

Effect of Surface Pretreatment (Air Abrasion) on Bond Strength of Polymethamethacrylate (PMMA) to the Soft Denture Lining Material

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ABSTRACT

Background: This study was conducted to investigate the effect of Air abrasion on bond strength of denture base to a soft liner in presence of artificial saliva, one RTV(Room temperature vulcanization, Ufigel P voco GmbH) silicone soft liner, and one HTV(Heat cure vulcanization, Molloplast B, detax, GmbH & company) were selected

Materials and Methods: DPI, Heat cure PMMA is used as a denture base.80 specimens were fabricated and divided into two groups, half samples were lined by Molloplast B and the other half were lined with Ufigel p. these subgroups were further divided into two groups. From each of the surface treated groups (AIR ABRASION) 10 samples tested the same day for tensile bond strength and the other 10 samples were stored in artificial saliva for 7 days and then tested for tensile bond strength. The universal testing machine (UTM) is used for tensile strength measurement.

Results: Air abrasion (alumina particle 50 um) of pmma surface decreased the bonding between liner and pmma resin. Artificial saliva significantly reduces the bonding between PMMA and liner.

Conclusion: Air abrasion treatment of the pmma surface decreased the bonding between liner and pmma.

Keywords: Surface Pretreatment, Polymethamethacrylate, Soft Denture Lining.

INTRODUCTION

soft denture lining material is a polymeric material placed on the intaglio surface of the denture base. It compensates for the lost tissue thickness and functions and absorbs some of the masticatory forces. soft lining material has been used in dentistry for more than a century. Adequate bonding between lining material and denture base resin is necessary to avoid bond failure and it creates a potential surface for bacterial growth and plaque or calculus formation. Favorable properties

of a denture liner become useless in the absence of a good bond to the denture base material.^{1,2,3}

Silicone base liners are long term lining material but have little or no chemical adhesion to denture base resin, so adhesive primer is used to aid bonding to the denture base resin. So the bonding of silicone soft denture liners depends on the tensile strength of the adhesive liners and the adhesive primer used.¹

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Bond strength can be altered by various methods namely, mechanical roughening by metal, sandpapering, laser, sandblasting, chemical treatment with acids, acetone, acid etching, and mechanochemical treatment.

During use, soft lining materials are immersed in saliva and during denture storage in water or an aqueous cleaning solution. Soft denture lining materials undergo two responses during immersion leaching out of plasticizers and other soluble components and absorption of water and saliva.^{12,13}

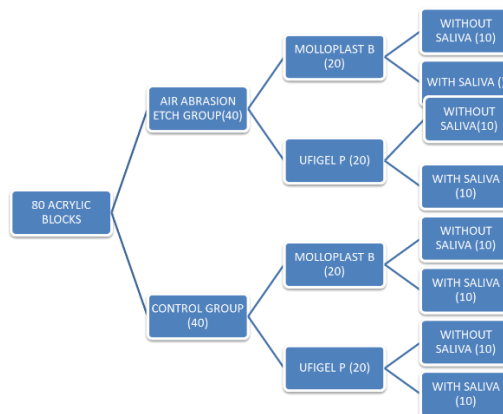
MATERIALS AND METHODS

160 pmma blocks size (10 *10*40) prepared (FIG 2). To prepare equal blocks first metal die of this size is prepared and putty index taken and poured with wax and flaked in a conventional manner.40 specimens were prepared from these b locks half were lined by Molloplast b (DETAX GMBH) by flasking and half were lined with ufi gel p (VOCO) without any surface pretreatment(control group) and the rest 40 were abraded with air borne alumina particle 50 um, the nozzle measuring 1 mm in diameter was held in light contact with each specimen (test group) among half (20)were lined by Molloplast b and half (20) were lined with RTV Ufigel p. these subgroups were further divided into two groups. From each of the surface treated groups, 10 samples tested the same day for tensile bond strength and the other 10 samples were stored in artificial saliva for 7 days(FIG 5) and then tested for tensile bond strength.

The specimen was subjected to tensile stress on UTM (universal testing machine) and deformed using a crosshead speed of 5 mm per minute. The load at which failures occurred was recorded. The machine has two arms which move in the opposite direction during tensile bond testing at 5 mm/ minute pulling acrylic blocks apart and stretching the soft liner until it debonds and the final maximum stress value recorded. (FIG 6)

The values were calibrated and the tensile bond strength was calculated using the following formula:

$$\text{Tensile bond strength} = \frac{\text{Load in newtons}}{\text{Surface area in mms}}$$



Flow chat 1: Grouping of test specimen.

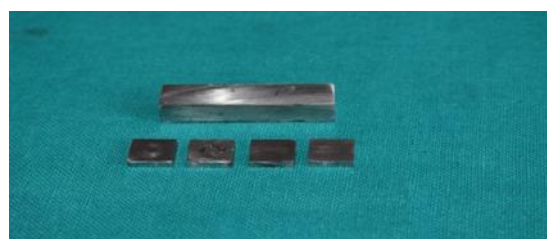


Fig 1: SS steel master die (10*10*40mm).



Fig 2: Wax block obtained from index moulds.



Fig 3: Fabrication of UFI gel p specimen.

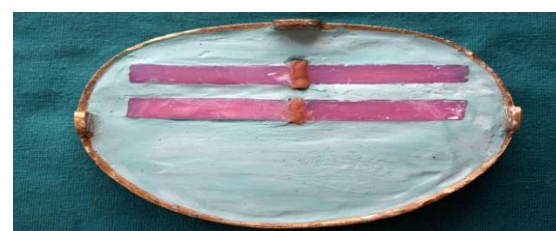


Fig 4: Fabrication of molloplast b specimen.



Fig 5: 5test specimen immerced in artificial saliva for 7 days.



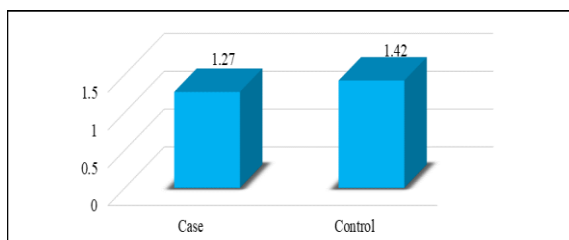
Fig 6: Specimen in UTM.

RESULTS

Table 1: Comparison of mean tensile bond strength of Malloplast B without saliva between the cases and controls using independent t test.

Groups	Sampl e size	Mea n	SD	Mean differenc e	t value	p value	Significanc e
Case	10	1.27	0.10	0.15	4.568	0.001	Statistically significant
Contro l	10	1.42	0.03				

The control group showed higher mean tensile bond strength of Malloplast B without saliva than the case group with mean difference of 0.15 mpa which is statistically significant ($p < 0.05$)

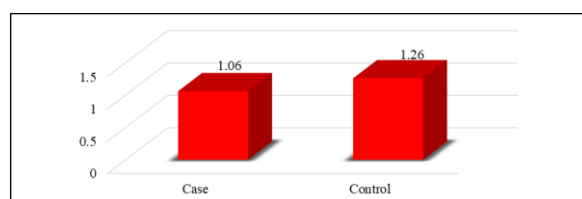


Graph 1: Comparison of mean tensile bond strength of Malloplast B without saliva between the cases and controls

Table 2: Comparison of mean tensile bond strength of Malloplast B immersed in saliva between the cases and controls using independent t test.

Groups	Sampl e size	Mea n	SD	Mean differenc e	t value	p value	Significanc e
Case	10	1.06	0.08	0.20	6.481	0.000	Statistically significant
Contro l	10	1.26	0.04				

The control group showed higher mean tensile bond strength of Malloplast B immersed in saliva than the case group with mean difference of 0.20 mpa which is statistically significant ($p < 0.05$)

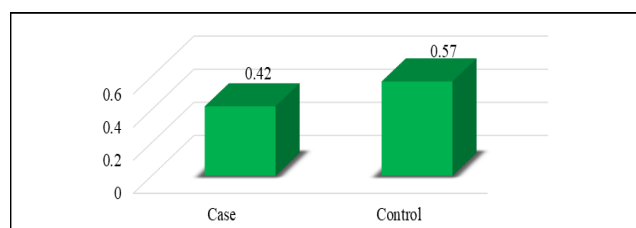


Graph 2: Comparison of mean tensile bond strength of Malloplast B immersed in saliva between the cases and controls.

Table 3: Comparison of mean tensile bond strength of Ufi Gel P without saliva between the cases and controls using independent t test.

Groups	Sampl e size	Mea n	SD	Mean differenc e	t value	p value	Significanc e
Case	10	0.42	0.04	0.15	8.027	0.000	Statistically significant
Contro l	10	0.57	0.03				

The control group showed higher mean tensile bond strength of Ufi Gel P without saliva than the case group with mean difference of 0.15 mpa which is statistically significant ($p < 0.05$).

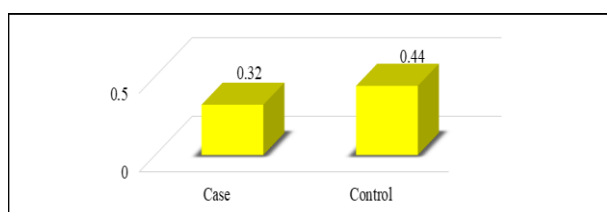


Graph 3: Comparison of mean tensile bond strength of Ufi Gel P without saliva between the cases and controls.

Table 4. Comparison of mean tensile bond strength of Ufi Gel P immersed in saliva between the cases and controls using independent t test.

Groups	Sample size	Mean	SD	Mean difference	t value	p value	Significance
Case	10	0.32	0.01	0.12	10.105	0.000	Statistically significant
Control	10	0.44	0.03				

The control group showed higher mean tensile bond strength of Ufi Gel P immersed in saliva than the case group with mean difference of 0.12 mpa which is statistically significant ($p < 0.05$)

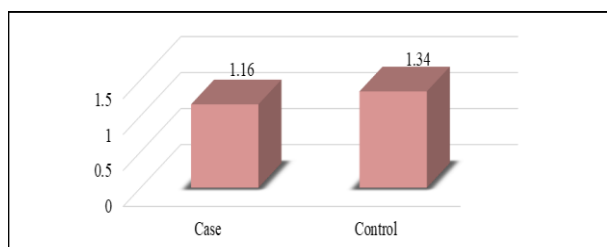


Graph 4: Comparison of mean tensile bond strength of Ufi Gel P immersed in saliva between the cases and controls.

Table 5: Overall comparison of mean tensile bond strength of Malloplast B between the cases and controls using independent t test.

Groups	Sample size	Mean	SD	Mean difference	t value	p value	Significance
Case	20	1.16	0.14	0.18	4.639	0.000	Statistically significant
Control	20	1.34	0.09				

The control group showed higher mean tensile bond strength of Malloplast B than the case group with mean difference of 0.18 mpa which is statistically significant ($p < 0.05$)

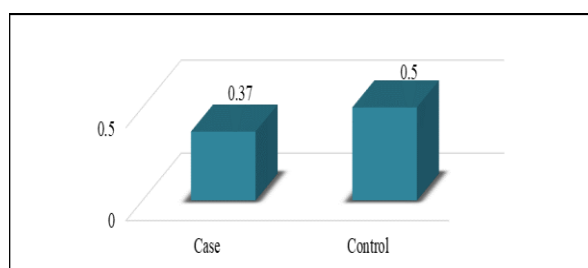


Graph 5: Overall comparison of mean tensile bond strength of Malloplast B between the cases and controls.

Table 6: Overall comparison of mean tensile bond strength of Ufi Gel P between the cases and controls using independent t test.

Groups	Sample size	Mean	SD	Mean difference	t value	p value	Significance
Case	20	0.37	0.06	0.13	5.958	0.000	Statistically significant
Control	20	0.50	0.07				

The control group showed higher mean tensile bond strength of Ufi Gel P than the case group with mean difference of 0.13 mpa which is statistically significant ($p < 0.05$).



Graph 6: Overall comparison of mean tensile bond strength of Ufi Gel P between the cases and controls.

DISCUSSION

This test was intended to evaluate the effect of mechanical pretreatment and artificial saliva effect on tensile bond strength 2 commercially available soft liner to heat-cured PMMA. resilient liner should have good adhesion to the pmma. Poor adhesion to the adhesive leads to functional and hygiene problems if they detach from each other during use. this study was undertaken to estimate the bond strength of different soft liners to pmma resin.

Test develop by various investigators for testing the bond strength include peel test, tensile test, and shear test. Peel test closely resembles intraoral forces but chances of cohesive failures are more. Craig and Gibbons 9 assessed TBS is 0.45 mm and is adequate adhesive value for an optimal bond. According to Kawano et al¹¹ a bond strength of 0.44 mpa is acceptable for the clinical use of resilient lining materials khan et al reported that soft denture liners should have a minimum of 0.44 mpa bond strength to be acceptable for clinical use¹². both the soft liners have tensile bond strength

higher than above so it indicates this study have got satisfactory bond strength for clinical application.

Craig and gibbons ¹² reported that a roughened surface enhanced the bond strength and that the adhesive values obtained with a roughened surface were approximately double that of a smooth surface. Amin et al¹⁵ and akin et al¹⁶ reported that roughening the acrylic resin base with airborne particle abrasion before applying a resilient lining material weakenes the bond. they proposed that lower bond strengths were due to stresses that occurred at interface of the pmma/ resilient liner junction or that the size of the irregularities created by airborne particle abrasion medium might not be sufficient to allow the resilient lining material to flow into it. in present investigation, abrasion pretreatment using 50um alumina significantly decreased the TBS for both the soft liners.

CONCLUSION

1) Air abrasion TREATMENT OF THE pmma SURFACE decreased THE BONDING BETWEEN LINER AND PMMA.

2) Mean bond strength of Molloplast b was significantly higher than ufi gel p in various surface treatment groups.

3) Both the material tested had mean bond strength values greater than the minimum acceptable standard(0.44 mpa) for clinical application.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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