. Another disadvantage of silicone-resilient liners is the failure of adhesion between a resilient liner and a denture base. This also creates a potential interface for micro leakage[4].

Various methods have been suggested to improve bond strength like mechanical roughening by sandblasting or lasers, chemical treatment with denture base monomer, chloroform, acetone, etc. The effect of sandblasting and chemical treatment with MMA monomer on the bond strength of various resilient liners has been studied previously[1,5–7]. However, there is scarce literature about the combined effect of sandblasting and MMA monomer treatment on the TBS of resilient liners.

It was hypothesized that the combination of sandblasting and MMA monomer treatment on the denture base does not affect the TBS of resilient liners. To test the alternate hypothesis, this study was undertaken to determine and compare TBS of two long terms resilient liners bonded to PMMA resin after surface treatment by sandblasting and chemical treatment with MMA monomer.

2. Materials and Methods

2.1 Design of Specimens

Eighty specimens of PMMA (Lucitone 199, Dentsply International Inc.) were fabricated in our institution for this study. Each specimen consisted of two rectangular PMMA resin blocks having standard dimensions of 10 × 10 × 40mm joined by either of the two resilient liners (PermaSoft, Dentsply International Inc. and GC Reline Soft, GC America Inc.) of thickness 3 × 10 × 10mm. (Figure 1) The dimensions of test specimens were such that they could be fabricated in conventional denture flasks and gripped easily in the testing machine[8]. The thickness of resilient liner was kept 3mm to replicate its clinical usage[9].

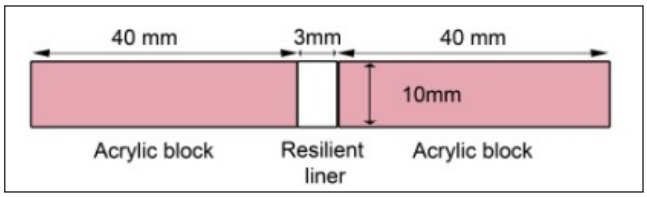


Figure 1. Schematic design of study specimen.

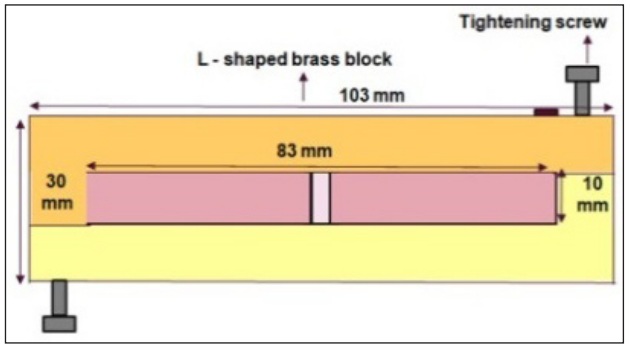


Figure 2. Schematic design of brass mold.

2.2 Preparation of PMMA Resin Blocks

Six equal sized brass dies of dimensions 10 × 10 × 40mm were made and elastomeric molds (Affinis, Coltene/Whaledent Inc.) were prepared to standardize fabrication of 160 PMMA resin blocks. Modeling wax (Maarc, Shiva Products) was melted and (Figure 2) poured into the molds. The wax blocks were removed from the molds and were invested in dental stone (Goldstone, Asian Chemicals) in denture processing flask. After dewaxing, heat polymerizing PMMA resin was mixed according to the manufacturer's instructions and packed in the flask. The flask was immersed in an acrylizer at room temperature. The temperature was raised to 73°C, held for 90mins, then raised to 100°C and was maintained for 30 mins. The flask was removed from the water bath and bench cooled for 30mins and immersed in cool tap water for 15mins prior to deflasking. The acrylic resin blocks were recovered from the flask, trimmed, finished and polished with 320 grit silicon carbide papers, polishing wheels and felt cones with pumice slurry.

2.3 Surface Preparation and Distribution of Specimens

The prepared 160 PMMA resin blocks were randomly divided into eight groups of 20 blocks each based on

type of resilient long term liner used (P=PermaSoft and G=GC Reline Soft) and the surface treatment performed (C=untreated Controls, S=Sandblasted, M=MMA monomer treated and SM=sandblasted and MMA monomer treated: Group PC (PermaSoft untreated Controls), PS (PermaSoft Sandblasted), PM (PermaSoft MMA monomer treated) and PSM (PermaSoft Sandblasted and MMA monomer treated, GC (GC Reline Soft untreated Controls), GS (GC Reline Soft Sandblasted), GM (GC Reline Soft MMA monomer treated) and GSM (GC Reline Soft Sandblasted and MMA monomer treated).

Group PC and GC was not given any surface treatment. The two surfaces of PMMA resin blocks facing the resilient liners were subjected to three types of surface treatments before bonding. Group PS and GS was sandblasted with aluminium oxide of 250μm (Safe Plus Blaster Sand, Neelkanth Healthcare Pvt. Ltd.) as the sandblasting medium at a pressure of 0.62MPa. The nozzle of the sandblasting unit measuring about 1.0 mm in diameter was held approximately 10 mm away from each block for 30s. These blocks were then placed in ultrasonic cleaner and distilled water for 10 min to remove any residue remaining on the prepared surfaces. Group PM and GM was chemically treated by swabbing with cotton saturated with the MMA monomer (DPI Heat Cure, Dental Products of India Ltd.) for 180s. Group PSM and GSM was sandblasted as well as chemically treated with MMA monomer. All the acrylic resin blocks were color coded for ease of identification and testing.

2.4 Preparation of Specimens

Two PMMA resin blocks separated by a brass spacer of dimension 10 × 10 × 3mm was seated in a specially designed mold. The spacer was removed and the surfaces were cleaned and dried. Permasoft specimens (Group PC, PS, PM and PSM) was made by mixing PermaSoft according to manufacturer's instructions and spreading into the space between PMMA resin blocks. The specimens were retrieved from the molds and placed into a cup filled with hot water and polymerized for 10 min. The excess flash was removed and a generous coat of PermaSoft Sealer was applied over the resilient liner and air dried for 2 mins.

GC Reline Soft specimens were made by first applying GC Reline Primer R to the bonding surface with a brush and gently drying with oil-free air. GC Reline Soft was dispensed from the cartridges onto the space created by spacer and polymerized for 5 mins. After curing, specimens were retrieved and excess liner was removed.

2.5 Testing of Specimens

The specimens were stored in distilled water at 37°C for one week in an incubator before testing. They were aligned in universal testing machine (Star Testing Systems) with one end attached to upper clamp and other end to the lower clamp and were pulled with a crosshead speed of 5 mm/min. The peak loads at which the bond failures occurred were recorded. The maximum tensile stress before failure divided by the cross sectional area of the interface produced the TBS value for the specimen. The least count of the universal testing was 0.05 kN. The modes of bond failures- adhesive, cohesive or mixed were recorded with the help of stereomicroscope. (LYNX, Lawrence and Mayo).

2.6 Statistical Analysis

The data were compiled and analyzed with Statistical Package for Social Sciences software (SPSS, Version 16). Means and standard deviations of TBS were determined for all the groups. One way analysis of variance (ANOVA) followed by Tukey post hoc test was used to compare TBS of different surface treatment group with similar resilient liner. Student t test was used to compare TBS of different resilient liner with similar surface treatment. The modes of bond failures were expressed in percentage.

3. Results

The descriptive statistics of TBS of different surface treatment groups is illustrated in Table 1. For PermaSoft lined specimens, the lowest mean TBS was observed in group PS (0.741 ± 0.103MPa) and highest mean TBS was observed in group PSM (1.104 ± 0.234MPa). For GC Reline Soft lined specimens, the lowest mean TBS was observed in group GS (1.304 ± 0.261MPa) and highest mean TBS was observed in group GSM (2.176 ± 0.262MPa).

There was highly significant difference in mean TBS of four surface treatment groups within PermaSoft lined specimens and GC Reline Soft lined specimens ($P<0.001$). The Tukey post hoc test showed significant difference ($P<0.05$) between group PC (0.837 ± 0.120MPa) and PSM (1.104 ± 0.234MPa); and GS (1.304 ± 0.261MPa) and GM

(2.053 ± 0.784MPa) and highly significant difference (P<.001) between group PS (0.741 ± 0.103MPa) and PSM (1.104 ± 0.234MPa); and GS (1.304 ± 0.261MPa) and GSM (2.176 ± 0.262MPa).

Table 1. Comparison of mean TBS among different surface treatment groups with ANOVA and Post hoc test

Group	N	Mean	SD	F value	P value
PC	10	0.837	0.120	8.176	<.001**
PS	10	0.741	0.103		
PM	10	0.921	0.190		
PSM	10	1.104	0.234		
GC	10	1.679	0.298	7.384	<.001**
GS	10	1.304	0.261		
GM	10	2.053	0.784		
GSM	10	2.176	0.262		

Multiple comparisons within groups	P value
PC and PS	.596
PC and PM	.685
PC and PSM	.007*
PS and PM	.102
PS and PSM	<.001**
PM and PSM	.097
GC and GS	.277
GC and GM	.278
GC and GSM	.091
GS and GM	.004*
GS and GSM	.001**
GM and GSM	.933

*P<.05 significant difference; **P<.001 highly significant difference

Table 2 shows that there was highly significant difference in mean TBS among different surface treatment subgroups of GC Reline Soft and PermaSoft lined specimens (P<0.001). The mean TBS of group GC and PC, GS and PS, GM and PM, and GSM and PSM and the difference was statistically highly significant (P<0.001).

Table 3 shows the distribution of modes of failures in percentage for different study groups. The overall modes of failures were predominantly cohesive type (63.75%) followed by mixed type (18.75%) and adhesive type (17.50%).

Table 2. Comparison of mean TBS between study groups for similar surface treatment with student t test

Group	N	Mean	SD	P value
PC	10	0.836	0.120	<.001**
GC	10	1.679	0.298	
PS	10	0.741	0.103	<.001**
GS	10	1.304	0.261	
PM	10	0.921	0.190	<.001**
GM	10	2.053	0.784	
PSM	10	1.104	0.234	<.001**
GSM	10	2.176	0.262	

**P<.001 highly significant difference

Table 3. Distribution of modes of failures in percentage for different study groups

Group	N	Cohesive	Adhesive	Mixed
PC	10	50	10	40
PS	10	100	-	-
PM	10	90	-	10
PSM	10	90	-	10
P	40	82.50	2.50	15
GC	10	-	50	50
GS	10	70	30	-
GM	10	30	50	20
GSM	10	80	-	20
G	40	45	32.50	22.50
Total	80	63.75	17.50	18.75

4. Discussion

The results of the study revealed that PermaSoft and GC Reline Soft Controls had mean TBS of 0.837 + 0.120 MPa and 1.679 + 0.298 MPa respectively and this difference was statistically highly significant (P<0.001) as illustrated in Table 2. Khan *et al.*[10] reported that soft denture liners should have a minimum of 0.44 MPa bond strength to be acceptable for clinical use. Considering this criterion, GC Reline Soft and PermaSoft liners had satisfactory TBS when bonded to PMMA denture base resin. The results of this study as regards for PermaSoft and GC Reline Soft are in agreement with findings of other studies[5,11–15].

The result of the present study indicated that PermaSoft which is acrylic resin based denture liner demonstrated lower tensile bond strength as compared to GC Reline Soft which is a silicone based denture liner. This may be attributed to the improved adhesive bonding systems that can penetrate the acrylic resin. The acrylic resin based liners though chemically similar to the resin denture base show lower bond strength because of the limited ability of the acrylic resin monomer to infiltrate this interface. These findings are in agreement with the similar studies conducted by Emmer *et al.*[11] and Madan and Dutta[16].

The effect of three different surface treatments of denture base resins on the bond strength with denture liners has been evaluated in this study. The sandblasting of the denture bases resulted in reduction of mean TBS of PermaSoft (0.741 + 0.103MPa) compared to TBS of PermaSoft Controls (0.837 + 0.120MPa) but the difference was not statistically significant (P=.596) as shown in Table 1. Similarly, the sandblasting of the denture bases resulted in reduction of mean TBS of GC Reline Soft (1.304 + 0.261MPa) as compared to mean TBS of GC Reline Soft Controls (1.679 + 0.298MPa) and the difference was not statistically significant (P=.277) as shown in (Table 1).

The sandblasted GC Reline Soft had greater mean TBS as compared to PermaSoft Controls and this difference was highly significant (P<0.001) as shown in (Table 2). The findings are in accordance with the other studies[5–7,17] who had also found out that sandblasting decrease the TBS of the resilient liners. The irregularities produced by sandblasting, increases the viscosity of the resilient liner for a given contact angle and the resulting surface tension reduces the penetration of the resilient liner[6].

However, the studies by Khanna *et al.*[1] and Gopal *et al.*[18] have shown that sandblasting increases TBS of the resilient liners which was contradictory to the present study. Khanna *et al.*[1] had used heat polymerized acrylic resin and silicone liner (SuperSoft and LuciSof). The increase in TBS for heat polymerized acrylic resin liner could be attributed to the high temperatures during polymerization and the similar chemical structures which could facilitate diffusion of methacrylate molecules from acrylic resin liners into the denture base material, thereby creating better bonding. The increase in TBS for silicone liner was statistically insignificant. The authors attributed this increase by surface roughening to the frictional forces that was generated when two contacting surfaces moved relative to each other.

The chemical treatment with MMA monomer of the denture bases resulted in increase of mean TBS of PermaSoft (0.921 + 0.190MPa) as compared to mean TBS of PermaSoft Controls but this difference was not statistically significant (P=0.685) as shown in (Table 1). Similarly, the chemical treatment with MMA monomer of the denture bases resulted in increase of mean TBS of GC Reline Soft (2.053 + 0.784MPa) as compared to mean TBS of GC Reline Soft Controls and this difference was not statistically significant (P=0.278) as shown in (Table 1). The MMA treated GC Reline Soft had greater mean TBS as compared to PermaSoft and this difference was highly significant (P<0.001) as shown in (Table 2).

These results are in accordance with the other studies[1,5,19,20] which also showed increased TBS after MMA treatment. PermaSoft forms a strong bond with acrylic resin as both have a similar composition. GC Reline Soft, being a silicone based liner, requires an adhesive, a solvent that dissolves the PMMA surface, and the bond strength of silicone liners will depend on tensile strength of the materials and the adhesive used. Therefore, use of monomer and adhesive together before the resilient liner application may effectively increase the dissolution of the PMMA surface. It enables added fluid to penetrate between polymer chains and become entangled when the added monomer or solvent is evaporated[20].

The combined effect of sandblasting and MMA treatment of the denture bases resulted in increase of mean TBS of PermaSoft (1.104 + 0.234 MPa) as well as GC Reline Soft (2.176 + 0.262 MPa) as compared to mean TBS of PermaSoft and GC Reline Soft Controls and the difference between PermaSoft Controls and combination of sandblasting and MMA treated PermaSoft was statistically significant (P<0.007) as shown in (Table 1). The combined effect of sandblasting and MMA treated GC Reline Soft had greater mean TBS as compared to PermaSoft and this difference was highly significant (P<0.001) as shown in (Table 2).

It was assumed that sandblasted surfaces may have pits, cracks, crevices, discontinuities with sharp corners and projections. These surface irregularities may not allow complete flow of the soft denture liner and may result in the formation of small voids by air entrapment. Therefore, stress concentration may be developed in the vicinity of the bonding interface and initiate failure during tensile testing[17]. The rubbing of a monomer into acrylic resin might result in greater bond strength due to increased penetrations of the chains of the acrylic resins

into the acrylic resin based liner or into the bonding agent dedicated to silicone based liners.

With regards to bond failures as illustrated in (Table 3), for PermaSoft lined specimens, the modes of failures were predominantly cohesive type (82.50%) followed by mixed type (15%) and adhesive type (2.50%). For GC Reline Soft lined specimens, the modes of failures were predominantly cohesive type (45%) followed by adhesive type (32.50%) and mixed type (22.50%). Other studies[5,11,13-15] also found wide range of bond failures. The modes of bond failure of soft liners are important in interpreting the results of bond strength tests. When the material fails cohesively, it may be concluded that the strength of the material is lower than the strength of the bond.[2] Thus PermaSoft has lower strength as indicated by 82.50% cohesive failures as against GC Reline Soft with 45% cohesive failures.

Since there are number of variables which can affect the bond strength of denture base to liners, it is not easy to derive any direct conclusions from this study. Results of this testing should be interpreted with caution as there are numerous factors which affect test results, e.g., liner thickness, duration of application of monomer, strain rate, test methods, etc.[21,22] Water sorption may also affect bond strength and further investigation is required to determine the influence of this factor[11,23]. This study was entirely laboratory based and because the most appropriate testing environment is the mouth, long-term clinical studies of these materials are required.

These results are helpful in determining which materials have the best bond strength when processed to new denture base resin. However, it should be pointed out that the bond strength will likely be lower when old dentures are relined, since the denture base may be contaminated by microorganisms and other materials absorbed into the denture base from food or cleansing agents[24].

In addition, the type of denture base material, the preparation of its surface with different-grit abrasive papers or the aging of denture base material substrates before denture liner application could affect the results[14].

5. Conclusions

It was found out that both the resilient liners exhibited the TBS values which were higher than the minimum acceptable standard for clinical applications. GC Reline Soft has demonstrated significantly higher tensile bond strength to the denture base than PermaSoft (P<0.001). Regarding the effect of different surface treatment of denture base on TBS of resilient liners, the combined treatment of sandblasting and chemical treatment with MMA monomer has shown significantly higher TBS, followed by MMA treated and sandblasting alone for both the resilient liners (P<0.05).

6. References

1. Khanna A, Bhatnagar VM, Karani JT, Madria K, Mistry S. A comparative evaluation of shear bond strength between two commercially available heat cured resilient liners and denture base resin with different surface treatments. *J Clin Diagn Res*. 2015; 9:ZC30–4. https://doi.org/10.7860/JCDR/2015/11504.5892. PMid:26155558. PMCid:PMC4484150
2. Braden M, Wright PS, Parker S. Soft lining materials – A review. *Eur J Prosthodont Rest Dent*. 1995; 3:163–74.
3. Phoenix RD. Denture base resins. In Phillips' Science of Dental Materials, 11th ed.; Anusavice K, Ed.; Saunders: St. Louis, MO, USA, 2003; p. 750–2.
4. Chladek GR, Żmudzki J, Kasperski J. Long-term soft denture lining materials. *Materials*. 2014; 7:5816–42. https://doi.org/10.3390/ma7085816. PMid:28788163. PMCid:PMC5456172
5. Surapaneni H, Ariga P, Haribabu R, Shankar YR, Kumar VH, Attili S. Comparative evaluation of tensile bond strength between silicon soft liners and processed denture base resin conditioned by three modes of surface treatment: an invitro study. *J Ind Prosthodont Soc*. 2013; 13:274–80. https://doi.org/10.1007/s13191-012-0235-5. PMid:24431747. PMCid:PMC3732717
6. Kulkarni RS, Parkhedkar R. The effect of denture base surface pretreatments on bond strengths of two long term resilient liners. *J Adv Prosthodont*. 2011; 3:16–9. https://doi.org/10.4047/jap.2011.3.1.16. PMid:21503188. PMCid:PMC3076568
7. Swapna C, Hareesh MT, Renjith M, Ahmed A, Abraham IA, Gopinathan M. An evaluation of the effect of surface treatment on the bond strength of soft denture liners. *J Int Oral Health*. 2016; 8:922–6.
8. Garcia RCMR, Leon BLT, Oliveira VMB, Cury AADB. Effect of denture cleanser on weight, surface roughness and tensile bond strength of two resilient denture liners. *J Prosthet Dent*. 2003; 89:489–94. https://doi.org/10.1016/S0022-3913(03)00126-4
9. Kawano F, Tada N, Nagao K, Matsumoto N. The influence of soft lining materials on pressure distribution. *J Prosthet*

Dent. 1991; 65:567–75. https://doi.org/10.1016/0022-3913(91)90301-C

10. Khan Z, Martin J, Collard S. Adhesion characteristics of visible light cured denture base material bonded to resilient lining materials. *J Prosthet Dent*. 1989; 62:196–200. https://doi.org/10.1016/0022-3913(89)90313-2
11. Emmer T J, Vaidyanathan J, Vaidyanathan TK. Bond strength of permanent soft denture liners bonded to the denture base. *J Prosthet Dent*. 1995; 74:595–601. https://doi.org/10.1016/S0022-3913(05)80311-7
12. El-Hadary A, Drummond JL. Comparitive study of water sorption, solubility and tensile bond strength of two soft lining materials. *J Prosthet Dent*. 2000; 83:356–61. https://doi.org/10.1016/S0022-3913(00)70140-5
13. Pinto JRR, Mesquita MF, Henriques GEP, de Arruda Nobilo MA. Effect of thermocycling on bond strength and elasticity of four long term soft denture liners. *J Prosthet Dent*. 2002; 88:516–21. https://doi.org/10.1067/mpr.2002.128953. PMid:12474002
14. Mutluay MM, Ruyter IE. Evaluation of bond strength of soft relining materials to denture base polymers. *Dent Mater.* 2007; 23:1373–81. https://doi.org/10.1016/j.dental.2006.11.014. PMid:17222898
15. McCabe JF, Carrick TE, Kamohara H. Adhesive bond strength and compliance for denture soft lining materials. *Biomaterials*. 2002; 23:1347–52. https://doi.org/10.1016/S0142-9612(01)00253-8
16. Madan N, Dutta K. Evaluation of tensile bond strength of heat cure and auto-polymerizing silicone-based resilient denture liners before and after thermocycling. *Ind J Dent Res*. 2012; 23:64–8. https://doi.org/10.4103/0970-9290.99041. PMid:22842252
17. Minami H, Suzuki S, Ohashi H, Kurashige H, Tanaka T. Effect of surface treatment on the bonding of an autopolymerizing soft denture liner to a denture base resin. *Int J Prosthodont.* 2004; 17:297–301.
18. Gopal KV, Padmaja BJ, Reddy NR, Reddy BM, Babu NS, Sunil M. Comparison and evaluation of tensile bond strength of two soft liners to the denture base resin with different surface textures: An in vitro study. *J NTR Uni Health Sci.* 2014; 3:102–6. https://doi.org/10.4103/2277-8632.134850
19. Sarac YS, Sarac D, Kulunk T, Kulunk S. The effect of chemi¬cal surface treatments of different denture base resins on the shear bond strength of denture repair. *J Prosthet Dent*. 2005; 94:259–66. https://doi.org/10.1016/j.prosdent.2005.05.024. PMid:16126078
20. Leles CR, Machado AL, Vergani CE, Giampaolo ET, Pavarina AC. Bonding strength between a hard chairside reline resin and a denture base material as influenced by surface treatment. J Oral Rehabil. 2001; 28:1153–7. https://doi.org/10.1046/j.1365-2842.2001.00786.x. PMid:11874516
21. Al-Athel MS, Jagger RG. Effect of test method on the bond strength of a silicone resilient denture lining material. *J Prosthet Dent.* 1996; 76:535–40. https://doi.org/10.1016/S0022-3913(96)90014-1
22. Vallittu PK, Lassila VP, Lappalainen R. Wetting the repair surface with methyl methacrylate affects the transverse strength of repaired heat-polymerized resin. *J Prosthet Dent.* 1994; 72:639–43. https://doi.org/10.1016/0022-3913(94)90297-6
23. Kulak-Ozkan Y, Sertgoz A, Gedik H. Effect of thermocycling on tensile bond strength of six silicone based resilient denture liners. *J Prosthet Dent*. 2003; 89:303–10. https://doi.org/10.1067/mpr.2003.41. PMid:12644808
24. Kawano F, Dootz ER, Koran A, Craig RG. Comparison of bond strength of six denture liners to denture base resin. *J Prosthet Dent.* 1992; 68:368–71. https://doi.org/10.1016/0022-3913(92)90347-D