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Evaluate and Compare the Hardness and Tensile Bond Strength of a Silicone Soft Lining Material, after Short Term Immersion in Two Different Denture Cleansing Solutions and Water over Varying Time Periods

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Abstract

***Background*: *Background*:** To evaluate and compare the hardness and tensile bond strength of a silicone soft lining material, after short term immersion in two different denture cleansing solutions and water over varying time periods. ***Materials & Methods*:** The study comprised of 3 groups followed by 3 subgroups under each groups of 10 specimens for evaluation of tensile bond strength with heat cure denture base acrylic resin, and 3 groups followed by 3 subgroups under each groups of 10 specimens each for the hardness test of soft liners. Group A: Heat polymerized silicone based resilient liner immersed in denture cleansing solution secure with 700mg of sodium perborate monohydrate, Group B: Heat polymerized silicone based resilient liner immersed in denture cleansing solution clinsodent with 480mg of sodium perborate monohydrate and Group C: Heat polymerized silicone based resilient liner immersed in water. ***Results*:** At day 1 and 1 week, Group B showed highest tensile bond strength (1.50±0.015) and (1.12 ± 0.012) respectively whereas at 1 month, Group C showed highest tensile bond strength (0.96 ± 0.016). ***Conclusion*:** A significant difference exists in the tensile bond strength and the hardness values of the soft liner specimen when immersed in water and two different denture cleansing solutions between the periods of immersion.

Keywords: Soft liner, hardness, tensile strength.

INTRODUCTION

Residual alveolar ridge is that portion of the alveolar ridge and its soft tissue covering which remains following the removal or loss of teeth [1]. Studies have demonstrated that alveolar ridge volume loss post extraction is an irreversible process that involves both horizontal and vertical reduction [2]. Alveolar ridge atrophy may have a considerable impact on tooth replacement therapy [3].

A soft liner is a layer of soft, pliable material that is fitted between the surface of a denture and oral tissues. Soft lining materials form a pressure absorbing layer on tissue surface of denture in contact with the oral mucosa and this allows less traumatic occlusal force transmission [4]. A soft (resilient) lining material may be defined as a soft elastic and resilient material forming all or part of the fit (impression) surface of a denture. It usually acts as a cushion between the hard denture base and the tissues to reduce the masticatory forces transmitted by prostheses to the underlying tissues [5]. The silicone rubber materials are basically composed of polymers of dimethyl siloxane a viscous liquid that can be crosslinked to give good elastic properties. The crosslinking agent is normally an alkyl-silane, and the reaction is usually catalyzed by an organometal salt or benzoyi peroxide. Silicone rubbers

have no natural adhesion to poly (methyl methacrylate), an adhesive composed of a silicone polymer in a volatile solvent must be used [6]. Hardness and tensile properties are fundamental properties of rubber material; hardness is a simple way of obtaining a measure of the elastic material by determining the resistance to a rigid indenter to which a force is applied. Nevertheless, these properties can be affected when the material is submitted to daily immersion in denture cleansers or disinfectants [7]. Disinfection of denture base material [8] as well as denture liners were recommended as a method of reduction in the microbial contamination or growth and reduces oral infection as well as cross contamination [9]. Hence, this study was conducted to evaluate and compare the hardness and tensile bond strength of a silicone soft lining material, after short term immersion in two different denture cleansing solutions and water over varying time periods.

MATERIALS & METHODS

The study comprised of 3 groups followed by 3 subgroups under each groups of 10 specimens for evaluation of tensile bond strength with heat cure denture base acrylic resin, and 3 groups followed by 3 subgroups under each groups of 10 specimens each for the hardness test of soft liners. Group A: Heat polymerized silicone based resilient liner immersed in denture cleansing solution secure with 700mg of sodium perborate monohydrate, Group B: Heat polymerized silicone based resilient liner immersed in denture cleansing solution clinsodent with 480mg of sodium perborate monohydrate and Group C: Heat polymerized silicone based resilient liner immersed in water. Tensile bond testing was done to evaluate the bond strength of the soft liners to acrylic denture base resin, using a universal testing machine after storing the samples in water and denture cleansing solutions for 1 day, 1 week and 1 month. The results were analysed using Kruskal- Wallis test.

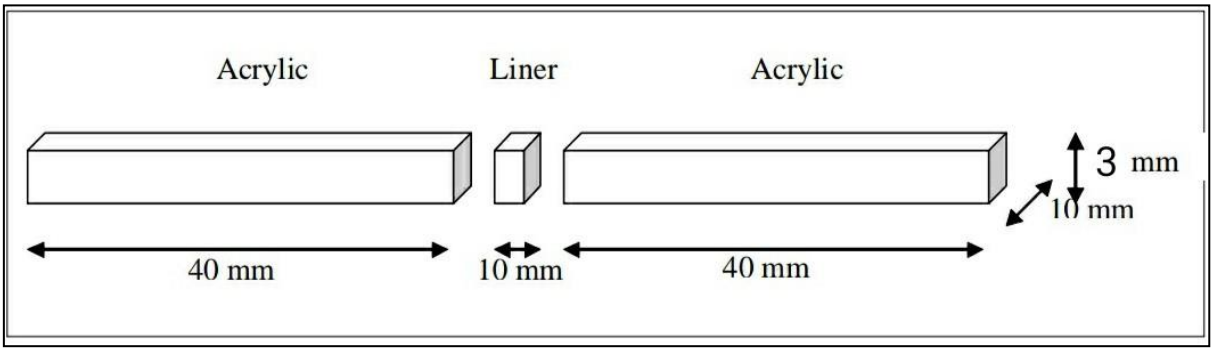

Fig. 1: The dimension of the dies used for testing tensile bond strength

Fig. 2: Metal die invested in a flask

Fig. 3: Metal die replaced with two polymerized acrylic block with silicone soft liner in between cure acrylic resin and silicone soft liner in between

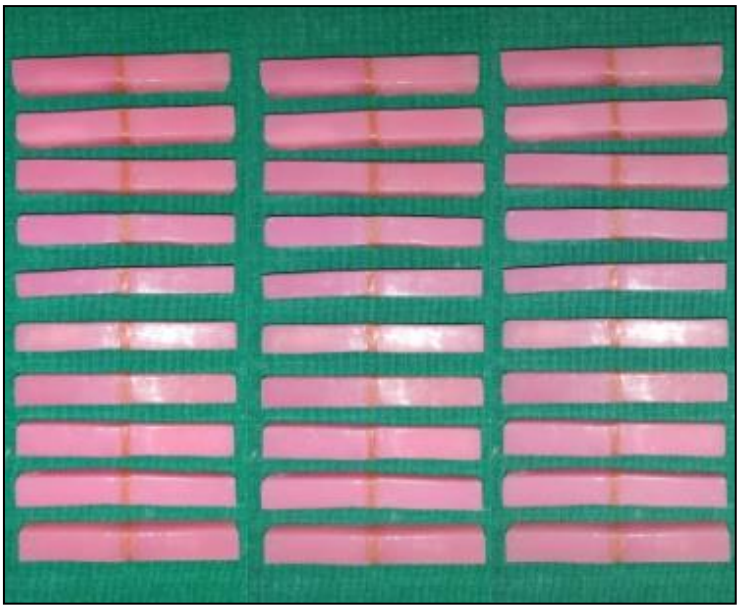

Fig. 4: Specimens for tensile bond strength testing

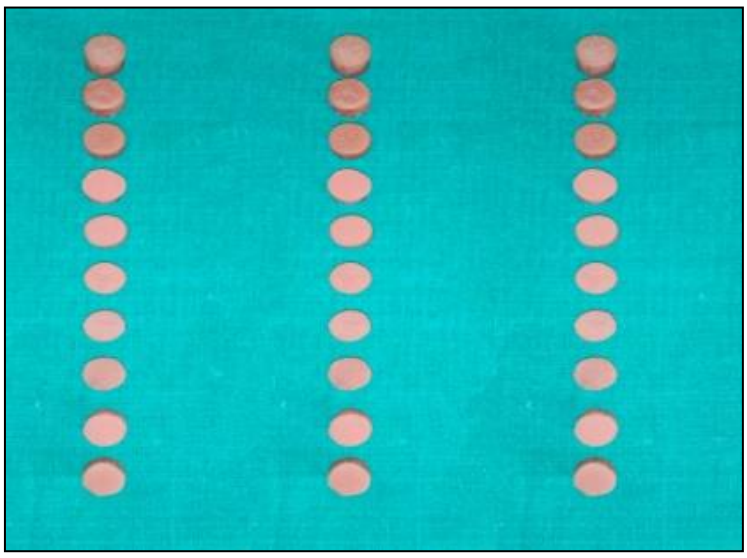

Fig. 4: Specimens for testing of Hardness

Fig. 5: Specimens immersed in two different types of denture cleansing solution and water

RESULTS

The study comprised of 3 groups followed by 3 subgroups under each groups of 10 specimens for evaluation of tensile bond strength with heat cure denture base acrylic resin, and 3 groups followed by 3 subgroups under each groups of 10 specimens each for the hardness test of soft liners. Kruskal-Wallis test showed significant difference among the groups at all the time intervals (p=0.00). At day 1 and 1 week, Group B showed highest tensile bond strength (1.50±0.015) and (1.12 ± 0.012) respectively whereas at 1 month, Group C showed highest tensile bond strength (0.96 ± 0.016).

Table 1: Comparison of the tensile bond strength among the Groups at Day 1, 1 Week, 1 Month using Kruskal-Wallis test

	Groups	Minimum	Maximum	Mean	Std. deviation	Kruskal- wallis	P - value
Day 1	Group A	.56	.62	.58	.024	23.15	0.00*
	Group B	1.48	1.52	1.50	.015		
	Group C	1.45	1.50	1.47	.017		
1 week	Group A	.56	.62	.58	.024	23.66	0.00*
	Group B	1.10	1.14	1.12	.012		
	Group C	1.02	1.12	1.07	.040		
1 month	Group A	.56	.62	.59	.024	19.79	0.00*
	Group B	.94	.98	.95	.016		
	Group C	.94	.98	.96	.016		

*: significant

Kruskal-wallis test showed significant difference among the groups at all the time intervals (p=0.00). At all the time intervals, Group C showed highest hardness-(40.20 ± 2.39) (40.90 ± 2.80) (44.60 ± 0.95) as compared to other groups.

Table 2: comparison of hardness among groups at Day 1, 1 Week, 1 Month using Kruskal-Wallis test

	Groups	Minimum	Maximum	Mean	Std. deviation	Kruskal- wallis	P - value
Day 1	Group A	33.30	38.00	36.21	1.63	17.17	0.00*
	Group B	36.00	44.00	40.20	2.39		
	Group C	39.40	42.00	40.73	.88		
1 week	Group A	35.00	40.00	38.59	1.71	10.68	0.005*
	Group B	36.00	46.00	40.90	2.80		
	Group C	39.40	42.60	41.12	1.20		
1 month	Group A	36.00	41.00	38.40	1.57	20.05	0.00*
	Group B	40.00	46.00	43.20	1.93		
	Group C	43.20	46.30	44.60	.95		

DISCUSSION

Many denture wearers fail to maintain a satisfactory level of hygiene although maintenance of appropriate denture hygiene is important. Brushing is not advisable because it can damage the resilient lining. A chemical soaking technique is primary method of choice [10]. Therefore, a wide range of chemical denture cleansers are available to facilitate denture hygiene. However, denture cleansers can cause significant deterioration because they can cause loss of

soluble components and plasticizers, or absorption of water or saliva by the resilient lining materials. This process can influence the properties of these materials. Thus the selection of denture cleanser should be considered to avoid or minimize changes in the properties of resilient materials [10]. Hence, this study was conducted to evaluate and compare the hardness and tensile bond strength of a silicone soft lining material, after short term immersion in two different denture cleansing solutions and water over varying time periods.

In the present study, the study comprised of 3 groups followed by 3 subgroups under each groups of 10 specimens for evaluation of tensile bond strength with heat cure denture base acrylic resin, and 3 groups followed by 3 subgroups under each groups of 10 specimens each for the hardness test of soft liners. Kruskal-wallis test showed significant difference among the groups at all the time intervals (p=0.00). At day 1 and 1 week, Group B showed highest tensile bond strength (1.50±0.015) and (1.12 ± 0.012) respectively whereas at 1 month, Group C showed highest tensile bond strength (0.96 ± 0.016). A study by Kawano F *et al.*, in 1992, conducted a comparison of bond strength of six soft denture liners to denture base resin. The bond strength of six commercial soft denture liners was evaluated using a modified tensile test. The soft denture liners investigated were Prolastic, VinaSoft, Flexor, Molloplast-B, NOVUS, and Super-Soft. The samples were processed according to the manufacturers' instructions to cured denture base resin (polymethyl methacrylate; PMMA). The soft denture liners were 10 x 10 x 3 mm and were processed between two PMMA blocks. The samples were placed in tension until failure. The mode of failure, cohesive or adhesive, was also recorded. The results of this study showed that the bond strength is related to the components of the materials. Prolastic, VinaSoft, and Flexor had the lowest bond strength to cured PMMA and ranged from 9.6 to 11.3 kg/cm2. Super-Soft, Novus, and Molloplast-B demonstrated better bond strengths and ranged from 16.7 to 17.6 kg/cm2. The bond strength of Novus could be improved by using the recommended bonding agent and bonded Novus at 26.1 kg/cm2 had the highest bond strength of all materials tested [11].

In the present study, Kruskal-wallis test showed significant difference among the groups at all the time intervals (p=0.00). At all the time intervals, Group C showed highest hardness-(40.20 ± 2.39) (40.90 ±2.80) (44.60 ±0.95) as compared to other groups. Another study by Pinto J.R. *et al.*, in 2004 coducted an in vitro study to evaluate the effect of varying amounts of thermal cycling on bond strength and permanent deformation of 2 resilient denture liners bonded to an acrylic resin base. Mean bond strength, expressed as stress atfailure (MPa), was determined with a tensile test using a universal testing machine at a crosshead speed of 5 mm/min. Analysis of failure mode, expressed as a percent (%), was recorded as either cohesive, adhesive, or both, after observation. Permanent deformation, expressed as a percent (%), was determined using ADA specification no. 18. Data from both tests were examined with a 2-way analysis of variance and a Tukey test (a=.05). The result for the tensile test, Softliner specimens submitted to different thermal cycling regimens demonstrated no significantly different bond strength values from the control; however, there was a significant difference between the PermaSoft control groups. With regard to failure type, the Softliner groups presented adhesive failure (100%) regardless of specimen treatment. PermaSoft groups presented adhesive (53%), cohesive (12%), or a combined mode of failure (35%). The author concluded that, this in vitro study indicated that bond strength and permanent deformation of the 2 resilient denture liners tested varied according to their chemical composition [12].

CONCLUSION

A significant difference exists in the tensile bond strength and the hardness values of the soft liner specimen when immersed in water and two different denture cleansing solutions between the periods of immersion.

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